HEALTH HAZARD EVALUATION REPORT

HETA 94-0238-2484
U.S. MARSHALS SERVICE
LOS ANGELES, CALIFORNIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the work place. 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 and 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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 94-0238-2484
JANUARY 1995
U. S. MARSHALS SERVICE
LOS ANGELES, CALIFORNIA

NIOSH INVESTIGATORS:
NANCY CLARK BURTON, MS, CIH
YVONNE BOUDREAU, MD, MSPH
TERESA A. SEITZ, MPH, CIH

I. SUMMARY

In April 1994, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation request from the management of the United States Marshals Service (USMS) in Los Angeles, California. The reason for the request was concern that deputy U.S. Marshals and administrative support staff were occupationally exposed to tuberculosis (TB) since seven of these employees had reportedly exhibited a positive reaction during recent tuberculin skin testing by the employee health office.

On June 13-14, 1994, NIOSH representatives conducted an environmental and medical evaluation at the Los Angeles USMS offices in the Federal Courthouse. Confidential medical interviews were conducted with five of the seven employees who were reported to have newly reactive tuberculin skin tests (TSTs). The on-site occupational health nurse was interviewed, and medical records and the employee TST program were reviewed for information pertinent to the request. The heating, ventilating, and air-conditioning (HVAC) units that served the offices and cell blocks were evaluated to determine their effectiveness in reducing the airborne transmission of infectious agents. As part of this evaluation, temperature, relative humidity, and carbon dioxide (CO_2) measurements were made at 16 locations inside and at one location outside the building twice during the day. The HVAC units servicing the offices and cell block were opened and visually examined.

Out of 107 USMS employees, 69 (65%) received a TST between January and June of 1994. Six (9%) of the tested employees had a reaction size of at least 10 millimeters, indicating a positive response. Of these, only one had a documented prior non-reactive TST while employed with the USMS. All denied known exposure to TB outside of work. There was no knowledge of active TB cases among the prisoners served by these employees.

All 16 indoor measurements of CO_2 ranged from 425 to 850 parts per million (ppm). The Occupational Safety and Health Administration (OSHA) and NIOSH have stated that levels of CO_2 above 800 ppm should trigger inspection of ventilation system operation, and that this level of CO_2 is an appropriate marker of potentially inadequate ventilation. One CO_2 measurement exceeded this level. Temperature (74°F to 78°F) and relative humidity (49% to 59%) were within the comfort ranges recommended by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). Some of the HVAC units serving the office areas had signs of deficient general maintenance. The recirculating HVAC units (heat pumps) were operated in an automatic mode, which resulted in no supply air delivery when temperature setpoints

were satisfied. There was pooled standing water in some of the condensate pans and evidence of water leakage on the ceiling tiles under the HVAC units. There were no particulate filters in the HVAC units, nor was there a place to install filters in the units. The return air plenums for the office and cell block areas were open in some locations, allowing for mixing of air between the two areas.

The available TST data are not sufficient to assess the prevalence of TB infection or the extent of work-related risk of TB among USMS employees. Methods for collecting and interpreting the data necessary to help answer these questions are provided in this report.

USMS employees may have an increased risk of occupationally acquired TB infection because they are in contact with prisoners, a group considered to be at high risk for developing active TB. Recommendations for an employee TB education and surveillance program, and for improving the work environment, especially the ventilation systems, can be found in Section IX of this report.

KEYWORDS: SIC 9221 (Police Protection), *Mycobacterium tuberculosis*, tuberculosis, TB, tuberculin skin test, TST, correctional facility, indoor environmental quality, IEQ, ventilation.

II. INTRODUCTION

In April 1994, the National Institute for Occupational Safety and Health (NIOSH) received a management request for a health hazard evaluation (HHE) of tuberculosis (TB) risk in employees at the United States Marshals Service (USMS) in Los Angeles, CA. The request was prompted by the employee health office's report of seven "positive" tuberculin skin test (TST) reactions among USMS staff between January and April 1994. There was no known exposure to TB among these employees. The TSTs were performed after one employee was noted to have a positive reaction when tested as part of a routine annual physical exam. In response to this request, NIOSH investigators conducted a site visit at the facility on June 13-14, 1994 to evaluate data collected from the current TST program, and to examine the ventilation systems that serve the office areas and cell block to determine their adequacy in reducing the concentration of airborne contaminants.

III. BACKGROUND

The Los Angeles USMS employs approximately 107 workers, including deputy U.S. Marshals and related operational personnel, guards, and administrative personnel. Prisoners are held in an enclosed cell block up to eight hours during the day where they are monitored by guards and deputy marshals. They are escorted by deputy U.S. Marshals within the court house for court appearances and are then returned throughout the day to nearby prisons. The maximum number of prisoners that had been held in the cell block during one day was 180. Approximately 95% of the prisoners are brought from the Metropolitan Detention Center where they are reportedly screened for signs of active TB disease. Tuberculosis skin tests may be administered at the detention center, but the prisoners are often allowed to be transported to the USMS facility prior to the evaluation of the TST. The other 5% of prisoners come from other correctional facilities including Terminal Island (a Federal penitentiary), halfway houses in the area (also federal), and four county facilities: the Los Angeles County Jail, Sable Brand Institution, Wayside Center, and Juvenile Hall. In addition, individuals may be brought in directly off the street for booking. Marshals also accompany prisoners when they are transported by air around the country, or when they are being transported to a medical facility.

The U.S. Marshals' offices are located on the ground floor of the Federal Building and Courthouse in downtown Los Angeles. Figure 1 (not to scale) is a sketch of the offices and cells where the environmental assessment was centered. The offices are separated from the cell block by a fire wall except where the small holding cells have been added. One of these small holding cells serves as an isolation cell when necessary for either health or security purposes. According to management and employees, the current ventilation systems have been in place at least 20 years.

There are no ventilation plans available to determine the time of installation or the specifications of the units. The large open area and adjacent offices are served by five recirculating heating, ventilating, and air-conditioning (HVAC) heat pump units. Outside air (OA) is supplied to four of these units from a common OA duct located in the parking garage. There is a common plenum return over the suspended ceiling tiles. In each air handler, outside air mixes with return air from the ceiling plenum. The mixed air passes through refrigerant cooling coils, the fan, and supply air ductwork, and is delivered to the occupied space through ceiling diffusers. The visitor side of the interview rooms is served by a separate HVAC unit that uses 100% recirculated air. All of the heat pump units are shut down over the weekend.

The recirculating HVAC unit that served the cell block is located in the basement. The outside air intake for this unit was located at ground level next to the building. This unit has an automatic damper system that is reportedly set to bring in a minimum of 10-15% OA. At outside air temperatures of 65-68ºF, the unit brings in 100% OA. This HVAC unit has polyester roll-type filters with an efficiency of 30%. In this unit, OA mixes with the return air from the ceiling plenum, passes through the roll-filters, refrigerant cooling coils, the fan, and supply air ductwork, and is delivered to the occupied space through ceiling diffusers. This unit is also shut down over the weekend.

IV. TUBERCULOSIS

Tuberculosis is an infectious disease caused by the bacterium *Mycobacterium tuberculosis*. *M. tuberculosis* is carried in airborne particles, known as droplet nuclei, that can be generated when persons with TB of the lungs or throat cough, sneeze, or speak. The droplet nuclei are so small (1-5 microns) that normal air currents keep them airborne and can spread them throughout a room or building. Infection occurs when a person inhales aerosolized* *M. tuberculosis* and bacteria become established in the alveoli of the lungs and spread throughout the body.[1,2] Within 2-10 weeks the immune system is typically able to prevent further multiplication and spread of the bacteria. At this point, a person will usually have a positive TST.

Because infection requires the inhalation of aerosolized *M. tuberculosis*, the probability that a person will become infected depends upon the concentration of infectious droplet nuclei in the air. The actual dose required to initiate infection is not known. Environmental factors that enhance transmission include: the sharing of a relatively small, enclosed space by uninfected persons and an infectious person; inadequate ventilation that results in insufficient dilution or removal of infectious droplet nuclei; and recirculation of air containing infectious droplet nuclei.[1]

---

* "Aerosolized" refers to the dispersion of aerosols. The aerosols of interest in this report are droplet nuclei that may contain *M. tuberculosis.*

Most persons infected with TB will never have symptoms from this infection. The bacteria will be contained by the immune system and cause no overt illness. In a small proportion of newly infected persons, the initial infection develops into "active" TB disease. In the United States, approximately 5% of newly infected individuals will develop active TB in the first two years after infection, and another 5% will develop active disease some time during the rest of their life. When a patient develops active pulmonary TB, the infection destroys lung tissue as it grows, forming a cavity. When the cavity erodes into an airway, infectious material (which includes live *M. tuberculosis*) in the airway causes the patient to cough, which can aerosolize *M. tuberculosis*. Cough is the predominant symptom associated with active TB disease. Fever, weight loss and fatigue are also common. Infected persons are more likely to develop disease if they experience physical or emotional stress, or if they become immunocompromised as can occur with human immunodeficiency virus (HIV) infection. To decrease the chance of developing active disease once infected, the Centers for Disease Control and Prevention (CDC) recommends that all persons with positive TSTs be evaluated for preventive drug therapy.

Since 1984, cases of active TB have been increasing in this country. This increase is thought to be associated with the epidemic of HIV infection, increased immigration from countries where TB is common, and outbreaks of TB in high-risk environments. Populations in the United States known to have a high incidence of TB include medically undeserved low-income populations, including racial or ethnic minorities (African Americans, Hispanics, and Asians/Pacific Islanders, Native Americans/Alaskan Natives); residents of correctional institutions, mental institutions, nursing homes, and other long-term residential facilities; persons living under crowded conditions; alcoholics and intravenous drug users; the homeless; the elderly; foreign-born persons from areas of the world with a high prevalence of TB; immunocompromised individuals such as those with HIV infection; and persons living in the same household as members of these high risk groups.[2,3,4] Workers who have close contact with individuals with unsuspected TB may have an increased risk of acquiring tuberculous infection, but the extent of the risk is unknown for most work settings.[5,6]

V. GUIDELINES FOR CONTROLLING OCCUPATIONAL TRANSMISSION OF TUBERCULOSIS

A. General Guidelines

In October 1993, the Occupational Safety and Health Administration (OSHA) issued enforcement guidelines concerning occupational exposure to TB.[7] The workplaces covered by the OSHA guidelines are those where the CDC has identified workers as having an elevated incidence of TB infection. These include health care settings, correctional institutions, homeless shelters, drug treatment centers and long-term care facilities for the elderly. At these facilities, the OSHA guidelines require: a protocol for the early identification of individuals with active TB; skin test surveillance for employees; medical evaluation and management of workers with positive skin tests or symptoms of active TB; placement of individuals with confirmed or suspected TB in isolation rooms; performing high risk procedures in areas with negative pressure and appropriate exhausts; and training and information for employees about TB transmission, signs and symptoms of the disease, medical surveillance and follow-up therapy, and proper use of controls.

The OSHA guidelines are based on 1990 CDC guidelines regarding prevention of TB in health-care facilities.[5] In October 1994, the CDC published a final revision of its TB guidelines.[1] This document discusses, in detail, the importance of administrative and engineering controls, personal protective equipment, early identification and screening, risk assessment, a written TB control plan, skin testing programs, and worker education. The CDC issued recommendations in 1989 addressing similar issues, in less detail, for correctional facilities.[6]

Criteria for evaluating the risk of TB transmission in office buildings and holding cells do not exist. Additionally, effective and practical control techniques for reducing risk or preventing exposures to TB have not been determined or thoroughly evaluated. Because the control measures discussed below were developed primarily for health care settings, they may not all be relevant to other workplaces. A discussion of these measures is included because it is useful in understanding the range of options available to control TB transmission.

The following basic approaches have been recommended to reduce the risk of TB transmission: (1) prevent infectious particles from entering the air by providing rapid identification, isolation, and treatment of persons with active TB, (2) reduce the number of infectious particles entering the air by containing

them at their source and using directional airflow and dilution ventilation, (3) use appropriate respiratory protection in areas where there is still a risk of exposure to *M. tuberculosis*, such as patient isolation rooms; and (4) use TST screening to identify persons with tuberculous infection, and provide preventive treatment (or treatment of active TB) when appropriate.

When infectious particles cannot be controlled at their source and they enter room air, both local and general ventilation can be used to reduce the concentration of particles. The goal of local exhaust ventilation is to capture and remove the infectious agent from the air before it comes in contact with susceptible individuals. It is most effective when the infection source is at a fixed location (such as when handling laboratory specimens in a lab hood or when performing aerosol generating procedures on a person with active TB in a treatment booth). General ventilation, which provides air flow to larger areas, reduces the concentration of infectious agent and/or moves the infectious agent away from susceptible individuals.

For many years, ventilation has been the primary environmental control method for TB. Ancillary control measures have included the use of air cleaning techniques such as high efficiency particulate air (HEPA) filtration and germicidal ultraviolet radiation, as well as the use of respiratory protection. All of the control measures discussed above may reduce exposure to TB; however, there is presently no reliable method for measuring the reduction achieved by each control measure. In addition, none of the control methods used alone or in combination can completely eliminate the risk of TB transmission.[5]

In January 1994, the California Department of Industrial Relations issued for public comment a draft of regulations to prevent occupational tuberculosis. Prisons and jails will be covered by these regulations which include TB surveillance, medical evaluation, exposure control, training, and record keeping.[8]

B. Early Identification and Screening

To minimize the transmission of *M. tuberculosis*, early identification and treatment of infected persons, both with and without active disease, is necessary. The identification of individuals with tuberculous infection is commonly accomplished using the tuberculin skin test (TST). A protocol for testing employees is required by OSHA at the facilities included in their enforcement policy. The TST involves injecting a small amount of purified protein from *M. tuberculosis* into the upper layers of the skin. If the person

being tested has previously been infected with *M. tuberculosis*, his or her immune system usually reacts against this protein; the reaction causes a reddish swelling at the site of the injection (a "positive" result if this swelling is of a certain size). If the person has not been infected previously, there will be little or no reaction (a "negative" result). There are standardized guidelines for interpreting the TST results.[1,3] The injection does not contain live *M. tuberculosis* bacteria and cannot cause infection; furthermore, repeated skin testing will not cause a positive test in a person who has not been infected with TB.

Interpreting skin tests for tuberculous infection can be complicated by the fact that some infected people react "negatively" on their first test after a long period of time without testing. The injection of the protein however, "reminds" the person's immune system to react, which will result in a positive result on subsequent tests. In this situation, it would be incorrect to assume that the person had been infected in the time between the most recent two tests. To avoid this problem, a "two-step" test procedure is recommended by the CDC for persons being enrolled in a TB surveillance system. If the first test is negative, a second TST is given a week later. If the second test is also negative, the person is considered to be free of TB infection and can then be enrolled in the periodic screening program. They need only receive a single TST at each subsequent periodic screening.[9]

Routine screening of health care workers at least annually is recommended by the CDC and required by OSHA at facilities included in their enforcement policy. If a person with a previously negative skin test reacts positively to a TST, the test should be followed by a chest X-ray to determine whether active TB has developed. The X-ray of an infected person without active disease may show no abnormalities or show little more than a small spot on the lung where the infection occurred, possibly with deposits in a nearby lymph node. A series of prophylactic (preventive) drug therapies are generally prescribed upon diagnosis to prevent the infection from advancing to active TB disease.[10] The two drugs most commonly used for this purpose are isoniazid (INH) and rifampin. The selection of drugs for treating a patient (either to prevent the development of active TB after identification of infection, or to treat active TB disease) depends on a number of factors including the health status of the patient and the strain of *M. tuberculosis* causing the infection. Some strains of *M. tuberculosis* are resistant to the most commonly used drugs necessitating the use of other pharmaceuticals.[11]

In addition to identifying individuals for whom prophylactic treatment is appropriate, routine TST screening can also serve as a surveillance tool to identify areas or occupations for which there may be an increased risk of TB transmission. It should be noted that even if the drug treatment successfully kills the TB bacteria and prevents the development of active disease, the patient will continue to test positive on later TB skin testing because his or her immune system will "remember" the TB protein and react to the skin test.

A diagnosis of TB should be considered for any person with persistent cough or other symptoms compatible with TB, such as weight loss, anorexia (loss of appetite), or fever. Because these symptoms are not specific for TB (they can be caused by a number of illnesses), a person may be infectious for some time before TB is diagnosed. For this reason, the possibility of TB should be kept in mind, especially for members of populations considered to be at high risk. Early diagnosis of TB is critical for minimizing transmission. Upon diagnosis, drug therapy should be promptly initiated, and the infected individual should be isolated until the drug therapy has been shown to have killed enough bacteria to leave the patient non-infectious.[1]

C. Ventilation in Office Buildings

The probability of tuberculosis transmission is affected by the number of persons with active TB, the susceptibility and proximity of uninfected individuals, and the building ventilation. Ventilation guidelines do not exist for holding cells but there are guidelines for minimum outside air intake and temperature control in office buildings. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 62-189, "Ventilation for Acceptable Indoor Air Quality", recommends outdoor air supply rates of 20 cubic feet per minute per person (cfm/person) for office spaces and conference rooms, and 15 cfm/person for reception areas.[12] These guidelines were established for comfort and odor control and do not address infectious disease transmission. This is of concern in the control of tuberculosis, because even the most dilute concentration of the infectious agent may present some risk of infection.

The measurement of ventilation and comfort indicators such as carbon dioxide (CO_2), temperature, and relative humidity (RH) has proven useful in providing information relative to the proper functioning and control of HVAC systems in office environments. Carbon dioxide is a normal constituent of exhaled breath and, if monitored, may be useful as a screening technique to evaluate whether adequate quantities of fresh air are being introduced into an occupied space. Indoor CO_2 concentrations are normally higher than the generally constant ambient CO_2 concentration (range 300-400 ppm). According to

NIOSH and OSHA, a level of 800 ppm should trigger inspection of ventilation system operation.[13] This level of CO_2 is an appropriate marker of potentially inadequate ventilation. Available research findings show a pattern of significantly higher symptom prevalence in association with ventilation rates below approximately 20 cfm of outside air per person. At average occupant densities, this ventilation rate corresponds to approximately 800 ppm of CO_2. ASHRAE uses a concentration of 1000 ppm as a guideline. Elevated CO_2 concentrations suggest that other indoor contaminants may also be increased. Building occupants produce water vapor, particulates, bioaerosols, and other contaminants in addition to CO_2.

The perception of comfort is related to one's metabolic heat production, the transfer of heat to the environment, physiological adjustments, and body temperatures. Heat transfer from the body to the environment is influenced by factors such as temperature, humidity, air movement, personal activities, and clothing. The ANSI/ASHRAE Standard 55-1992, specifies temperature and relative humidity conditions in which 80% or more of the occupants would be expected to find the environment thermally comfortable.[14]

VI. METHODS

Industrial Hygiene Evaluation

An inspection of the offices and cell block was conducted to evaluate the ventilation systems, including the mechanical units, outside air intakes, and filters. Airflow measurements were made using an Alnor Flowhood®. Using this instrument, airflow through a supply diffuser or exhaust grill can be read directly in cfm. Smoke tubes were used to visualize airflow in the evaluated areas.

In addition, indicators of IEQ were measured. These indicators were carbon dioxide (CO_2) concentration, temperature (T), and relative humidity (RH). These measurements were collected at 16 locations and outside the building; the locations are shown in Figure 1. Measurements were made at each location between 8:10-9:10 a.m. and 1:55-3:10 p.m.

Real-time CO_2 concentrations were measured using a Gastech Model RI-411A, portable CO_2 indicator. This battery-operated instrument uses a non-dispersive infrared absorption detector to measure CO_2 in the range of 0-4975 ppm, with an accuracy of ±25 ppm. Instrument zeroing and calibration were performed prior to use with zero air and a known concentration of CO_2 span gas (800 ppm). Real-time temperature and humidity measurements were made using a Vaisala, Model HM 34, battery-operated meter. This meter is capable of providing direct readings for dry-bulb temperature and RH, ranging from -4 to 140°F and 0 to 100%, respectively.

Instrument calibration is performed monthly using primary standards. Carbon monoxide levels were measured in the parking garage in the morning and the afternoon using a Draeger detector tube with a limit of detection of 5 ppm.

Medical Evaluation

An attempt was made to interview all seven of the USMS employees who were reported to have a positive TST. However, only five of these employees were available at the time of the NIOSH site visit. These five employees were privately interviewed. Medical records were reviewed for TB testing history and results. The occupational health nurse was interviewed for information about the employee TST program, as well as other pertinent information.

VII. RESULTS

Industrial Hygiene Evaluation

Inspection of the air handling systems revealed some general maintenance problems. For the five package HVAC units that serve the large office area, there are no maintenance records and the maintenance staff did not know the last time the units had been balanced. The thermostats are set on the automatic mode which meant that when the thermostats are satisfied, the units turn off. As a result, there are times when no airflow is provided by the HVAC systems. There is some confusion between office staff and maintenance staff as to who has control over the thermostats. There are no particulate filters in the units or any obvious place to install them. The design of the condensate pans is such that water can build up in the pan and overflow. There is standing water in some of the condensate pans and stained ceiling tiles under each of the units. According to the maintenance staff, the units are cleaned with a disinfectant two to three times a year. The supply flow from the units is variable (62 to 388 cfm). The outside air intake in the garage is supplying 83 cfm of air to the air handlers in the afternoon. This does not meet the ASHRAE guideline of 20 cfm/person.
There are two supply diffusers in the partitioned office area and an adjacent private office that have been covered with cheese cloth to catch material from the supply air stream.

The HVAC unit that serves the cell block is located in the basement. The coils are cleaned on one side using a high pressure water wash. The air is filtered using a polyester roll filter system which automatically advances based on changes in static pressure. The design of the unit is such that it was not possible to see the condensate pan. There is a tube leading to a drain from the condensate pan. The exhaust grill in the central hallway of the cell block opens into the ceiling plenum. There are conduit holes for utility lines in the firewall of the cell block. These connect the return ceiling plenums for the Marshals offices and the cell block. The ceiling tiles do not fit closely

together in many areas allowing air to mix with the ceiling plenum. There is visible dust and possible microbial growth on the returns in the holding cells. The returns are covered by grills that are welded in place.

Environmental measurements for both areas (offices and cell block) are presented in Figures 2-4. Indoor CO_2 concentrations (Figure 2) at the 16 monitoring locations ranged from 425 to 850 ppm. The outdoor CO_2 concentration was 375-425 ppm throughout the day. Measured CO_2 concentrations in excess of 800 ppm indicate that the ventilation system should be inspected. This level of CO_2 is an indication of potentially inadequate ventilation. All of the 16 CO_2 concentrations were lower than 1000 ppm, the guideline recommended by ASHRAE.[12] There was a distinct increase in CO_2 concentrations in the afternoon when compared to the morning measurements.

Indoor temperatures (Figure 3) ranged from 74 to 78°F in all areas measured throughout the day. Outside temperatures were 67 and 76°F. Inside RHs (Figure 4) ranged from 49 to 59%, and the outside RH was 81% in the morning and 57% in the afternoon. The temperature and RH measurements were within the acceptable seasonal ranges of operative temperature and relative humidity recommended by ASHRAE for comfort.[14] It should be mentioned that the holding cells contained between 20 to 30 prisoners on the day of the site visit, but it was reported that they hold up to 180 individuals in these cells on a given day.

Carbon monoxide levels inside the garage near the loading dock and outside air intake for four of the ventilation units were below the limit of detection (5 ppm) in the morning and afternoon on the day of the site visit.

A limited indoor air quality survey had been conducted on April 12-13, 1994, in five locations on the basement and ground floors of this building by private consultants hired by the General Services Administration (GSA).[15] The investigation had been conducted in response to employee health complaints. The survey of the cell block and Marshals office was conducted in the afternoon while the HVAC units were working. Measurements were collected for carbon monoxide (CO), carbon dioxide (CO_2), temperature, and relative humidity using a direct reading monitor, Metrosonic Model AQ501. Carbon monoxide was not detected in the evaluated portion of the Marshals area or in the cell block during this investigation. Carbon dioxide measurements ranged from 690 to 768 ppm (three samples) and 765 to 842 ppm (three samples) for the Marshals area and cell block, respectively. Temperature and RH measurements were 72.7 to 74.9°F and 27.2 to 29.8% RH for the Marshals area and 73.3 to 74.0°F and 28.7 to 30.2% RH for the cell block. These measurements were within current ASHRAE guidelines and similar to those collected during the NIOSH

site visit. However, the RH was at the low end of the ASHRAE thermal comfort chart, and CO_2 concentrations in excess of 800 ppm exceed OSHA and NIOSH guidelines.

Medical Evaluation

One of the employees who was reported to have a "positive" TST had a documented reaction size of only 8 millimeters (mm). This result had been counted as "positive" because CDC guidelines used by the occupational nurse recommended a cutoff of 5 mm for highest risk groups, and it was unclear to her whether the USMS employees were indeed at highest risk. However, the revised guidelines define the highest risk groups as including HIV-infected persons, recent close contacts (occupational exposure similar in intensity and duration to household contact), or persons with abnormal chest radiographs consistent with old TB.[1] Since this employee was not known to fit into one of these categories, NIOSH investigators chose to count this as a negative TST for the epidemiologic purposes of this investigation.

Of 107 USMS employees, 69 (65%) received a TST between January and June of 1994, the most recent testing period. Six (9%) of the tested employees had a reaction size of at least 10 mm. Only one had a documented prior negative TST result in 1989. The other five reported that they had negative TSTs in the past, but records of these tests were not available. Four of the six were U.S. Marshals, one was a guard, and one worked in administration but reported occasionally visiting the cell block area. All denied any known exposure to TB outside of work.

VIII. DISCUSSION/CONCLUSIONS

The NIOSH investigators observed some ventilation system deficiencies which could lead to the risk of exposure to airborne infectious agents, including *M. tuberculosis*, if present. These included an inadequate amount of outside air being supplied to the office area, and ventilation units that cycled on and off throughout the day leaving areas without continuous supply ventilation. Other general maintenance problems that were identified in the office areas included standing water in some of the condensate pans, evidence of water leakage on the ceiling tiles under the units, lack of particulate filters in the HVAC units, and improper location of the outside air intake. The cell block recirculating system return air plenum connected with the office area ceiling plenum through gaps in the fire wall which could also increase the risk of exposure to airborne infectious agents.

The data available at the time of our site visit showed that 9% of the USMS employees tested for TB exhibited a positive TST (reaction size at least 10 mm). Because only 65% of the USMS employees were tested, the results may not reflect the prevalence of TB infection among *all* USMS employees. In addition, documentation of results of previous testing was not complete. Without baseline data (i.e., status of TST upon first

employment at the USMS), it is difficult to assess whether a positive test result indicates a possible work-related TST conversion or a prior infection. Therefore, results of this screening effort cannot be used to assess the extent of work-related risk of TB among USMS employees.

The USMS employees do not fall into one of the CDC's defined high-risk categories of workers thought to be at an elevated risk for TB infection. However, residents of correctional institutions are among those persons considered to be at an increased risk of developing active TB, and the CDC recommends employees of these institutions be monitored for TB. Because USMS employees work around a high-risk group of individuals, they may be at an increased risk for TB infection and should therefore be monitored for TB infection.

IX. RECOMMENDATIONS

Early identification and treatment of persons with TB remains the most effective method of preventing subsequent transmission. The following recommendations were adapted from those published by the Centers for Disease Control and Prevention for employees in health-care settings and correctional institutions.[3,4] Data collected through the recommended TB screening program will help establish the magnitude of the risk for TB infection, and the need for additional control measures. Recommendations are also provided to improve the ventilation systems in the office areas and cell block.

1. The USMS, in consultation with qualified medical or public health personnel, should establish a TB screening policy and program for employees. The California Department of Health Services, Division of Environmental and Occupational Disease Control, would be a helpful resource for establishing this program and for consultation in interpreting results. Employee representatives should be involved in the development of the policy and program. The program should be offered at no cost to employees.

   At the time of employment, USMS employees should receive a Mantoux TB skin test unless documentation is provided for: (1) a previously positive reaction, (2) completion or current preventive drug therapy, or (3) current or completed therapy for active disease. Individuals who have a history of BCG vaccination should receive a TST, even though interpretation of a reaction is more difficult. Employees with a positive TST should be evaluated for active TB. (More information about administration, interpretation, and follow-up is given below.)

Employees with negative TSTs should be retested at least yearly to identify persons whose skin test converts to positive.

Current guidelines for administration and interpretation of tuberculin skin testing should be followed.[1,3] Key aspects of these guidelines include the following:

Use of a two-step procedure for initial skin-testing. This involves retesting within 1 to 3 weeks those who are initially negative.

Intracutaneous administration of 5 units of purified protein derivative (PPD) tuberculin (Mantoux test) is the best means of detecting infection.

Tests should be read by a qualified person between 48 and 72 hours after injection.

The size of the reaction in millimeters of induration should be recorded for all tests. The definition of a positive tuberculin skin reaction varies according to several factors, particularly the immune status of the tested individual. A skin test conversion is defined as an increase in reaction size of 10 mm or more (for persons younger than 35 years of age) or 15 mm or more (for those older than 35 years of age) in a person whose previous reaction was negative.

2. Employees with positive TSTs, skin test conversions, or symptoms suggestive of TB should be clinically evaluated for active TB.[16] Appropriate therapy should be instituted for those with active TB. Employees with positive TSTs or with skin test conversions, but without clinical TB, should be evaluated for preventive therapy according to published guidelines.[17]

   In addition to individual medical evaluation following a skin test conversion, a history of possible exposure should be obtained in an attempt to determine the potential source of TB infection.

   Individual TST results and clinical evaluations should be maintained in confidential employee health records, and should be recorded in a retrievable aggregate data base of all employee test results. Identifying information should be handled confidentially. Summary data (e.g., the percentage of positive reactions among all tested) can be reported to management and employees. Individual test results should remain confidential.

The rate of skin-test conversions should be calculated periodically so that the risk of acquiring new infection can be estimated and the effectiveness of control measures can be evaluated. On the basis of this analysis, the frequency of re-testing may be altered accordingly.

3. An in-service TB education program should be instituted for USMS employees. This program should be developed in consultation with qualified medical or public health personnel. The program should initially cover the basic concepts of TB transmission, pathogenesis and diagnosis, signs and symptoms of TB, proper precautions for minimizing risk of infection and active disease, purpose of testing and interpretation of TST results, principles of preventive therapy for TB infection and of drug therapy for active disease, and follow-up procedures for skin test conversions and suspicion of active disease. Additionally, periodic updates should be provided to disseminate new information about TB and to share summary information about the extent of TB transmission among USMS employees.

4. Prisoners who are frequently coughing should spend a minimum amount of time in common waiting areas. Disposable tissues should be available in the cell block and waiting areas, and prisoners should be encouraged to cover their mouths and noses when coughing or sneezing.

5. With assistance from a qualified ventilation engineer, the following HVAC system deficiencies should be corrected. The outside air intake for the four recirculating HVAC units should be moved to an area outside the parking garage where there is no possible entrainment of auto or building exhaust. A filtration system should be installed to remove particulate matter from the supply air. The slope of the condensate drain pans should be modified to prevent the build-up of water and allow proper drainage. To prevent a build-up of air contaminants, the systems should be balanced and set up to continuously supply a minimum amount of airflow with a sufficient amount of outside air (at least 20 cfm/person) at all times when the building is occupied.[12] An outside air source should be added for the interview rooms. Water-damaged ceiling tiles cannot be effectively disinfected and, therefore, should be replaced to prevent possible microbial growth.

6. To prevent air mixing between the ceiling plenums that serve the holding cells and office areas, the fire wall between the two areas should be completed and the conduit holes sealed. The supply diffusers and return grills in the holding cells should be cleaned on a routine basis to remove dirt, debris, particulates, and potential microbial contaminants.

X. REFERENCES

1. CDC [1994]. Guidelines for preventing the transmission of *Mycobacterium tuberculosis* in health-care facilities, 1994. **MMWR** 43:RR-13.

2. CDC [1992]. Transmission of multidrug-resistant tuberculosis among immunocompromised persons in a correctional system - New York, 1991. **MMWR** 41(28): 507-509.

3. CDC [1990]. Screening for tuberculosis and tuberculous infection in high-risk populations - recommendations of the advisory committee for elimination of tuberculosis. **MMWR** 39:RR-8:1-6.

4. Spencer SS, Morton AR [1989]. Tuberculosis surveillance in a state prison system. **Am J Public Health** 79(4):507-509.

5. CDC [1990]. Guidelines for preventing the transmission of tuberculosis in health-care settings, with special focus on HIV-related issues. **MMWR** 39:RR-17:1--29.

6. CDC [1989]. Prevention and control of tuberculosis in correctional institutions: recommendations of the advisory committee for the elimination of tuberculosis. **MMWR** 38(18):313-320.

7. OSHA [1993]. Enforcement policy and procedures for occupational exposure to tuberculosis. Washington, DC: Occupational Safety and Health Administration. Memorandum (10/20/93).

8. California Code of Regulations [1994]. Title 8, California Code of Regulations, Division 1, Chapter 4, Subchapter 7, Group 16, Control of Hazardous Substances and Processes: Section 5197 - Prevention of Occupational Tuberculosis. (Draft-1/3/94). San Francisco, CA: California Department of Industrial Relations.

9. Comstock GW [1982]. Tuberculosis. In Evans AS, Feldman HA. Bacterial Infections of Humans. New York: Plenum Medical Book Company, 605-632.

10. CDC [1990]. The use of preventive therapy for tuberculous infection in the United States. Atlanta, GA: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. **MMWR** 39:RR-8, May 18.

11. CDC [1992]. Management of persons exposed to multidrug-resistant tuberculosis. Atlanta, GA: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. **MMWR** 41:RR-11, June 19.

12. ASHRAE [1990]. Ventilation for acceptable indoor air quality. Atlanta, GA: American Society of Heating, Refrigerating, and Air-conditioning Engineers. ANSI/ASHRAE Standard 62-1989.

13. NIOSH [1994]. NIOSH testimony on the Occupational Safety and Health Administration's proposed standard on indoor air quality, September 28, 1994, OSHA Docket No. H-122. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

14. ASHRAE [1992]. Thermal environmental conditions for human occupancy. Atlanta, GA: American Society of Heating, Refrigerating, and Air-conditioning Engineers. ANSI/ASHRAE Standard 55-1992.

15. Cape Environmental Management Inc. [1994]. U.S. Courthouse - Limited Air Quality Assessment Report - Los Angeles, CA. Torrance, CA: Cape Environmental Management Inc., Project No. 2403C.07.

16. American Thoracic Society [1990]. Diagnostic standards and classification of tuberculosis. **Am Rev Respir Dis** 142:725-35.

17. American Thoracic Society [1986]. Treatment of tuberculosis and tuberculous infection in adults and children. **Am Rev Resp Dis** 134:355-363.

XI. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:	Nancy Clark Burton, M.P.H., M.S., C.I.H. Industrial Hygienist Industrial Hygiene Section
	Yvonne Boudreau, M.D., M.S.P.H. Medical Consultant Region VIII - Denver, CO
	Teresa A. Seitz, M.P.H., C.I.H. Supervisory Industrial Hygienist Industrial Hygiene Section
Report Formatted by:	Caren B. Day Office Automation Assistant Industrial Hygiene Section
Originating Office:	Hazard Evaluations and Technical Assistance Branch Division of Surveillance, Hazard Evaluations and Field Studies

XII. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report may be freely reproduced and are not copyrighted. Single copies of this report will be available for a period of 90 days from the date of this report from the NIOSH Publications Office, 4676 Columbia Parkway, Cincinnati, Ohio 45226. To expedite your request, include a self-addressed mailing label along with your written request. After this time, copies may be purchased from the National Technical Information Service (NTIS), 5285 Port Royal Rd., Springfield, VA 22161. Information regarding the NTIS stock number may be obtained from the NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. United States Marshals Service, Los Angeles, California
2. United States Marshals Service, Arlington, Virginia
3. American Federation of Government Employees
4. OSHA, Region IX, San Francisco, California

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.