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SAFETY INFORMATION PROFILE

Chainsaw Operations in the Logging Industry

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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Division of Safety Research
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A safety information profile is presented for chainsaw operations in the logging industry (Standard Industrial Classification 241). Felling and bucking procedures are described. Potential safety and health hazards are reviewed, including cuts from the chainsaw blade, and noise and vibration levels. Existing controls that primarily protect the worker from the blade are discussed. Accident and injury statistics are summarized. Worker exposure to levels of vibration and noise from the chainsaw operation is discussed. Industry trends and existing federal standards are considered. Names and addresses of industry associations and other interested parties are provided. It is concluded that most chainsaw accidents are due to careless operation of the tool and laxities in training. It is recommended that chainsaw safety controls be devised and that the use of personal protective gear be encouraged. More comprehensive federal safety regulations are advised, as is further study to evaluate noise and vibration exposure.

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PREFACE

The information in this profile was prepared in accordance with the provisions of NIOSH Contract #210-78-0130-0000 and is only one of twenty-seven Industry Profiles prepared under the contract. The reader should understand that this study is not intended to be an in-depth analysis, but rather, a limited overview of the industry. Each individual profile was prepared by a Profile Manager utilizing approximately 45 hours of professional time. Each profile is a reflection of the available literature, and other information obtained from industry, government, and labor contacts. Information Profiles are primarily intended for use in determining future study needs, priorities and directions. From this preliminary study may come various in-depth studies such as criteria documents, technology assessments, epidemiological studies, etc.

Radian gratefully acknowledges the guidance and direction of Mr. Ted Pettit, Project Officer, and Ms. Pat Gussey, Assistant Project Officer. Radian also thanks the many industry labor and government officials who provided information and assistance on short notice.

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EXECUTIVE SUMMARY

There are estimated to be over 300,000 employees covered by SIC 241 - "Logging Camps and Contractors". A large number of these workers are employed as small independent contractors. Operations are mainly concentrated in the South, Northwest and Northeast.

Chainsaws are only of concern in two major operations: (1) felling (cutting the tree down) and (2) bucking (removing the limbs and cutting it into log sections). Safety and health hazards include cuts, burns, eye injuries, vibration induced injury, strains and sprains, hearing loss and toxic exposure to exhaust gases (carbon monoxide). Chain saw fatality statistics are not significant, but injuries related to chain saws account for about one-fourth of the total logging injuries. The majority of injuries are cuts and are highly attributable to saw kickbacks with the largest number of injuries occurring during limbing operations. The cause of the high injury statistics can probably be spread between lack of training, inexperience, an often hurried attitude, insufficient enforcement (especially in small operations), use of unsafe procedures, and lack of proper personal protective gear and chain saw safety controls.

Chainsaw activities for pulpwood logging are regulated by 29 CFR 1910.266(c)(5). Chainsaw activities for all other types of logging operations are covered by ANSI 03.1-1978. Other applicable OSHA standards are 29 CFR 1910.242, 1910.95, 1910.106 and 1910.1000. There appears to be a definite need to bring all logging operations under one OSHA standard.

Further study seems warranted in areas of controlling the high number of cuts received from chain saws and in evaluating the magnitude and severity of exposures to noise and vibration.

A. Standard Industrial Classifications Included

The scope of this profile has been limited to chainsaw operations conducted in activities associated with SIC 241 - "Logging Camps and Contractors". This SIC includes logging camps and logging contractors primarily engaged in cutting timber and in producing rough, round, hewn, or primary forest or wood raw materials.(1) Eliminated from consideration were the other SIC's in the major category 24 - "Lumber and Wood Products, Except Furniture". Of these classifications it should be noted that chainsaw operations related to logging conducted in combination with sawmills or pulp mills under SIC 242 - "Saw Mills and Planing Mills: were also excluded from this study. Although SIC 242 was excluded in the scope of the study in accident statistics and numbers of employed, the overall findings of this study should be applicable to the chainsaw logging operations within this category.

The activities encompassed by SIC 241 include: surveying, building and maintaining logging roads and landings; transport of workers to the worksites; building logging camps; removing dead trees, overhanging trees and other hazards; felling trees; bucking felled trees; limbing felled trees; transporting or yarding trees or logs to the landing; setting chokers (cables used to hitch logs to tow lines or cables); releasing chokers; sorting, grading, and scaling logs; staking logs for loading; loading and securing logs for transport; transporting loads to the process plant or sorting location; and unloading the logs.(2)

The number of workers employed in SIC 241 has been estimated by the Bureau of Labor Statistics (BLS) to be about 83,700.(3) It has been reported in previous studies that the logging population is grossly underestimated by the BLS figures, and it is generally concluded that the population may be as high as 300,000.(4, 5) Part of the underestimation may be explained by the large number of small independent operators and seasonal employment. Large companies employing loggers generally indicate that their loggers produce less than half and even less than one-quarter of the logs required by their mills.(6) The remainder of the required product is obtained through independents. The size distribution of logging operations range from one to four man operations up to those employing over a thousand persons.(7) In 1976 it was estimated that 11,542 logging establishments existed and of those 7717 (approximately 67%) were operations involving less than five employees.(7) A west coast study showed that approximately 23% of those employed in logging operations with 20 or more employees were fellers or buckers, in other words, chain saw operators.(4) Women have been found to constitute only about 5% of the workforce.(4) Distributions of employee numbers and establishments by size class are shown in Table 1.

The logging operations are generally broken down into regions (southern, northeastern, and western). The various regions differ in their operations and equipment used due to the climate, terrain, type and size of timber harvested, and use of the timber (pulpwood or saw logs). Logging operations in the south tend to be small and independent operations compared to those in the other two regions.

UNITED STATES - ESTABLISHMENTS, EMPLOYEES, AND PAYROLL BY INDUSTRY BY EMPLOYMENT - SIZE CLASS: 1976

TABLE 1

(Excludes government employees, railroad employees, self-employed persons, etc. - see "General Explanation" for definitions and statement on reliability of data. Size class 1 to 4 includes establishments having payroll but no employees during mid-March pay period. "D" denotes figures withheld to avoid disclosure of operations of individual establishments, the other alphabetics indicate employment-size class - see footnote.)

SIC code	Industry, establishments, employees, and payroll	Total	Employment-size class								
			1 to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 to 249	250 to 499	500 to 999	1000 or more
241	Logging Camps & Logging Contractors										
	No. of Establishments	11,542	7,717	2,257	1,046	388	74	38	12	8	2
	No. of Employees	80,859	(D)	16,604	14,627	11,875	5,397	6,228	(D)	4,651	(D)

A: 0-19; B: 20-99; C: 100-249; E: 250-499; F: 500-999; G: 1,000-2,499; H: 2,500-4,999; I: 5,000-9,999; J: 10,000-24,999; K: 25,000-49,999; L: 50,000-99,999; M: 100,000 or more.

U.S. Bureau of the Census, County Business Patterns, 1976, Table 1B.

B. Process Descriptions

The major categories of logging operations are felling, bucking, skidding, loading, and transporting.(4) Felling is the actual process of cutting the tree from its standing position and letting it fall to the ground. Bucking is the process of cutting the felled tree into predetermined length logs and also often includes the limbing process of the removal of limbs from the tree. Skidding is a means of transporting felled timber or cut logs to the loading area or landing. Loading and transporting operations are the actual loading of logs and transporting them to the processing plant. Only felling and bucking (including limbing) require chainsaw operations.

Felling and bucking operations commonly are interrelated and often are accomplished by the same person. Fellers and buckers are usually assigned as a team and they may switch back and forth from one job to the other. Planning is essential in order to keep the various felling and bucking teams separated by safe distances and to keep from felling trees across skid roads.

The feller must first assess the characteristics of the tree and the surrounding area. He then selects a falling direction which will minimize product damage and also assure his own personal safety. He must also select an escape route to the direction opposite of the expected fall and to one side before starting to cut. An undercut is made as a wedge-shaped cut on the side of the tree toward the direction of the intended fall. The backcut (that on the side of the tree opposite the

fall) is made horizontally and slightly above the undercut. A wooden or metal wedge is often used to keep the two faces of the backcut separated to prevent binding of the saw. The tree is allowed to fall with sufficient holding wood always remaining to maintain control and prevent slipping or twisting off the stump. Sometimes trees are felled in directions opposite their lean, and extreme care must be taken, using wedges, to control the direction of the fall. In mountainous areas the trees may be felled uphill to prevent unnecessary damage to the product.

In the bucking operation, the protruding limbs are first removed before the tree is cut into log sections. The bucker generally walks along the trunk shaft of the felled tree while limbing. The tree, in practice, should be blocked to prevent rolling and care should be taken in cutting limbs which may be under stress and could lash back when cut. The bucker normally starts at the butt end of the tree and removes all limbs as he travels the length to the tip. The actual bucking or cutting of the timber into lengths should only be performed when the felled tree is rigidly blocked. The bucker will measure and mark the appropriate section lengths on the felled tree if it is a saw log (lumber use) by attaching one end of a tape which he wears fastened at his waist to the butt end of the timber. The bucker is usually careful to avoid standing on the downhill side of the timber when sawing the sections.

There are several procedural differences between the three major logging regions. Standard operations applicable to the relatively flat terrain and harvesting of small diameter pulpwood in the southern region are not appropriate for operations in the western region where the terrain

is often mountainous and the timber is large. In the western region, bucking and limbing usually take place at the felling site, because of the timber size, whereas, the timber may be skidded to a landing before bucking and limbing in the other regions. In the southern region and some parts of the northern region mechanical tree harvesters may also be used if the terrain is relatively flat.(2) If a chainsaw is used in the south, it is usually a bow type saw rather than the standard chainsaw. Also, some southern operations tend to use a procedure of bucking the tree prior to limbing.(6)

C. Potential Hazards

The hazards considered in this study have been limited to those directly related to operating chain saws in logging operations. Other hazards not related to the use of chain saws have been excluded. Among the potential safety hazards associated with chain saws are: (1) cuts and bruises from chain saw blades not moving, (2) cuts from chain saw blades moving, (3) cuts from broken chain backlash, (4) fires from refueling saws, (5) burns from mufflers on the chain saws, and (6) eye injuries.

Among the potential health hazards associated with chain saws are: (1) vibration induced disability, (2) back injury, stains, or sprains, (3) hearing loss due to noise generated by the chain saw, (4) exposure to toxic exhaust gases emitted by chain saws (carbon monoxide, gasoline vapors, etc.)

Several of the above mentioned hazards require an explanation. Cuts and bruises from chain saw blades not in motion can occur as a result of transporting chain saws with the saw unsecured or without the blade covered by a sheath. Another source may also be tripping or slipping and falling while carrying a chain saw that is shut off.

There are a number of explanations for cuts received from moving chain saw blades. These include chain saw kickback, falling while carrying a running chain saw, the trigger being caught on a limb or twig causing an unexpected actuation of the blade, and contact with the blade while starting the saw. Cuts received during the starting procedure may occur as a result of being thrown off balance, or the saw being kicked up due to the pulling motion of the starter cord.

Vibration induced disability, Raynaud's Syndrome, may occur as a result of operating hand-held vibrating chain saws. The fingers may periodically turn white through poor circulation with resultant numbness and poor control.(8) The symptoms usually first occur while the operator is actually operating the chain saw in the winter and later the symptoms may occur during leisure hours. The factors involved with the onset of vibration-related injury are not totally understood and the variables are numerous. It is known that the injury is related to time of exposure.

D. Existing Controls

Many of the controls for preventing or reducing the safety and health hazards associated with logging chain saw operations are procedural or administrative in nature, while others may be mechanical or engineered controls.

Accidents involving chain saw blades not in motion may be controlled by securing the saw during transportation, by using sheaths or blade covers when transporting or carrying the saw, and by carrying the saw with the blade to the rear.

Cuts from chain saw blades in motion can be reduced when carrying the saw by, once again, keeping the blade to the rear when going from tree to tree or by shutting the saw off when transporting it a considerable distance. Trigger guards on chain saws are also useful in preventing inadvertant actuation of the chain as are trigger interlocks, which prevent throttle engagement while idling.

Contact with the blade while starting the saw can be reduced or eliminated by assuring that the saw is steadied on a firm surface. The steadying process is enhanced by having a free hand to hold the saw firm in a rigid position while using the other hand to pull the starter cord. The hazards of the starting process have been reduced by the use of decompression valves, which allow starting with a less energetic cord pull.(9)

Chain saw kickback often occurs as a result of cutting with the upper edge of the blade, by cutting with the tip of the blade, or catching the tip on an object while the saw is running. Cutting with the top of the blade could be restricted and at the same time the upper portion of the blade can be guarded by using an upper blade guard which pivots 90 degrees out of the way when sawing normally. The use of lighter weight saws is said to reduce fatigue and thus produce less chance of the grip being relaxed when the saw kicks back; however, one large company suspects an increase in the number of injuries due to kickback from the lighter-weight saws.(2)

Chain brakes are another useful device available for most saws, which are actuated when the forward hand strikes the lever as a result of a slip or kickback; however, the saw must first rotate backward at least 45 degrees before the lever is struck by the wrist and the brake is engaged.(9) These conventional chain brakes have several drawbacks, they are only operational when the saw is in the upright position, and it may take longer for the brake to engage than the time in which a human can react. A study sponsored by McCulloch Corp. shows that it may take up to 0.50 seconds to stop the chain after the 45 degree revolution required to actuate the lever, however, kickbacks through 45 degrees have been found to occur at between .07 and 0.16 seconds.(9) A newly developed inertial type chain brake the Husqvarna "Swed-O-Matic", is triggered whenever the anti-vibration mounts are stressed beyond a certain limit.(10) The advantages of the new inertial system are that it works with the saw in any orientation and it is triggered much quicker than the conventional type.

Tip guards are also available to prevent catching the tip of the saw on an object or sawing with the tip. Many of the newer saws are equipped with a "banana" shaped blade tip (small radius at the upper part of the tip and larger radius at the bottom) which should be instrumental in preventing kickbacks.(11) Several types of "low-kick" chain are available which do not dig into the surface as readily as conventional chain, thus avoiding the tendency to cause kickbacks.

Protective clothing or personal protective devices which are helpful in preventing cuts are gloves, heavy protective toed boots, and ballistic nylon pads for the legs. The use of heavy protective toed boots and the nylon ballistic pads have both been rejected by the western loggers because of the reduction in leg flexibility, which the logger needs in that terrain.(6) Gloves are commonly found in use by most loggers in all regions. The use of nylon ballistic pads, which are worn on the legs to prevent injury from kickback, are highly encouraged by the American Pulpwood Association (APA) and the Western Wood Products Association (WWPA).(12, 13) These pads have been somewhat in use by northern loggers and are highly used by the Canadians. A representative of the APA suggests that as much as two seconds of additional time may be provided for the logger to escape injury by use of the pads.(13) In an accident analysis of several APA northeastern operations in the early 1960's, it was indicated that 10% to 20% of lost-time accidents from chain saws could have been prevented by use of the pads.(14) One Canadian company has also reported that 35% of their chain saw injuries were traditionally in the knee area and that compulsory wearing of the ballistic pads reduced that type of accident to practically nil.(14)

Cuts from broken chain backlash are not very common, but account for the only mechanical failure which presents a significant hazard. Some saws have a broad shield below the rear handle to protect the operator's hands from this type of injury.(9)

Fires from refueling saws can be effectively reduced by refueling outdoors and away from persons smoking or other sources of ignition, by storing and dispensing gasoline only from approved safety containers, by refueling only with the engine stopped, and by wiping free any spilled gasoline on the saw prior to starting. Hazards from exhaust sparks causing refueling fires or forest fires can be reduced by use of spark arrestors which are required in some situations.

It is argued that eye injury is not a significant hazard because the motion of the chain carries the chips and dust away from the operator. Proper face shields or other eye protection may be used if required.

Control for the prevention of vibration-induced injury has been researched for some period of time. Some of the controls have attempted to eliminate the vibration by counter-weighting the crankshaft or using an opposing dead cylinder. It has been found that certain sources of vibration cannot be eliminated, therefore, designers have turned to isolation rather than elimination. The mass of the power head (vibration source) assembly has been reduced in comparison to the total mass of the saw and isolated from the remaining mass by damping, with materials such as rubber mounts. The harmful effects of vibration may also be reduced by increasing the frequency or reducing the amplitude of the source.

Noise from gasoline powered chain saws has been reduced by mufflers to the point where the exhaust noise is nearing that of the mechanical noise. The mechanical noise will be much harder to reduce.(9) Even with the noise reduced to this level, chain saw operation may be hazardous for long exposures. A combination of limiting the time of exposure, use of ear protective devices (plugs or muffs), and use of saws with the lowest noise ratings are the best currently available controls.

E. Accident and Illness Statistics

When the OSHA Target Industry Program was first initiated in 1971, lumber and wood products became one of the target industrial groups, based on the 1969 injury frequency rate of 34.6 injuries/million man-hours worked; logging camps and logging contractors contributed an injury frequency rate of 38.4 injuries/million man-hours worked.(5) This rate was considerably higher than the general industry rate. SIC 241 has continually maintained an illness and injury rate among the highest in this country for the private sector. The incidence rates for the logging industry have averaged approximately twice that of the private sector for the past few years.(15) SIC 241 had the second highest injury and illness incidence rate of lost workdays (287.1) in 1976 of all 3-digit SIC's in the private industry.(3)

The statistical data available for SIC 241 may not be representative of chain saw operations, since many other types of accidents are included in the logging industry data. Recent data relating specifically to chainsaw operations in logging is not obtainable on a national level. Most of the recent studies concerning logging-chainsaw related injuries and illnesses have been based on either a small region of the country, or have been based upon states' accident statistics.

Fatalities as a result of chain saw operations are infrequent in comparison to other causes, such as felling of trees into standing trees and kickback of trees and snags.(6) The chain saw is not infrequent as a cause of injury, and it is common in most studies to find the chain saw is implicated in the range of 24% to 26% of all logging injuries.(6, 16)

TABLE 2

Occupational injury and illness incidence rates, private sector, by industry and employment size, United States, 1975

Industry and employment size 1/	SIC code 2/	Incidence rates per 100 full-time workers 3/			
		Mean 4/	Median 4/	Middle range 4/	
				First quartile	Third quartile
Logging Camps & Logging Contractors	241	25.1	14.0	10.9	287.1
Private Sector		9.2	3.5	5.7	60.5

1/ Totals for divisions and 2- and 3-digit SIC codes include data for industries not shown separately.

2/ Standard Industrial Classification Manual, 1967 Edition.

3/ The incidence rates represent the number of injuries and illnesses per 100 full-time workers.

4/ The mean incidence rate is calculated as (N/EH) X 200,000, where

N = number of injuries and illnesses
EH = total hours worked by all employees during calendar year
200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

The median incidence rate is the middle measure in the distribution; half of the establishments have an incidence rate lower than or equal to the median and half have a rate higher than or equal to the median rate.

The middle range (interquartile) is defined by 2 measures; one-fourth of the establishments have a rate higher than or equal to the first quartile rate and one-fourth of the establishments have a rate lower than or equal to the third quartile.

5/ Data conforming to the OSHA definitions for coal and lignite mining (SIC 11 and 12) and metal and nonmetal mining (SIC 10 and 14), and for railroad transportation (SIC 40) were provided by the Mining Enforcement and Safety Administration, U.S. Department of the Interior, and by the Federal Railroad Administration, U.S. Department of Transportation.

NOTE: Asterisk (*) indicates incidence rate of less than 0.05 per 100 full-time workers.

n.e.c. = not elsewhere classified.

SOURCE: Bureau of Labor Statistics, U.S. Department of Labor.

Occupational Injuries and Illnesses in the United States by Industry, 1975. U.S. Department of Labor, Bureau of Labor Statistics, 1978, Bulletin 1981, Table 2.

TABLE 3

RECORDABLE OCCUPATIONAL INJURY AND ILLNESS INCIDENCE RATES*,

1975-1977, BY INDUSTRY, REPORTERS TO THE NATIONAL SAFETY COUNCIL, CONT.

Industry†	SIC Code‡	Incidence Rates per 100 Full-Time Employees** Total Recordable Cases	Total Lost Workday Cases	Cases Involving Days Away From Work & Deaths	Nonfatal Cases Without Lost Workdays	Total Lost Workdays	Days Away From Work
Logging Camps & Logging Contractors	241	17.13	5.61	4.62	11.44	147	129
All Industries		8.47	3.14	2.28	5.31	57	43

OSHA Definitions (See OSHA form No. 100 and Recordkeeping Requirements, Revised 1975):

Occupational injury is any injury such as a cut, fracture, sprain, amputation, etc., which results from a work accident or from an exposure involving a single incident in the work environment.

Occupational illness of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases which may be caused by inhalation, absorption, ingestion, or direct contact.

Lost workdays are those days which the employee would have worked but could not because of occupational injury or illness. The number of lost workdays should not include the day of injury or onset of illness. The number of days includes all days (consecutive or not) on which, because of injury or illness: (1) the employee would have worked but could not, or (2) the employee was assigned to a temporary job, or (3) the employee worked at a permanent job less than full time, or (4) the employee worked at a permanently assigned job but could not perform all duties normally connected with it.

Recordable cases are those involving an occupational injury or occupational illness, including deaths. *Not* recordable are first aid cases which involve one-time treatment and subsequent observation of minor scratches, cuts, burns, splinters, etc., which do not ordinarily require medical care, even though such treatment is provided by a physician or registered professional personnel.

Nonfatal cases without lost workdays are cases of occupational injury or illness which did not involve fatalities or lost workdays but did result in: (1) transfer to another job or termination of employment, or (2) medical treatment, other than first aid, or (3) diagnosis of occupational illness, or (4) loss of consciousness, or (5) restriction of work or motion.

Source and footnotes for table above and on page 31.

Source: Bureau of Labor Statistics, U.S. Department of Labor, survey involving a nationwide sample of approximately 420,000 units, of which 210,000 were used to develop national estimates.

*Industry division 2 and 3 digit SIC code totals include data for industries not shown separately.

**Standard Industrial Classification Manual, 1972 Edition.

†Incidence Rate = $\frac{\text{(No. of injuries \& illnesses} \times 200{,}000) \text{ OR (No. of lost workdays} \times 200{,}000)}{\text{Total hours worked by all employees during period covered}}$

200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

††Includes fatalities. Because of rounding, the difference between the total and sum of the rates for lost workday cases and nonfatal cases without lost workdays may not reflect the fatality rate.

‡Excludes farms with less than 11 employees.

The National Safety Council states that cuts are the most frequent and serious type of accident resulting from the use of running chain saws.(14) A Department of Labor (DOL) study in 1955 showed that cuts, lacerations, or punctures accounted for 29% of all the logging injuries.(6)

In a recent study by Dempsey and Wolf of 1172 logging injuries in central Appalachia, many statistical findings evolved.(16) This study was particularly interesting because of the use of the Employer's First Reports of Injury, which are thought to present correct injury characteristics in over 90% of all cases. The chain saw was once again found to be the direct source of the greatest number of injuries - 24.2%. Kickbacks of chain saws were found to be the cause of approximately 58% of chain saw injuries. Chain saw accidents were greatest for limbing (50.6%), then bucking (27.7%), and finally felling operations (9.5%). Most injuries occurred on the legs and ankles (47.8%). It was also interesting to note that although chain saws accounted for nearly one-fourth of all logging injuries, they accounted for only 11.6% of time lost. A Swedish study showed very similar results to Wolf and Dempsey, in that 60% of all chain saw accidents were attributed to kickbacks, and kickbacks occurred most commonly in limbing operations.(9)

In another study by Crown Zellerbach Corporation, pertaining to four of their logging operations over a two-year period, it was learned that about one-third of the serious injuries in felling and bucking were due to saw cuts. They also found that 44% of the injuries occurred during limbing, and that approximately 80% of these injuries occurred to the leg opposite of the major hand used (right handed - left leg injured). This was attributed to crossing the saw over and operating it on the opposite side of the body during limbing.(18)

F. Exposure Levels

Most data pertaining to vibration levels to which chain saw operators are exposed are found in foreign publications. The level of vibration transmitted is extremely variable from one operator to another due to the tightness of the grip on the handle and physiological differences from one body to the next. In a Swedish study in 1968 it was determined that all chain saws presently used in that country exceeded the proposed vibration limits of intensity.(19)

In a 1971 Canadian government report it was stated that the average sound level measured at the chain saw operator's ear was 106 dB(A), with a 92-119 dB(A) range for various saws from idle to high speed.(9) The largest contribution is exhaust noise; however, the mechanical noise, particularly in the chain bar and sprocket, is only 5-15 dB lower.(9) The exposure level depends on exposure time to this intermittent type source. It is quite possible that hearing damage can occur if the exposure is long enough. Exposure evaluations are based on continuous noise data, which is contended to present a different degree of hazard than intermittent noise.

There appears to be very limited data regarding measured exposures to the exhaust gases, especially carbon monoxide, from gasoline powered chain saws. Measurements of carbon monoxide content of exhaust gases under actual working conditions by Kaminski and Steinlin in 1956 suggest that it is not a hazard to health.(8)

G. Related Studies

Conversations with various trade related associations, government agencies, and equipment manufacturing organizations revealed only one other related study being conducted at this time. This study is being conducted by the U.S. Bureau of Labor Statistics, Office of Federal and State Periodic Studies, in gathering power saw injury statistics from selected states.

H. Industry Trends

Goldberg has shown that it is distinctly evident that a trend toward a reduced frequency rate for disabling work injuries for loggers is occurring.(4) The illness and injury statistics for the past four years also show a downward trend.

The trend in equipment has been to produce lighter and more maneuverable saws. The use of lightweight equipment should continue, although chain saws may not be manufactured much lighter. It has been the trend in the south and other flat areas with smaller pulp timber to use tree harvesting machines, and this trend will probably continue to expand.

I. Existing Standards

OSHA regulation 29 CFR 1910.266 includes a particular set of standards for pulpwood logging, which excludes other operations such as saw logs, veneerbolts, poles, pilings, etc. 29 CFR 1910.266(c)(5) covers chain saw operations involved in pulpwood logging. This standard was derived from the national consensus standard, ANSI 03.1-1971. The ANSI standard has since been updated to include all logging operations (ANSI 03.1-1978), however, the OSHA standard has not. Additionally, NIOSH has published a recommended standard for all logging operations.(5) Logging operations, not covered by the OSHA pulpwood logging standard, are subject to other applicable sections of the OSHA "General Industry Standards". The portions of the "General Industry Standards" pertaining to chain saw operations are 1910.242 - "Hand and Portable Powered Tools and Equipment", 1910.95 - "Occupational Noise Exposure", 1910.106 - "Flammable and Combustible Liquids", Subpart I - "Personal Protective Equipment", and 1910.1000 - "Air Contaminants".

Many of the logging states have logging codes which specifically spell out the occupational hazard precautions that must be taken by logging operations within their states. A summary of a 1973 study showing those states with logging codes is presented in Table A-1 in the Appendix.

J. Names of Industry Associations, Unions, Other Interested Parties

American Pulpwood Association
1619 Massachusetts Avenue, N.W.
Washington, D. C. 20036
(202) 265-0670

Chain Saw Manufacturers Association
Suite 403
Eighteenth Street, N.W.
Washington, D. C. 20036
(202) 466-4113

National Safety Council
444 North Michigan Avenue
Chicago, Ill. 60611
(312) 527-4800

Western Wood Products Association
1500 Yeon Building
Portland, Or. 97204
(503) 224-3930

Northwest Hardwood Association
1303 Terminal Sales Building
Portland, Or. 97205
(503) 243-2094

K. Names and Addresses of Companies

Names and addresses of companies were limited to only those larger firms due to the difficulty in finding information on the smaller ones.

Simpson Timber Co.
900 Fourth Avenue
Seattle, Washington 98164

Boise Cascade Corp.
Box 2885-T
Portland, Oregon 97208

Weyerhaeuser Corporatin
Tacoma, Washington 98401

Potlatch Corporation
One Maritime Plaza
San Francisco, California 94111

St. Regis Paper Company
150 E. 42nd Street
New York, New York 10017

Crown Zellerbach
White Bldg.
Gulfport, Mississippi 39501

International Paper Company

Box 231-T

DeRiddler, LA 70634

American Forest Products Corp. (Bendix)

2740 Hyde

San Francisco, CA 94104

Louisiana-Pacific Corp.

1300 S.W. 5th Street

Portland, Oregon 97201

Willamette Industries, Inc.

3800 First National Bank Tower

Portland, Oregon 97204

L. Summary Analysis of Data

Chain saw operations have not been statistically implicated as a major source of fatalities in the logging industry, but they are highly responsible for many non-fatal injuries. It has been demonstrated that about one-fourth of all logging injuries are related to chain saws and that the largest category for injuries are cuts and lacerations. These injuries are largely attributable to saw kickbacks. The major operations in which chain saw injuries occur are, in order of highest magnitude: limbing, bucking, and felling. The high number of chain saw injuries occurring during limbing may be due to using the saw in a non-upright orientation and the continuing use of the limbing method whereby the logger walks the log and cuts limbs on either side of the body. It appears that a high number of these limbing injuries occur from crossing over with the saw and cutting on the opposite side of their favored hand. Injury data also indicate that a significant number of eye injuries do occur in logging, but the data does not reflect the specific cause.

There are many other possible factors underlying the large number of injuries in the logging field and chain saw operations. Much of the work is performed on contract, and workers are paid on a piece-work basis, so there is an incentive to hurry and take short cuts. Also it is reported that temporary help and high employment turnover are common and, thus, may be another source of high accident frequency. (One study showed that half of all logging injuries involved employees with less than one year experience.) It is also reported that training is often lax in many areas.

The literature also tends to indicate that noise and vibration may be problems involved in operating chain saws. However, there is very little evidence of the magnitude or severity of the problem or of investigative work being conducted in this country.

Controls for safety on chain saws have not been mandatory and neither has the use of valuable personal protective gear for employees, such as ballistic nylon pads. In most cases the employee furnishes his own saw and it is quite probable that price and not safety controls are the major consideration. The protective gear requires careful consideration and may need some redesign to afford certain loggers the flexibility needed. Regulation is indicated as necessary to prompt action in both of these areas; however, regional operating differences should be taken into account. Action is necessary to bring all logging operations under the same or similar types of safety and health regulation.

REFERENCES AND SOURCES

(1) Office of Management and Budget (1972), Standard Industrial Classification Manual, U.S. Government Printing Office, Washington, D.C., 1972. pp. 90

(2) Safety Sciences (1976) "An Overview of the Occupational Safety and Health Problems in the Lumber and Wood Products Industry", Safety Sciences, San Diego, California, June 8, 1976, pp. 3-4, 3-5, 4-12, 3-10.

(3) Bureau of Labor Statistics (1978), Chartbook on Occupational Injuries and Illnesses in 1976, U.S. Department of Labor, Washington, D.C., Report #535, 1978, p. 7 and 19.

(4) Goldberg, M.N., (1973), "Analysis of Worker Safety in Logging Industry Operations", Synsis Inc., Los Angeles, California, Technical Report 73-13, June 1973, pp. 18, 22, 25, 65.

(5) National Institute for Occupational Safety and Health (NIOSH) (1976), Logging from Felling to First Haul - Criteria for a Recommended Standard , U.S. Department of Health, Education and Welfare, Cincinnati, Ohio, HEW Publication No. (NIOSH) 76-188, July 1976, pp. 33 and 36.

(6) NIOSH (1974) Worker Safety in Logging Operations, U.S. Department of Health, Education and Welfare, Cincinnati, Ohio, HEW Publication No. (NIOSH) 74-103, April 1974, pp. 5, 43, 47, 58, 69, 72, A-22.

(7) U.S. Bureau of Census (1976), "County Business Patterns", U.S. Department of Commerce, Washington, D.C., 1976, p. 21.

(8) Groves, K. W., and Lyons, R. G., (1968), "Occupational Hazards for Chain Saw Operators", Australian Forestry, Vol. 32, No. 4, March 28, 1968, pp. 205-210.

(9) Thompson, Stephen E. (1975), "Chain Saw Safety", National Safety News, Vol. 112, No. 5, November 1975, pp. 86-92.

(10) American Pulpwood Association (APA) (1976), "Swed-O-Matic Chain Brake for Professional Saws", APA, Washington, D.C., December 17, 1976.

(11) Personal Communication with Mr. Robert Williams, Chain Saw Manufacturer's Association, Washington, D.C., November 2, 1978.

(12) Personal communication with Mr. Ken Patrick, Western Wood Products Association, Portland, Oregon, November 2, 1978.

(13) Personal communication with Mr. K. S. Rolston, American Pulpwood Association, Washington, D.C., November 2, 1978.

(14) APA (1962) "Nylon Safety Pads for Work Pants", APA, New York, New York, April 20, 1962.

(15) National Safety Council Accident Facts, 1978 Edition, National Safety Council, Chicago, IL, 1978, p. 31, 34, 35.

(16) Wolf, C. H., Dempsey, G. P. (1978), "Logging Work Injuries in Appalachia", Forest Service, U.S.D.A., Northeastern Forest Experiment Station, Broomall, PA, Forest Service Research Paper NE-416, 1978, pp. 1-13.

(17) National Safety Council (NSC) "Portable Power Chain Saws", NSC, Chicago, Illinois, Data Sheet 320- Revision A, 1973, pp. 1-7.

(18) -- (1975) "Target Industry - Lumber and Wood Products", National Safety News, Vol. III, March 1975, pp. 88-92.

(19) NIOSH TIC (1978), a summary of an article by S. A. Axelsson, "Analysis of Vibrations Produced by Power Saws", Studia Forestalia Suecica, No. 59, Stockholm, Sweden, 1968.

APPENDIX

Table A-1

SUMMARY OF STATE RESPONSES TO REQUESTS FOR LOGGING STANDARDS AND INJURY DATA(4)

STATE	LOGGING CODE AVAILABLE	PROMULGATES OSHA STANDARD	PLAN TO ADOPT OSHA STANDARD	REMARKS
ALABAMA			X	
ALASKA	X			
ARIZONA			X	
ARKANSAS	X			No injury data is compiled for logging.
CALIFORNIA	X			
COLORADO				No injury data compiled for logging.
CONNECTICUT				
DELAWARE				State uses ANSI code; reports only few logging operations.
FLORIDA			X	Code covers only safety rules & provisions; penalty.
GEORGIA				No response
HAWAII	X			No injury data available; no large scale logging operations.
IDAHO	X			
ILLINOIS				No response
INDIANA				No response
IOWA		X		
KANSAS				No injury data compiled for logging: state uses ANSI code.
KENTUCKY	X			
LOUISIANA				No injury data compiled for logging

Table A-1 continued

STATE	LOGGING CODE AVAILABLE	PROMULGATES OSHA STANDARD	PLAN TO ADOPT OSHA STANDARD	REMARKS
MAINE		X		State has deleted OSHA restriction to pulpwood; state promulgates code for sanitation of Labor camp
MARYLAND				No injury data compiled for logging.
MASSACHUSETTS				No response.
MICHIGAN	X			
MINNESOTA			X	State reports no logging operations.
MISSISSIPPI			X	
MISSOURI		X		No injury data complete for logging.
MONTANA	X			Injury data available.
NEBRASKA				No code dealing with logging.
NEVADA	X			State logging operation at a stand still.
NEW HAMPSHIRE				Code covers only woods labor camps.
NEW JERSEY				Logging operations considered minor.
NEW MEXICO		X		
NEW YORK				No logging code.
NORTH CAROLINA				No logging code.
NORTH DAKOTA				No logging injuries in last two years. Very few operations.
OHIO				No response.

Table A-1 continued

STATE	LOGGING CODE AVAILABLE	PROMULGATES OSHA STANDARD	PLAN TO ADOPT OSHA STANDARD	REMARKS
OKLAHOMA	X			
OREGON	X			
PENN.	X			
RHODE ISLAND				State reports no logging operations.
SOUTH CAROLINA		X		
SOUTH DAKOTA				No injury data compiled for logging.
TENNESSEE		X		State Statistical Div. inoperative since 1966; has just been reactivated.
TEXAS		X		
UTAH	X			
VERMONT				No response.
VIRGINIA				State logging code process of adoption.
WASHINGTON	X			
WEST VIRGINIA			X	
WISCONSIN				No response.
WYOMING				No response.