HAZARD EVALUATION AND TECHNICAL ASSISTANCE REPORT
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BOISE CASCADE
RUMFORD, MAINE
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Hazard Evaluations and Technical Assistance Branch
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I. INTRODUCTION

In December 1982, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request from Local 900 of the United Paperworkers International Union for a health hazard evaluation at the Boise Cascade paper mill in Rumford, Maine. Specifically, the Paperworkers requested that we look at certain chemical exposures and evaluate "general illness" and cancer among the worker population.

A site visit was made in May 1983, which concentrated on four areas of the mill specified by the union to be of primary interest. Some limited environmental characterization was conducted by the NIOSH industrial hygienist. There was also an industrial hygiene survey performed by a private consultant contracted by management. The NIOSH medical officers interviewed mill workers to address the concerns of chronic chemical exposure. This included a questionnaire survey designed to elicit symptoms of respiratory dysfunction.

The results of both the environmental survey and the medical survey were presented in a report dated January 1984 (Appendix 1). The report concluded that the workplace conditions created potential exposure to lime dust, talc, mercaptan, wood dust, dimethyl sulfide, dimethyl disulfide, various terpenes, and small amounts of toluene, ethanol, and ethyl benzene. At the time of the 1983 visit, the investigators measured overexposures to mercaptans and to lime and talc dust. NIOSH investigators did not observe an increased prevalence of chronic bronchitis (defined as productive cough on most days for 3 or more months a year for at least 2 years). However, complaints of eye, nose, and throat irritation were frequently reported, usually associated with the environmental conditions of the workplace.

In the 1984 report, an assurance was made that there would be additional attention given to the concern expressed about cancer among the workforce. This letter reports on the steps taken to further investigate the relationship of employment at the mill and the cancer experience of the workers.

II. MATERIALS AND METHODS

NIOSH investigators considered the available study options that could be employed to examine the association between work at the facility and the development of cancer. After determining that the mill was the predominant employer in the surrounding community, we decided to look at cancer deaths that had occurred in the community at large, in relationship to employment at the mill. This approach was chosen on the basis of its practicality and economy of resources; evidence that would have warranted an epidemiologically more definitive approach was not available at the time.

The Bureau of Health Planning and Development in Augusta, Maine was asked to provide the identity and cause of every death that had occurred in the towns of Rumford, Mexico, and Dixfield between 1/1/73 and 12/31/82. (It was estimated by the original NIOSH medical investigator, after conferring with plant officials, that 90% of the mill's workforce resides in one of these three towns.) Names of deceased, their sex, race, date of birth, year of death, and cause of death were assembled by the Bureau and forwarded to NIOSH. We then submitted to the company the list of names (without information as to the cause of death). We asked the company to compare this list with their own employment records (previously determined to be complete by the NIOSH medical investigator) and report back to us the dates of employment for each person who worked at least one year at the mill.

A case control study of these deaths was conducted. Each death due to a malignant neoplasm, as indicated by an International Classification of Disease (ICD) code from 140 through 208 was considered a "case." All other deaths (deaths due to causes other than a malignant neoplasm) were used as controls. For those persons who died from any malignant neoplasms, odds ratios *for ever having worked at the mill were calculated, taking into account the usual confounders of age and sex. Similarly, odds ratios were calculated for each of the following groupings of cancers:

1) Lymphatic and hematopoietic system
2) Lymphosarcoma and reticulum-cell sarcoma
3) Leukemia
4) Digestive organs and peritoneum
5) Stomach
6) Intestines
7) Pancreas
8) Buccal cavity and pharynx
9) Respiratory system
10) Trachea, bronchus and lung
11) Bladder
12) Brain
13) Connective and other soft tissue
14) Other cancers not specified as to site.

When elevated odds ratios were found (odds ratios greater than 1) for ever having worked at the mill, the analysis was repeated, substituting duration of employment for the question of whether the individual had ever worked in the mill. This allowed us to see if there was a relationship between a person's death and how much time a person worked in the mill. When such an "exposure- response" relationship is present, it strengthens the argument for a workplace cause.

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*The odds ratios is a measure of the likelihood that someone dying of a specific cause of death had a particular prior exposure or risk factor. Under certain conditions, the odds ratio is a reasonable estimate of the increased risk of dying from a specific cause of death.

III. RESULTS

After removing from consideration all persons who died younger than 20 years of age, a total of 1476 deaths from the surrounding communities became the basis for the analyses. Of these, 299 (20.3%) died of malignant neoplasms, and 1177 died of some other cause. Of the 1476, 821 (56%) of the deceased were male; 655 (44%) were female. Three hundred eighty-five (26%) of the deceased were identified by Boise Cascade as having worked for 1 year or more at the mill. Forty-four percent of the deceased males had worked at the mill, but only 4% of the deceased females had. The mean age at the time of death overall was 73 years. For cancer deaths, Table 1 presents the odds ratio for having worked in the mill for at least 1 year.

For the 299 deaths due to malignant neoplasms, the odds ratio for having worked at the mill was 1.37 (a 37% greater likelihood ($p < 0.05$)), with a 95% confidence interval of 1.00, 1.87* (Table 1).

There was a statistically significant elevated odds ratio for ever having worked in the mill among persons who died of malignancies of the lymphatic and hematopoietic system, (28 deaths, OR=2.85, $p < 0.05$, 95/CI:1.13 - 7.19). This was due primarily to the markedly elevated odds ratio of 13.16 for eight persons dying from "lymphosarcoma and reticulum-cell sarcoma". All of the "lymphosarcoma and reticulum-cell sarcoma" cases had as their cause of death the designation reticulum-cell sarcoma.

There were 17 people who died of "malignant neoplasm of the stomach," where the odds ratio for having worked in the mill for at least 1 year was elevated, but not statistically significantly. The odds ratio increased, however, about 3% for every additional year worked at the mill. None of the other specific cancer sites examined had statistically significantly elevated odds ratios, although most were in excess of one.

The excess of deaths due to "lymphoma and reticulum-cell sarcoma" is the most conspicuous in this analysis. Of the eight persons who died in this category, five worked at the mill (Table 2). These five ranged in age from 59 to 85 at the time of their deaths, and included 4 males and 1 female. The earliest history of work at the mill dates back to 1923; the latest ended in 1975. All of the individual work histories were long, ranging from 25 years to 48 years.

We attempted to obtain the detailed work histories of these individuals to look for common workplace exposures. However, the work histories collected were not adequately detailed to support an examination of this issue.

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*In this analysis, the term statistically significant means that there was less than a five percent probability that the observation made occurred as a matter of chance alone. If the "p value" is less than 0.05 (five percent) that means that we consider the observation significant and therefore related to the risk factor, in this case, employment at Boise Cascade. The confidence interval means that we are 95 percent certain (with 100 percent equal to complete certainty) that the true value of the odds ratio falls in this range.

IV. DISCUSSION

A search of the existing literature on workers in the paper (and pulp) industry revealed several reports of increased risk for the two malignancies found to be in excess in this analysis, "malignancies of the hematopoietic system" and "stomach cancer."[1-4] Suspected exposures responsible for these malignancies as identified by the authors included wood dusts, formaldehyde, sulfur compounds, and other chemicals.

There are some problems with this analysis that preclude arriving at any definitive conclusions concerning the work relatedness of the cancers in this cohort. The type of study done, a cumulative incident case-control study from deaths occurring in the community, was chosen as a matter of practicality.

The epidemiologically optimal method of investigating the question, a cohort mortality study, would have required resources beyond those available to the hazard evaluation program. An additional 5 years have elapsed since the list of deaths were collected from the State in 1984. There undoubtedly have been many more deaths in the community, perhaps including persons who started work at the mill later in the century and who therefore worked in the mill in more contemporary conditions. Inclusion of these additional deaths might reveal more about the role of workplace exposures.

These shortcomings aside, the findings of this investigation, together with the existence in the literature of similar reports, suggest that a health hazard existed in this mill, and further, to the extent that other mills used the same or similar process, may have existed, or may currently exist, on an industry-wide basis.

REFERENCES

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TABLE 1

CASE CONTROL ANALYSES OF DEATHS DUE TO MALIGNANT NEOPLASMS (MN)

ODDS RATIOS (OR) FOR HAVING WORKED AT LEAST ONE YEAR AT THE BOISE CASCADE PAPER MILL

(ORs adjusted for age and sex)

TYPE MALIGNANCY	OR EVER WORKED	# OF CASES
All cancers	1.37*	299
MN of the Hematopoietic System	2.85**	28
Leukemia	0.86	8
Lymphosarcoma and Reticulum-cell sarcoma	13.16***	8
MN Digestive System	1.36	80
MN Stomach	2.06	17
MN Intestines	1.52	39
MN Pancreas	0.26	11
MN Buccal Cavity	0.67	7
MN Respiratory System	1.25	71
MN Trachea, Bronchus, & Lung	1.33	67
MN Bladder	1.31	10
MN Brain	1.16	5
Other Cancers Not Specified as to Site	1.55	14
Connective and Other Soft Tissue	8.69	3

MN = malignant neoplasm

* = $p < 0.05$, 95% CI: 1.00 - 1.87
** = $p < 0.01$, 95% CI: 2.17 - 79.58
*** = $p < 0.05$, 95% CI: 1.13 - 7.19

TABLE 2

DEATHS DUE TO RETICULUM-CELL SARCOMA
SEX, AGE, YEARS WORKED AT MILL, DATES OF DEATH

CASE #	SEX	AGE	YEARS WORKED	DATE OF DEATH
1	F	74	not employed at mill	May 1973
2	M	74	1937-1962	Jun 1973
3	F	59	1947-1972	Jan 1974
4	F	61	not employed at mill	May 1976
5	M	85	1937-1958	Dec 1976
6	M	64	1941-1975	Nov 1977
7	M	81	1923-1961	Nov 1977
8	F	70	not employed at mill	Dec 1981