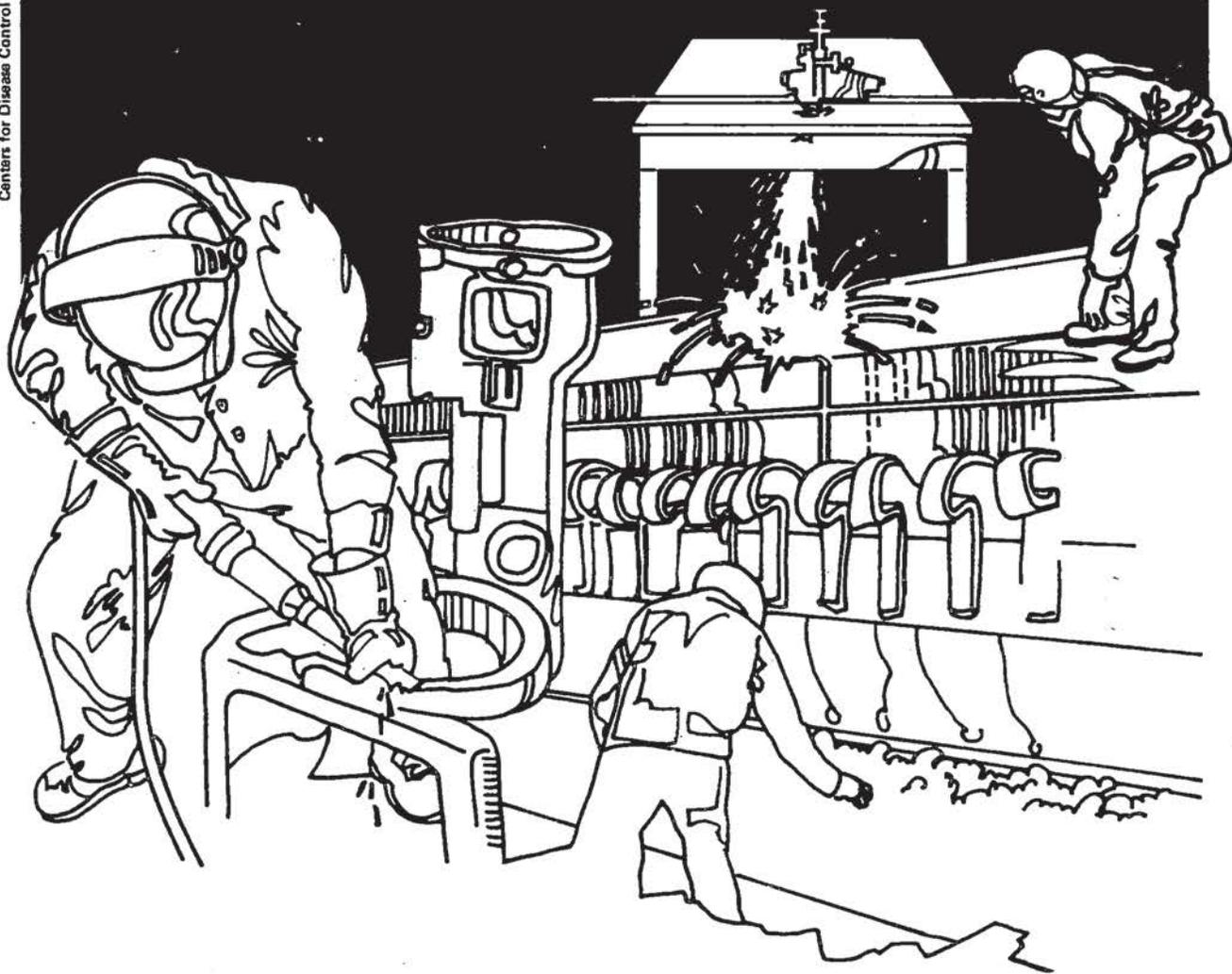


# NIOSH



## Health Hazard Evaluation Report

HETA 82-185-1353  
MARKLAND LOCK & DAM  
MARKLAND, KENTUCKY

## PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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RIVERFRONT STADIUM  
CINCINNATI, OHIO

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## I. SUMMARY

On August 5, 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate occupational exposure to ammonia during the removal of painted lines (line conversion) from Riverfront Stadium's artificial turf. On August 6, 1983, NIOSH investigators conducted a preliminary investigation of the line conversion operation following a night football game. Short-term area air samples for measurement of exposure to airborne ammonia were collected using direct-reading Draeger® tubes. Ammonia levels ranged from 20 parts per million (ppm) to greater than 350 ppm depending upon the operation which was sampled. NIOSH's recommended short-term (5 minute) exposure limit (STEL) for ammonia is 50 ppm. The American Conference of Governmental Industrial Hygienists (ACGIH) STEL (15 minute) for ammonia is 35 ppm. Ammonia concentrations in four of the six short-term samples exceeded these limits.

On August 18-19, 1983, a NIOSH study team conducted a follow-up industrial hygiene and medical evaluation. During this follow-up study, 18 personal breathing-zone air samples were collected from line conversion workers for approximately 6 hours to measure their exposure to airborne ammonia. The ammonia concentrations ranged from 11.9 ppm to 52.4 ppm (arithmetic mean: 21.9 ppm). Assuming no exposure for the remaining 2 hours, an 8 hour time weighted average (TWA) exposure has been calculated. For the 18 personal samples, the TWA values range from 8.9 to 39.3 ppm. The Occupational Safety and Health Administration's (OSHA) 8 hour TWA exposure limit is 50 ppm. None of the 18 TWA air samples exceeded this limit. However, since the primary health effect is acute irritation, the STELs (NIOSH-50 ppm, ACGIH-35 ppm) are the appropriate environmental criteria for evaluation. It is likely that the personal samples exceeded NIOSH's STEL of 50 ppm some time during the work shift.

In the follow-up evaluation, 29 medical questionnaires were administered to 17 line conversion, 10 ground crew, and 2 other workers. The questionnaires revealed that, during the line removal operations, eye irritation was experienced by both line conversion (100%) and grounds crew (100%) workers. Skin irritation was noted by 50% of the line conversion and 60% of the grounds crew workers. Respiratory irritation was cited by 87% of line conversion and 90% of the groundscrew personnel. Nasal congestion and dryness were reported by 81% of the line conversion and 50% of the grounds crew workers. Smaller percentages of workers reported headache (38%) and dizziness (27%).

Although NIOSH approved respirators were available, their condition and use were unacceptable. Also, few workers were observed wearing protective gloves and goggles.

Based on these results, NIOSH concluded there was a health hazard (eye, skin, respiratory irritation) from exposure to ammonia at Riverfront Stadium during line removal operations. Of particular concern were the documented high short-term levels of exposure which in one case exceeded 350 ppm. Recommendations are contained in Section VII of this report.

KEYWORDS: SIC 9999 (Nonclassified Establishments); ammonia, artificial turf, stadium.

## II. INTRODUCTION

On March 29, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request from the U.S. Army Corps of Engineers, Louisville District, to evaluate a reported cluster of cases of skin cancers among employees at the Markland Lock & Dam facility located in Markland, Kentucky. Seven employees (three current and four past workers) were reported to have had skin cancer.

## III. BACKGROUND

### A. Markland Lock & Dam

The Markland Lock & Dam Facility is located on the Ohio River about 27 miles upstream from Madison, Indiana and four miles downstream from Warsaw, Kentucky. The structure, dedicated in 1963, is owned and operated by the U.S. Army Corps of Engineers. It is one of eight such lock and dam installations on the Ohio River.

The two navigation locks at Markland are located on the Kentucky side of the river. The size of the main lock chamber is 1200' X 110' (55 million gallon capacity), whereas the auxiliary lock is somewhat smaller at 600' X 110' (23 million gallon capacity). The sizes of boats passing through the locks varies from small crafts (15' or less) to large barges (1150'). The number of boats passing through the docks ranges from 0-15 per shift and from 15-28 per day. The dam, nearly 1400' in length is made up of 12 "tainter-type" gates with each gate measuring 100' X 42'. The upper pool extends upstream for a distance of nearly 95 miles. Like the locks, the difference between the upper pool and lower pool elevations is 35'.

The Public Service Company of Indiana constructed and operates a hydro-electric power plant on the Indiana side of the Markland dam. The lock and dam facility operates 24 hour per day, 7 days per week, with employees working on one of three eight-hour shifts. The work schedules rotate every four weeks with one complete cycle being made every 16 weeks. The employees working at the site include: 11 lock and dam operators; three equipment repairmen; one lockmaster; and one laborer. Secretarial staff, involved mainly with administrative duties were not included in this study. The equipment repairmen, laborer, and lock & dam operators spend 75% or more of their working hours outside. The lockmaster spends nearly 50% of his working hours outdoors. Almost all of this outdoor work is near the water.

### B. McAlpine Locks & Dam

The McAlpine Locks & Dam, also located on the Ohio River and operated by the Army Corps of Engineers, is at the northwestern end of Louisville, Kentucky.

Original work on the McAlpine site was completed in 1830. Various improvements and alterations were made over the years until a combined navigation and hydroelectric development was completed in 1930. The new dam was finished in 1964, and the new locks completed in 1965.

The McAlpine facility has the unique distinction of being the only installation in the entire 981-mile Ohio River navigation system to have three locks of various sizes: a small lock 56' X 360'; an auxiliary lock 110' X 600'; and a main lock chamber 110' X 1200'. These navigation locks have the highest lift (37') of any on the Ohio River and were built so that river traffic could by-pass the former "Falls of the Ohio River".

The dam, nearly 8600' in length, is geographically separate from the locks, with four tainter-type gates located adjacent to the hydro-electric plant and fixed weir concrete and five tainter type gates positioned upstream from the Ohio River Falls. The upper pool extends about 75 miles to the Markland Locks and Dam.

The McAlpine Locks and Dam is very similar to Markland in regards to operation and work schedules, employee job tasks and titles, amount of worktime spent out of doors, and materials/chemicals used. There are 18 employees on staff at the McAlpine site.

#### IV. METHODS

##### A. Medical

A medical questionnaire was administered to 15 out of 16 employees at Markland dam. This questionnaire was designed to obtain information on work history, medical history, and dermatological problems. A limited clinical examination of exposed areas of the skin (hands, arms, face, and neck) was also done. Histological and general medical records of those who have had medical treatment for dermatological conditions were traced. Attempts were also made to trace records and whereabouts of past employees, but other than incomplete and conflicting information obtained from interviewing current employees, no complete list of names and addresses of past workers were available. Instead, employees at the next lock and dam facility down the Ohio river (the McAlpine dam at Louisville, Kentucky) were chosen as a comparison group for question- naire administration and examination. Seventeen out of 18 employees at this facility participated.

#### V. EVALUATION CRITERIA

##### A. Skin Cancer

Skin cancers are the largest single type of cancer in the U.S. (1), comprising one-third of new cancer cases diagnosed each year.

Excluding melanomas, there are an estimated 400,000 new cases annually (2). The main types of skin cancer are melanoma, squamous cell carcinoma, and basal cell carcinoma. Most melanomas arise de novo, but some appear in association with pre-existing lesions that occur almost exclusively in sun-exposed areas in the elderly. Several observations suggest that a majority of cases of malignant melanoma are linked to sun exposure, though the exact role of the sun in the pathogenesis of melanomas is uncertain (3). In individuals who produce little pigment in the skin, and who spend a lot of time outdoors exposed to the sun, sun exposure is tolerated less well and there is an increased likelihood of developing melanomas and basal cell carcinomas (4). Squamous cell carcinomas have numerous predisposing factors including chronic sun-exposure in fair-complexioned persons. Other factors include exposure to arsenic compounds (5), organic hydrocarbons such as pitch and tar (6,7), chewing betel nut and tobacco, chronic ulcers, and radiation or thermal injury. A condition that, while not in itself malignant, may progress to squamous cell carcinoma is actinic keratosis (8,9). This occurs at skin surfaces previously damaged by the sun. Hence, occupational groups with chronic sun exposure have a higher risk than similiar workers in sun-sheltered jobs to developing skin malignancies. Other occupational factors include exposure to arsenic compounds and polychlorinated biphenyls (4). Some genetic conditions (e.g., xeroderma pigmentosum) also increase the risk for developing basal cell carcinoma.

## VI. RESULTS

### A. Environmental

Review of the material inventory/usage list from both dams showed that the main chemicals used are grease compounds, oils, paints, and solvents. In addition to this list, there are small amounts of coal tar pitch used for filling up cracks in the concrete, and a coal tar epoxy coating used for painting the hull of a boat, but this work is done less than once a year. The frequency and conditions of use of all these substances makes it unlikely that any occupational overexposure to these materials would routinely occur.

### B. Medical

The 15 employees interviewed at Markland dam included one lockmaster, 10 lock and dam operators, three equipment repairmen, and one laborer. The 17 workers seen at McAlpine dam included one lockmaster, one assistant lockmaster, 14 lock and dam operators, and one equipment repairman. The two groups were comparable with respect to age, sex, and job seniority.

	Markland Dam	McAlpine Dam
Number Interviewed	15	17
Age: Range	33 - 66 yrs.	26 - 58 yrs.
Mean	49 yrs.	44 yrs.
Median	47 yrs.	48 yrs.
Sex	14 males; 1 female	17 males
Race	15 whites	16 whites; 1 non-white
Length of Time in Present Job		
Range	1 - 29 yrs.	2 - 29 yrs.
Mean	9 yrs.	12 yrs.
Median	8 yrs.	11 yrs.

All except two workers at Markland dam have lived in Kentucky or Indiana for a major part of their lives. Other than two persons at Markland dam and three workers at McAlpine dam, none of the others have spent a year or more living in the tropics (between 30 degrees latitude North and 30 degrees latitude South of the equator) or hot, arid states such as Nevada or Arizona. Eleven out of 15 (73%) of those from Markland dam, and 9 out of 17 (53%) from McAlpine dam regularly participated in outdoor hobbies. Only one worker in each group uses sun-screen lotions, and none use suntan or other skin ointments and lotions regularly. All the workers in both groups use hard hats when outdoors on the job, short-sleeved shirts in summer, and long trousers (rather than shorts) at work. The exposure to sunlight in the two groups is, therefore, comparable. The work activity is similar and so is the relative lack of exposure to chemicals at work.

Five workers at Markland dam gave a history of having ever undergone a skin biopsy, excision, or other surgical procedure to the skin or subcutaneous tissues. Seven workers at McAlpine dam had a similar history. Excluding one case from Markland dam and three cases from McAlpine dam who developed their skin problems (all benign) before starting work at these dams, the specific dermatological conditions are as follows:

#### Markland Dam

1. Benign mole, associated with a dermatofibroma - 1 case
2. Actinic keratosis - 2 cases
3. Basal cell carcinoma - 1 case (confirmed by histology)

McAlpine Dam

1. Sebaceous cyst - 1 case
2. Other dermal cyst (unspecified) - 1 case
3. Excision of unspecified growth on the chin - 1 case
4. Liposarcoma with seborrheic keratosis - 1 case  
(confirmed by histology)

Hence, four workers (27%) at Markland dam and four (24%) at McAlpine dam developed skin conditions after starting work at these dams.

VI. DISCUSSION AND CONCLUSIONS

In the health hazard evaluation request, seven reported cases of skin cancer among present and past employees of Markland dam were reported. Four of these persons were retired and could not be traced for interview or examination. The remaining three were current employees. One had a histologically confirmed skin cancer (basal cell carcinoma). The other two had actinic keratosis - a pre-malignant condition which is very common among fair-complexioned, middle-aged persons with a history of chronic sun exposure (10,11). The workers at Markland dam have all these characteristics. The workers at McAlpine dam have similar characteristics and may also be prone to develop actinic keratosis, though our study found none. Persons involved in outdoor work have more sun exposure and are at greater risk of developing actinic keratosis and skin cancer than those whose occupations and hobbies keep them indoors.

Chronic exposure to sunlight is likely to be the main contributory factor to some of the skin conditions seen at Markland dam. Exposure to and direct contact with chemicals is infrequent at both dams.

VII. RECOMMENDATIONS

1. Some degree of limitation of excessive exposure to direct sunlight, especially in the summer months, may reduce solar damage to the skin. Continuation of the practice of using hard hats and long trousers at work may help. The use of long-sleeved shirts in summer may provide additional protection against the direct rays of the sun. Sunscreen ointments may also be used, but some of these have been known to induce photosensitization (12). Management should ensure that lock and dam operators who use such ointments are aware of this risk. Preparations containing benzophenones seldom cause photosensitization (13). Sunscreens containing para-aminobenzoates have a high "sunscreen index" and have been found to be effective and cosmetically acceptable (13). Where doubt exists as to the choice of an effective and safe sunscreen ointment, consultation with a pharmacist would be helpful.
2. Even though use of coal tar compounds is infrequent, it would be advisable for workers to use appropriate gloves and protective garments when working with them.

3. The supervisors at both the Markland and McAlpine facilities should familiarize themselves and their employees with any manufacturer's recommendations regarding precautionary measures and specific directions before attempting to use any materials in the conduct of their work. Current Material Safety Data Sheets and all available information concerning products used (including health effects) should be obtained and made available to all personnel.

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1. U.S. Army Corps of Engineers, Louisville District
2. Markland and McAlpine Locks and Dam
3. NIOSH, Region IV
4. OSHA, Region IV

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