PULPWOOD AND OUTDOOR LOG STORAGE

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1.0 SCOPE

This data sheet covers the hazards and protection of pulpwood and outdoor log storage.

Wood chip, lumber and wastepaper storage are covered by other data sheets.

1.1 Changes

May 2000. This revision of the document has been reorganized to provide a consistent format.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Human Element

2.1.1 Fire Fighting

2.1.1.1 Organize and maintain a trained fire brigade on each shift The group should be as large as practical (20-30 persons), with a much larger group available in an emergency.

2.1.1.2 Instruct the group in the importance of attacking fire promptly, digging down to the seat of the fire, and other specialized methods.

2.1.1.3 Security personnel should be instructed in the use of monitor nozzles and in the importance of summoning aid promptly.

2.1.1.4 Proper maintenance of fire fighting equipment is paramount. Fire pumps, monitors, hydrants, hoses, etc., should be inspected regularly and maintained.

2.1.1.5 The public fire department and Plant Emergency Organization should be notified immediately upon the discovery of a fire, regardless of its size.

2.1.2 Hot Work

2.1.2.1 A permit system should be used to supervise cutting and welding operations in log storage areas.

2.2 Operation and Maintenance

2.2.1 Fire Prevention

2.2.1.1 Motor and conveyor housings should be of noncombustible construction.

2.2.1.2 Properly lubricate moving parts of conveyors. Do not run conveyors through steel troughs unless water sprays are operating.

2.2.1.3 Install and maintain spark arresters on stacks of locomotives, engines, vehicles and waste-burning boilers.

2.2.1.4 Do not use dynamite to free frozen piles. Use such methods as winch-and-cable drag, power rake, or grab bucket.

2.2.1.5 Strictly enforce ‘‘No Smoking’’ rules.

2.2.1.6 Remove wood refuse, rotted wood and bark from piles of pulpwood and equipment used in storage areas.

2.2.1.7 Remove dry grass, brush, and rubbish. Maintain order and neatness throughout the storage area. A 100 ft (30 m) clear space should be provided for light brush exposures and 200 ft (60 m) for forested areas.

2.2.1.8 Remove all sheds and unprotected buildings from wood yards.

2.2.1.9 Provide continuous hourly recorded security personnel service at stacked piles and at extensive yards of ranked piles.

2.2.1.10 Wet down stacked piles and the surrounding ground once or twice daily during dry weather.

2.2.1.11 Vehicle fueling operations should be conducted away from storage areas.

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2.3 Occupancy

2.3.1 Size and Separation

2.3.1.1 Stacked Piles

2.3.1.1.1 The minimum separation between stacked pulpwood piles, regardless of capacity, should be 100 ft (30 m) to permit fire fighters to operate effectively. Figure 1 shows advisable pile size (30,000 cords) (109,000 m^3) and recommended separation between multiple units of this capacity. Figures 1 and 2 show recommended separation between stacked piles of 30,000 and 45,000 cords (109,000 and 163,000 m^3), respectively. Storage requirements, available land, and the economics of wood handling may result in storage piles of even greater capacity. Preferably, pile sizes should be limited to 30,000 cords (109,000 m^3).

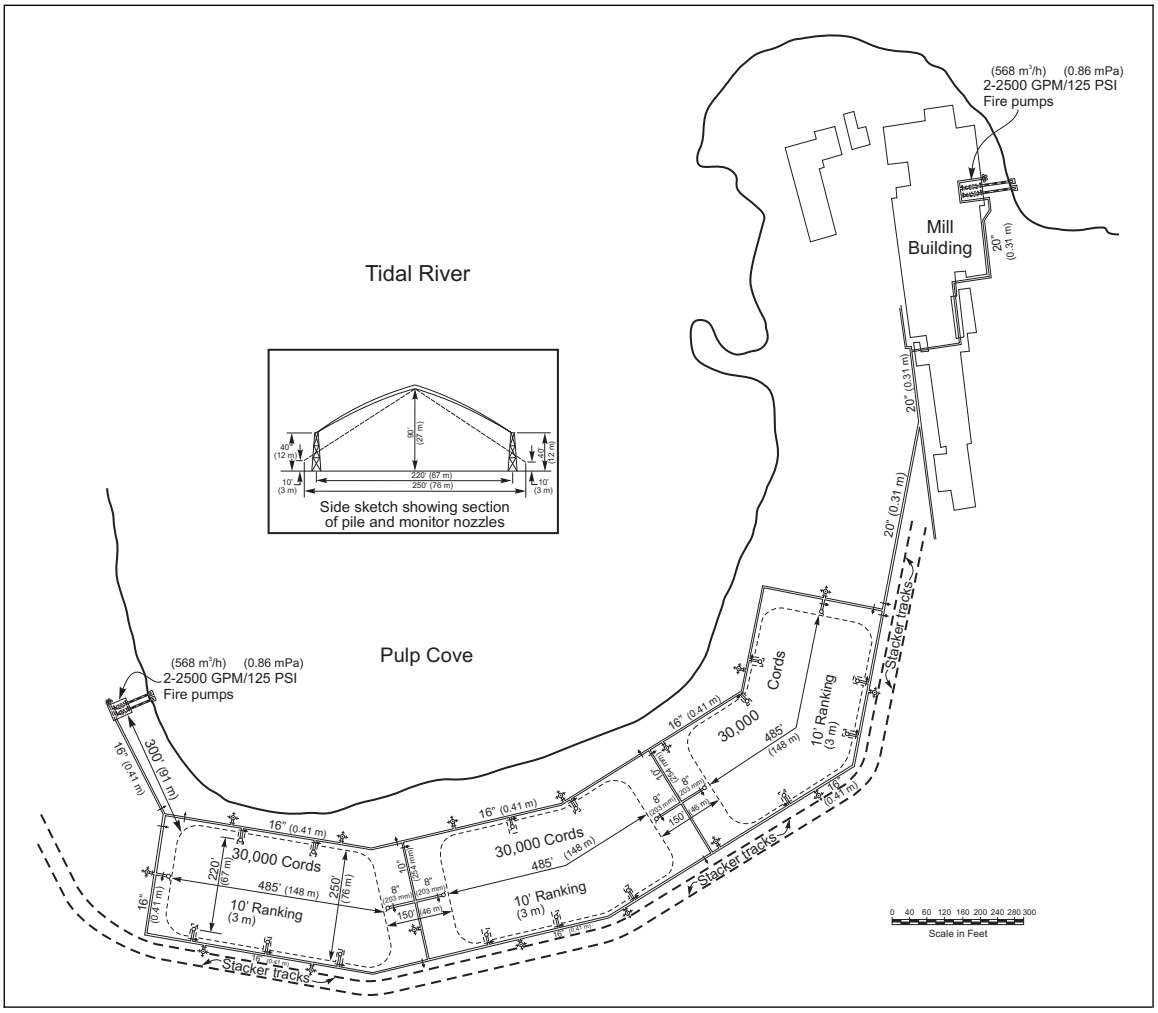

Fig. 1. Typical layout for three 30,000 (76,000 m^2) cord pulpwood piles.

2.3.1.1.2 At all storage sites a clear space of at least 100 ft (30 m) should be maintained between the base of piles and main buildings. Clear separation of 300 ft (91 m) or greater may be advisable where piles are high and have large side surfaces parallel to vulnerable important buildings.

2.3.1.1.3 It is necessary to limit pile widths and heights so that peaks will be within range of monitor nozzles located along the sides of the piles. Stacked piles should not usually be over 200 ft (61 m) wide, but if monitor nozzles can be located to reach every part of the surface of the piles, the maximum width may be 250 ft (76 m) (see Fig. 2). Forty feet (12 m) is the maximum practical height for monitor nozzle towers. Pile height should be limited to 95 ft (29 m) maximum to ensure that the peak is within the range of monitor nozzle streams and to limit the size of the pile.

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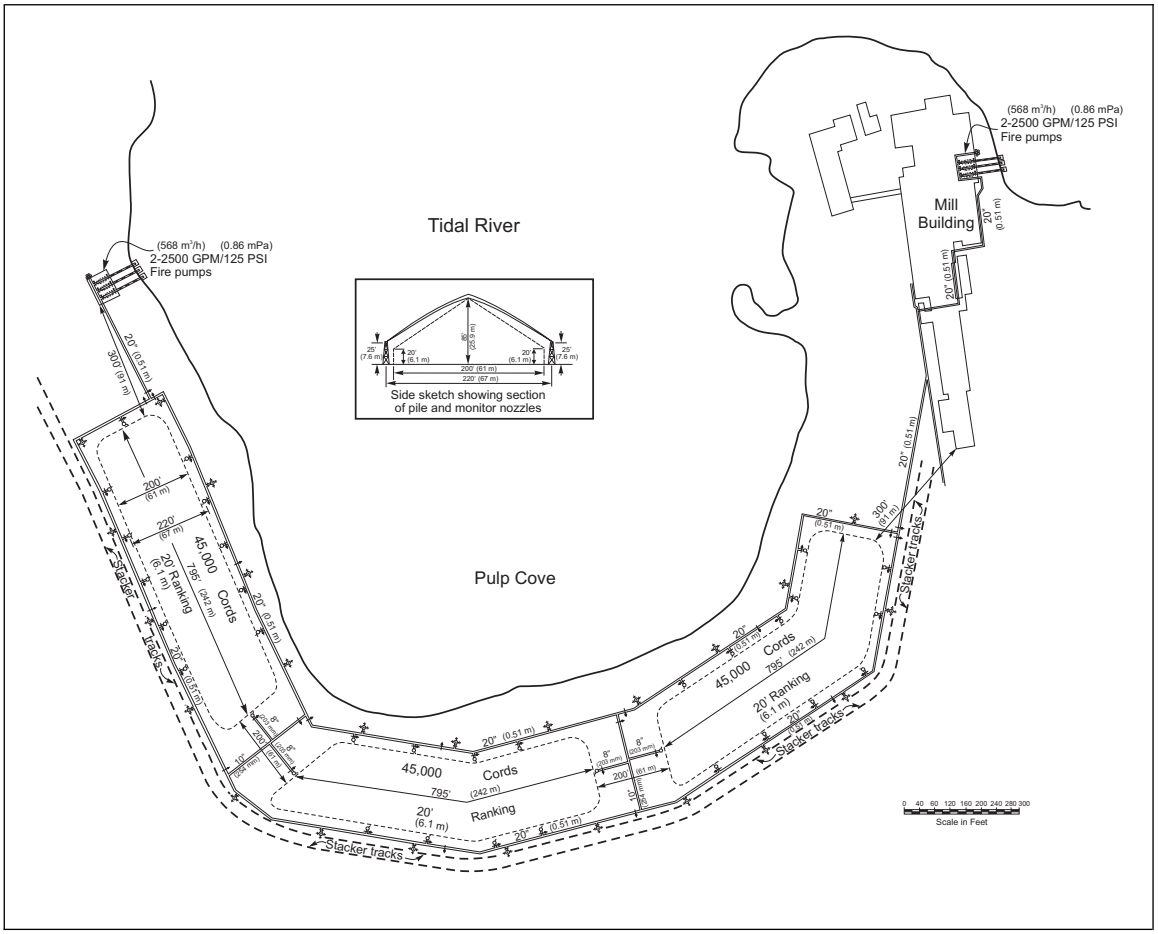

Fig. 2. Typical layout for three 45,000 (113,000 m^2) cord pulpwood piles.

2.3.1.2 Ranked Piles

2.3.1.2.1 Individual piles should be kept as small as practicable, preferably less than 30,000 cords (109,000 m^3). Pile areas should be such that no point would be over 50 ft (15 m) from a fire lane to permit effective application of hose streams. Fire lanes should be wide enough for fire fighting operations, generally at least 25 ft (7.6 m). Piles totaling 30,000 cords (109,000 m^3) should be separated from other piles by a clear space of at least 100 ft (30 m). Separation from main buildings should be at least 100 ft (30 m).

2.4 Protection

2.4.1 Alarms

2.4.1.1 Provide for prompt alarm in case of fire (e.g., horn, bell, loud whistle). Provide a complete Class A or B manual fire alarm system for yards containing piles 20,000 cords (73,000 m^3) or larger, or where storage is remote from the main plant.

2.4.2 Water Supply

2.4.2.1 Provide water supplies at 100 to 110 psi (0.69 to 0.76 mPa) residual pressure at wood yard hydrants and monitors. Figure 3 shows the water supplies needed for stacked pulpwood piles.

2.4.2.2 Stacked piles of 20,000 cords (73,000 m^3) or less generally need 12 and 14 in. (305 and 356 mm) main feeders and 8 and 10 in. (203 and 254 mm) laterals.

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2.4.2.3 Sixteen inch (406 mm) feeders are usually needed at stacked piles of 30,000 cords (109,000 m^3) and 20 in. (508 mm) feeders at stacked piles of 45,000 cords (163,000 m^3) with 10 and 12 in. (254 and 305 mm) laterals.

2.4.2.4 Most ranked piles need 8, 10 and 12 inch (203, 254, and 305 mm) mains. Ranked pile storage greater than 30,000 cords (109,000 m^3) generally needs 12 and 14 in. (305 and 356 mm) main feeders and 8 and 10 in. (203 and 254 mm) laterals.

2.4.2.5 For ranked piles, provide water supplies at wood yard hydrants and monitors as shown in Table 1.

Table 1. Water Supplies for Ranked Piles

Number of Cords in One Yard	*Cubic Meters in One Yard*	*Water Supply, gal/min*
Under 10,000	Under 36,300	1,500 (340 m^3/h)
10,000	36,300	2,000 (454 m^3/h)
20,000	73,000	2,500 (568 m^3/h)
30,000	109,000	3,000 (681 m^3/h)
40,000	145,000	4,000 (908 m^3/h)

2.4.3 Monitor Nozzles

2.4.3.1 Install monitor nozzles around piles so that every part of the pile surface is within range of at least one "good" 2 in. (51 mm) stream (Fig. 4). Maximum spacing should be 150 ft (46 m) along the side of the pile and 220 ft (67 mm) across the pile. If width of pile ranges from 220 to 250 ft (67 to 76 m) and ranking is low, locate monitor nozzles inside the pile limits and provide protection against falling logs (Figs. 6 and 7).

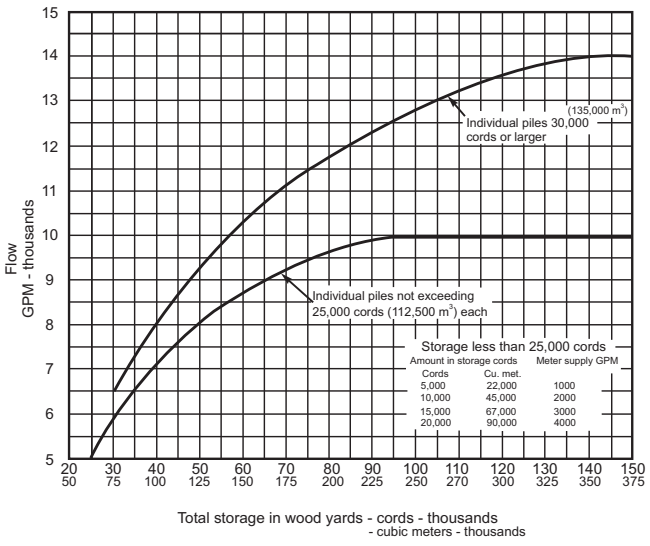

Fig. 3. Water supplies for stacked pulpwood piles.

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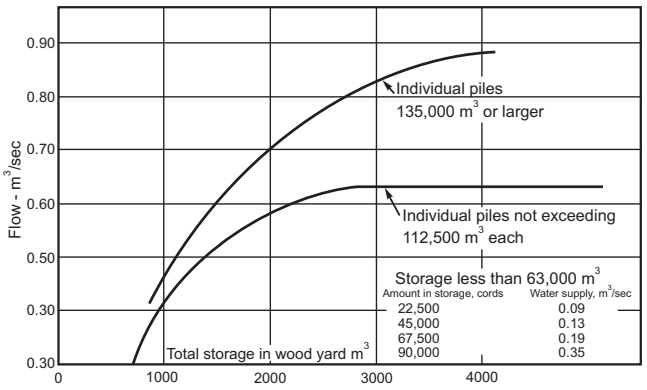

Fig. 3. Water supplies for stacked pulpwood piles (metric).

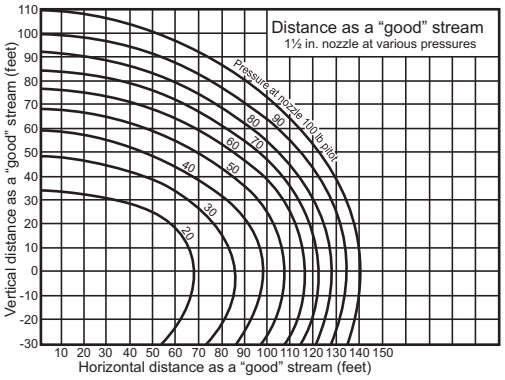

Fig. 5a.

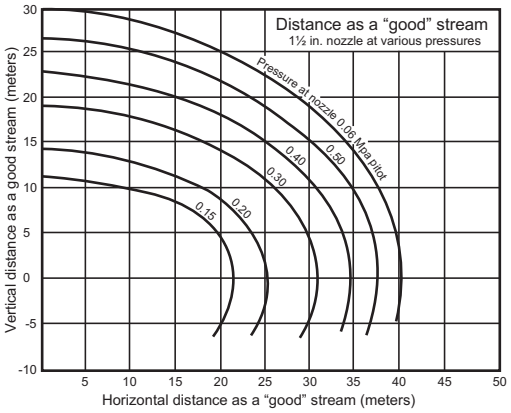

Fig. 5b.

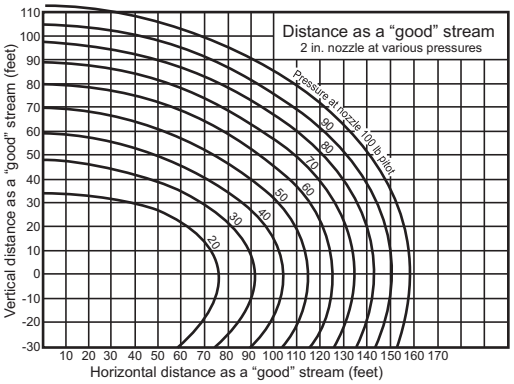

Fig. 5c.

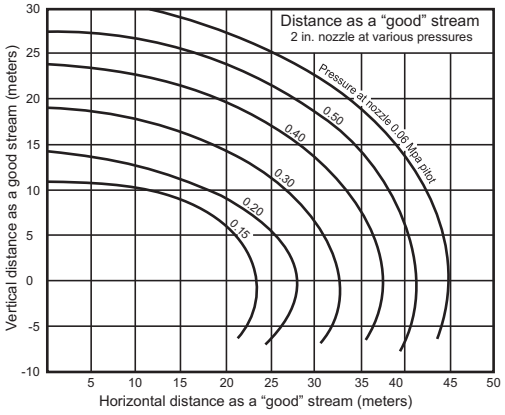

Fig. 5d.

Fig. 4. Range of monitor-nozzles streams. The curves show the range of "good" monitor-nozzle fire streams in still air or light winds (5 mph, 2.2 m/s). The curves represent the point where the stream loses its continuity. Water in good quantity will be thrown much farther, but will be in the form of heavy rain, easily carried away by the wind. In adverse winds of 10 mph (4.5 m/s) or more, the range may be shortened as much as 40%.

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2.4.3.2 Six to eight 2 in. (51 mm) monitor nozzles are usually needed at each 20,000 (73,000 m^3) and 30,000 cord (109,000 m^3) pile, depending on the length, width, and height of the pile. As many as ten or twelve such nozzles are needed at each 45,000 cord (163,000 m^3) pile.

Monitor-nozzle discharges for various tip diameters at various pressures can be calculated using information in Data Sheet 3-0, *Hydraulics of Fire Protection Systems*.

2.4.3.3 Monitor-nozzle towers are advised at piles over 60 ft (18 m) high and at lower piles if ranked edges prevent the stream from reaching over the peak. Monitor towers are usually steel structures with platform and ladder (Fig. 5). Single pipes serving as both tower and waterway also are used. Towers as high as 40 ft (12 m) may be constructed of a concrete-filled pipe and a second pipe to supply the nozzle. Monitor towers should be constructed and designed to withstand impact of falling logs.

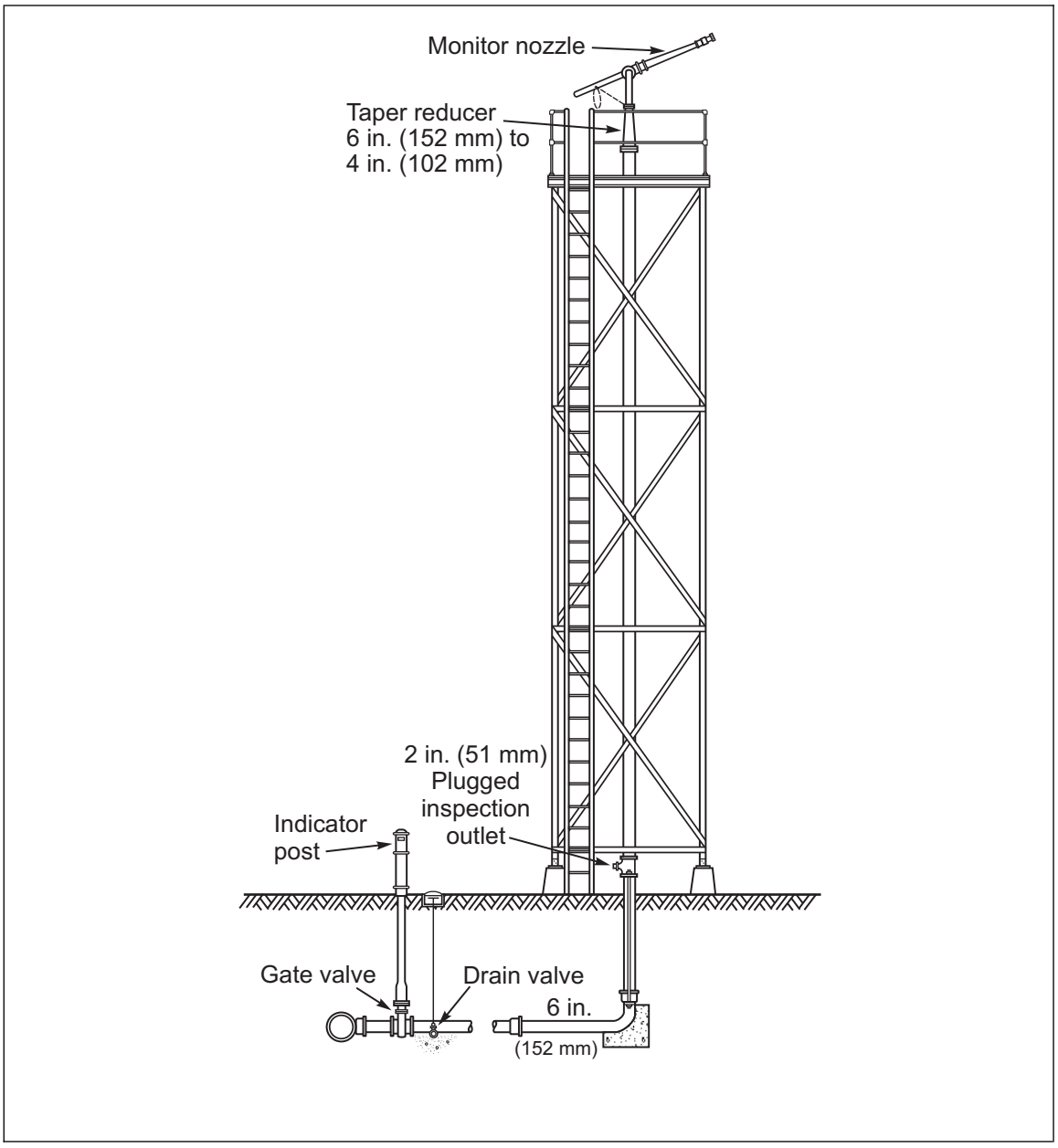

Fig. 5. Monitor nozzle, piping, and steel tower.

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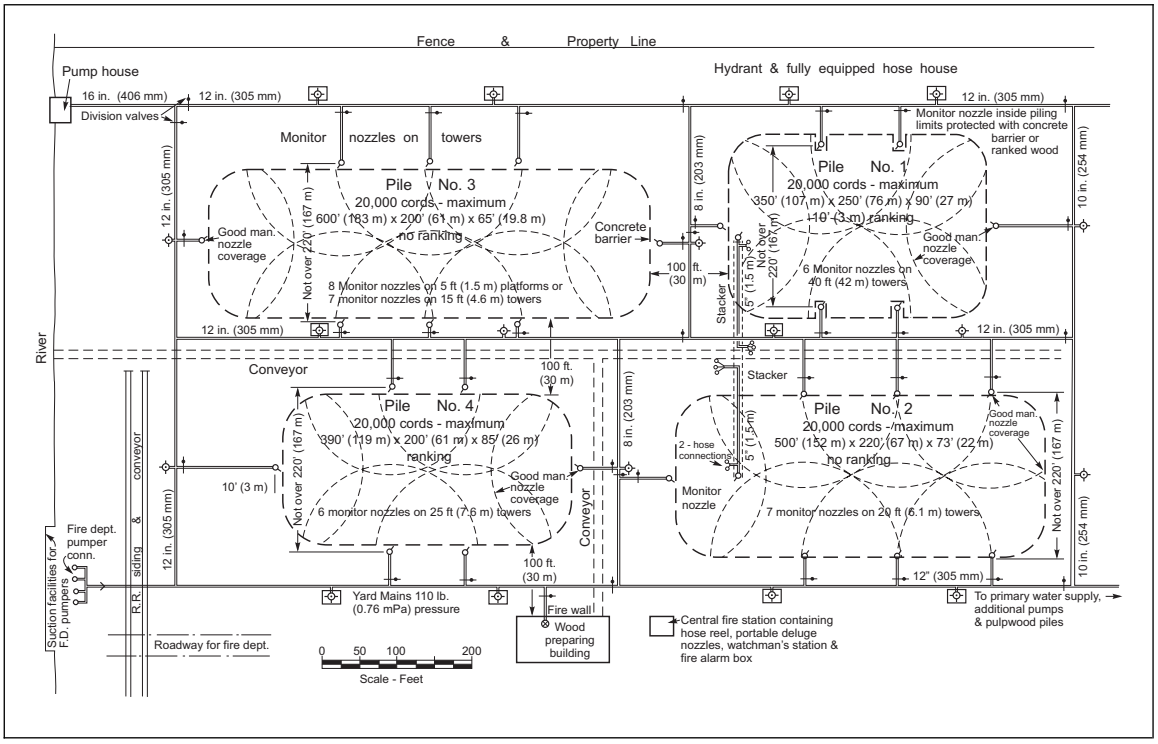

Fig. 6. Recommended layout for fire-protection equipment for 20,000 cord stacked piles of various dimensions.

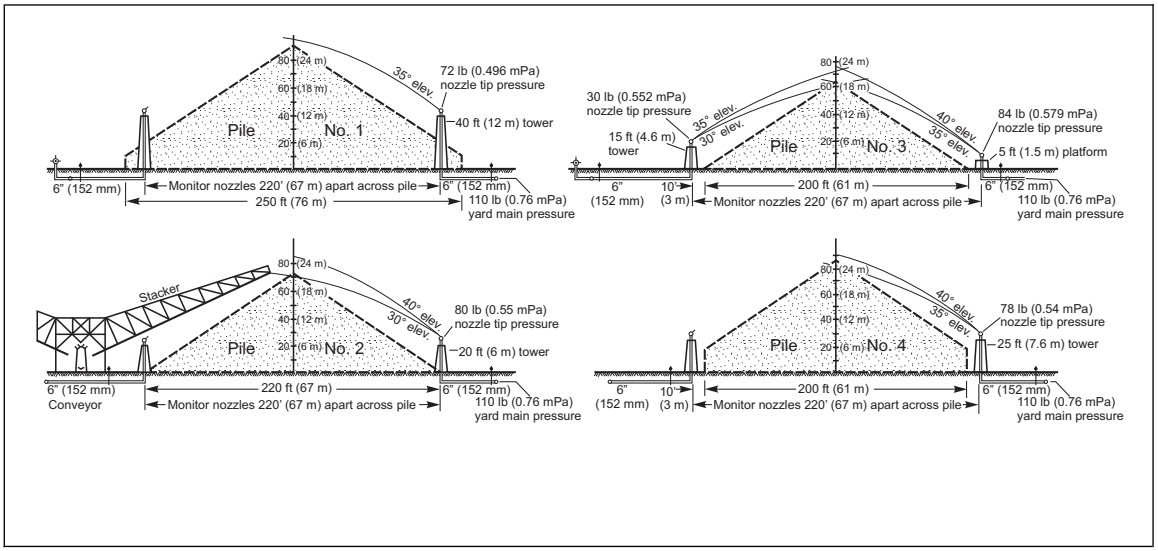

Fig. 7. Cross sections of pulpwood piles shown in Fig. 6 and trajectories of monitor-nozzles streams.

2.4.3.4 Each monitor nozzle should be controlled by an indicator post gate valve. Provide a drain below grade for exposed piping and a 1-½ or 2 in. (38 or 51 mm) plug in the riser for inspecting and sounding the pipe in winter. Equip all conveying systems with hose connections.

2.4.4 Hydrant and Hose Equipment

2.4.4.1 Install three-way hydrants with independent gates and space them about 250 ft (76 m) apart. Two-way hydrants spaced about 200 ft (61 m) apart in each direction may be used at ranked piles.

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2.4.4.2 Provide completely equipped hose houses and a reserve supply of hose on reels. Also provide two or three portable deluge nozzles at yards having 20,000 cord (73,000 m^3) piles, whether stacked or ranked, and at least one nozzle at yards having smaller individual piles. At 30,000 to 45,000 cord (109,000 to 163,000 m^3) piles, provide four to six portable deluge nozzles.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 Loss History

The most common causes of fires are: sparks from conveyors, sparks from passing locomotives or other vehicles, cutting and welding operations, and smoking.

3.2 Description and Hazards

3.2.1 Storage Configuration

Log and pulpwood storage occurs in two configurations: stacked piles and ranked piles. Stacked piles, sometimes called ‘‘tumbled’’ piles, are cone-shaped piles formed by conveying and randomly depositing logs in the center of the pile. Ranked piles are evenly arranged, usually by conveyors or cranes.

3.2.2 Units of Measure

Several units of measure have been devised for these types of storage. In ranked piles, the amount of wood that occupies 128 ft^3 of space (3.6 m^3), including voids, is a cord. In stacked piles, the information in Table 2 may be used to estimate the number of cords as roughly piled by a conveyor or stacker:

Table 2. Estimate of Cords Piled by Conveyor or Stacker

Wood Length	*Type of Wood*	*ft^3/cord (m^3/cord)*
2 ft (0.61 m)	barked wood	150 (4.2)
4 ft (1.2 m)	barked wood	165 (4.7)
4 ft (1.2 m)	unbarked rough wood	170 (4.8)

The number of cunits in a cord of pulpwood or wood logs varies with the size and nature of the wood. One cunit of Ontario wood averages 1.11 cords; one cord, 0.90 cunits. For conversion to board feet, 1 ft^3 equals 12 board feet.

3.2.3 Burning Characteristics

Combustion of wood takes place in two stages. The first is destructive distillation, such as occurs in a charcoal kiln; the heat drives off flammable gases from the wood and leaves charcoal. The second stage involves burning of the gases in the air above the wood, and burning of the charcoal combined with oxygen, forming an intensely hot and luminous bed of coals. The heat from burning both gases and charcoal distills more volatiles from the wood and increases the temperature and rate of combustion. The acceleration of combustion is limited only by the rate at which air can be brought into contact with the burning wood.

The orderly arrangement of ranked piles restricts air circulation and the surfaces available to burn. Once the fire is established in a ranked pile, however, an intense fire will still result, but will propagate at a slower rate and radiate less heat than a fire in a similarly sized stacked pile.

A strong updraft is characteristic of fires in stacked piles of logs. Many fires start near the top of the pile, and falling embers carry the fire downward into the interior. With abundant air spaces between the logs, a strong draft from the outside inward tends to hold the fire in the interior (Fig. 8). The logs serve as a grate. As a fire reaches the center of the pile, it begins to burn slowly toward the sides. After the fire is well under way, the updraft created by the heat causes a strong suction at the base of the fire. With such a powerful updraft, hose streams cannot reach the seat of combustion, but are instead either partially evaporated or carried away by the updraft It is extremely important to attack fires before much heat and thermal updraft have developed. The best fire fighting method is to apply water to the hot coals at the base of the fire.

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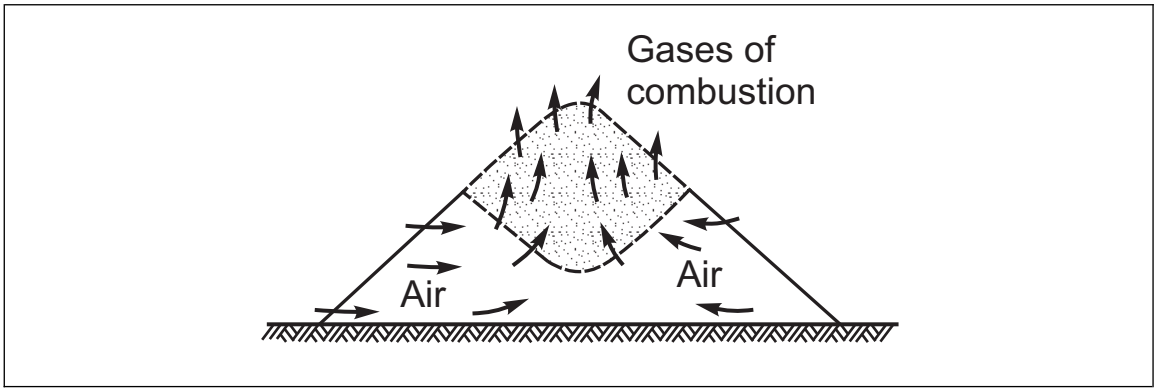

Fig. 8. How fire burns in pulpwood or log storage. Process of combustion and updraft in stacked piles.

3.3 Size and Separation of Piles

Storage requirements and the economics of wood handling have led to very large piles of pulpwood. Where land is scarce, the wood is stored with limited separations between piles. All the pulpwood within one storage yard could possibly be subjected to a single catastrophe. Recommended separations, especially those specified as minimal, will aid in fire control in three important ways: 1) by providing access areas for manual fire fighting by fixed monitor nozzles, portable deluge nozzles, and hose streams; 2) by reducing the amount of heat radiated to adjacent piles; and 3) in combination with wetting of pile surfaces, by reducing the probability of igniting adjacent piles by flying sparks. There is no practical way to determine the space separation that would positively stop spread of fire from one pile to another. Width of burning surface and height of pile rather than volume of the pile, are the essential elements in radiant heat transfer. In addition to the configuration of radiating and receiving surfaces, wind direction, and promptness and effectiveness of manual fire fighting are other important variables.

Separation of important mill buildings from pulpwood and log piles is vital because possible damage to production depends upon vulnerability of the exposed building as determined by height, wall openings, combustibility of construction, and occupancy, as well as the factors described above regarding exposing the pulpwood pile.

3.4 Fire Fighting

Efficient fire fighting by both plant personnel and fire departments has often been the deciding factor between relatively small and very heavy damage. Fires in large pulpwood piles have been successfully extinguished by well organized fire brigades using proper fire fighting equipment, whose leaders knew how to handle this type of fire.

Prompt discovery and alarm and prompt application of large amounts of water are the major factors in bringing pulpwood fires under control. Adequate monitor nozzles, close-range fire fighting with hose streams, and removal of surface wood to reach the actual seat of the fire are all essential.

3.4.1 Monitor Nozzles and Towers

Hose streams are inadequate as sole protection for pulpwood and log piles. Their inability to maintain direction and force to reach the seat of a fire at long range limits their effectiveness and has resulted in the complete destruction of large piles. Monitor nozzles have a much longer effective horizontal and vertical range and, when properly located and promptly applied, have aided greatly in extinguishing fires in well arranged pulpwood and log piles.

4.0 REFERENCES

4.1 FM

Data Sheet 3-0, *Hydraulics of Fire Protection Systems*.

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APPENDIX A GLOSSARY OF TERMS

Cunit: a measure of logs and lumber used in Canada, is 100 ft^3 (2.8 m^3) of solid wood without voids.

Ranked piles: piles that are evenly arranged, usually by conveyors or cranes.

Stacked piles (sometimes called "tumbled"): cone-shaped piles formed by conveying and random depositing of logs in the center of the pile.

APPENDIX B DOCUMENT REVISION HISTORY

May 2000. This revision of the document has been reorganized to provide a consistent format.

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