

NIOSH

CRITERIA FOR A
RECOMMENDED STANDARD.....

OCCUPATIONAL
EXPOSURES IN

Coal Gasification Plants

U S DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health

criteria for a recommended standard

**OCCUPATIONAL EXPOSURES
IN COAL GASIFICATION PLANTS**



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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National Institute for Occupational Safety and Health

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PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and provide for the safety of workers occupationally exposed to an ever-increasing number of potential hazards. The National Institute for Occupational Safety and Health (NIOSH) has projected a formal system of research, with priorities determined on the basis of specified indices, to provide relevant data from which valid criteria for effective standards can be derived. Recommended standards for occupational exposure, which are the result of this work, are based on the effects of exposure on health. The Secretary of Labor will weigh these recommendations along with other considerations, such as feasibility and means of implementation, in developing regulatory standards.

Successive reports will be presented as research and epidemiologic studies are completed and as sampling and analytical methods are developed. Criteria and standards will be reviewed periodically to ensure continuing protection of workers.

The contributions to this document on coal gasification by NIOSH staff members, the Review Consultants on Coal Gasification, the reviewers selected by the American Industrial Hygiene Association and the American Conference of Governmental Industrial Hygienists, and by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine, are gratefully acknowledged.

The views expressed and conclusions reached in this document, together with the recommendations for a standard, are those of NIOSH. They are not necessarily those of the consultants, reviewers selected by professional societies or other Federal agencies that evaluated the document, or of the contractor. The comments from the Review Consultants and other reviewers have been considered carefully and, whether or not incorporated into the document, have been sent along with the criteria document to the Occupational Safety and Health Administration for its consideration in setting standards. A list of review consultants and a list of the Federal agencies to which the document was submitted are given on pages vi and vii.


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The Division of Criteria Documentation and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for the development of the criteria and recommended standard for coal gasification. Murray L. Cohen of this Division served as criteria manager and had program responsibility for this document. Enviro Control, Incorporated, developed the basic information for consideration by NIOSH staff and consultants under contract CDC-210-76-0171.

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Environmental Protection Agency

National Aeronautics and Space Administration

Department of Health, Education, and Welfare

CRITERIA FOR A RECOMMENDED STANDARD...
OCCUPATIONAL EXPOSURES IN COAL GASIFICATION PLANTS

Contents

	Page
PREFACE	iii
REVIEW CONSULTANTS	vi
FEDERAL AGENCIES	vii
I. RECOMMENDATIONS FOR A COAL GASIFICATION STANDARD	1
Section 1 - High-BTU Coal Gasification	3
Section 2 - Recommended Standard for Low- or Medium-BTU Gasification Utilizing Bituminous Coal or Lower Ranked Feedstocks	15
Section 3 - Recommended Standard for Low- or Medium-BTU Gasification Utilizing Anthracite Feedstock or Very High Temperatures	15
II. INTRODUCTION	16
III. HAZARDS TO HEALTH AND SAFETY FROM EXPOSURES IN COAL GASIFICATION PLANTS	18
Potential Exposures	18
Biological Effects	39
IV. WORKPLACE MONITORING	51
The Indicator Monitoring Concept	51
Polycyclic Aromatic Hydrocarbons (PAH's)	57
Surface Contamination	58

CRITERIA FOR A RECOMMENDED STANDARD...
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COAL GASIFICATION PLANTS

I. RECOMMENDATIONS FOR A COAL GASIFICATION STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to toxicants and hazardous conditions in coal gasification plants be controlled by adherence to the following sections. The recommended standard is designed to protect the health and provide for the safety of employees for up to a 10-hour workshift, 40-hour workweek, during a working lifetime. Compliance with all sections of the recommended standard should prevent or greatly reduce the adverse effects of toxicants or hazardous conditions on the health of employees and provide for their safety.

No attempt has been made in this document to develop permissible levels of exposure to toxic substances specific to coal gasification plants. It is recommended that where applicable existing Federal occupational exposure limits (29 CFR 1910, Subpart Z) be enforced, except where NIOSH has recommended a reduction in the existing Federal limit or where there is no existing Federal limit, in which cases the NIOSH recommendations should apply. Valid and reproducible techniques for measuring exposure are available to industry and government agencies. Furthermore, existing technology is adequate to permit compliance with the recommended standard. The criteria and recommended standard will be subject to review and revision as necessary.

These criteria and the recommended standard apply to the exposure of employees to toxicants and hazardous operating conditions in commercial coal gasification plants. As used herein, the term "commercial coal gasification plant" refers to any plant using coal to produce a gas that will be sold as a source of energy or otherwise utilized for commercial purposes. These criteria and the recommended standard pertain principally to the types of plants whose technology, construction, and utilization are anticipated around the year 1985. The term "toxicants" applies to all raw materials, products, and byproducts of coal gasification processes that may produce a toxic effect; toxicants include, but are not limited to, asphyxiants, irritants, nuisance particulates, poisons, and carcinogens. The following terms are used interchangeably with the term "toxicant(s)": "toxic compound(s)," "toxic material(s)," "toxic gas(es)," "hazardous material(s)," and "hazardous agent(s)." The term "hazardous operating conditions" refers to conditions that may impair the health of, or cause physical injury to, employees.

For all sections of the recommended standard except workplace monitoring, the terms "occupational exposure" and "employee exposure" are defined as any contact with any toxicant(s) in the work environment. For purposes of workplace monitoring, these terms are defined as in the existing Federal standards (29 CFR 1910) except where NIOSH has used different language, in which case the NIOSH definition applies.

Epidemiologic and toxicologic evidence from related processes has led NIOSH to conclude that employment in coal gasification plants may entail exposure to a number of chemical compounds that can increase the risk of cancer in exposed employees. Because of the large number of toxicants that may be present in a coal gasification plant, guidelines are presented for an indicator monitoring method to allow real-time detection of leakage in coal gasification plants. However, before it is adopted as a procedure for compliance with standards, this method should be compared with methods for the detection of specific hazardous compounds in terms of accuracy and sensitivity.

These criteria for a recommended standard encompass the entire coal gasification process and all of the attendant hazards. An engineering approach, separating coal gasification processes into unit operations, has been used to facilitate the orderly development of these criteria. Recommendations herein for the effective control of hazardous exposures are specific for the hazards associated with individual unit operations, although there are many recognized commonalities among the unit operations. These recommendations are not intended to replace existing general industry safety and engineering standards, although they do supplement such standards as necessary for coal gasification plants.

Each of three types of coal gasification processes is presented in a separate section of the recommended standard, distinguished not only by operating process and technology but also by the nature and extent of potential exposures: (1) high-BTU product coal gasification, (2) coal gasification (low- or medium-BTU product) utilizing bituminous coal or lower ranked feedstocks, and (3) coal gasification (low- or medium-BTU product) utilizing anthracite feedstock or very high temperatures. This allows the unique aspects of various processes to be discussed within a framework of principles and requirements that are common to all coal gasification processes.

Section 1 - High-BTU Coal Gasification

General Process Requirements

(a) Safety Procedures

During the design of a commercial coal gasification plant or during the design of a major modification of an operating plant, a thorough fault-tree systems analysis, failure-mode evaluation, or equivalent safety analysis shall incorporate a review of potential exposures to toxicants and physical agents as well as safety considerations. Process operating modes, including startup, shutdown, and emergency, shall be considered. Control options to protect employees during any identified failure mode shall be incorporated into the final plant design or into the standard operating and emergency procedures.

Automatically activated fire extinguishing equipment or its equivalent shall be installed in compressor areas, over lubricating oil consoles, over pumps containing material at or above its autoignition temperature, and over process vessels containing flammable liquids.

(b) Engineering Control Objectives

All lines or equipment containing toxic gases, vapors, or liquids shall be designed, constructed, and maintained to minimize leakage.

Collection systems draining to sealed sumps or equivalent shall be designed for the disposal or reuse of toxic materials which may leak from pumps, vessels, and other equipment.

Equipment and systems for handling or transferring tar and tar oil shall be enclosed to the extent feasible or shall otherwise be designed or controlled to prevent skin or eye contact and to minimize exposure to airborne particulates.

Drains and sumps from which flammable or toxic vapors may escape shall be engineered in such a manner as to prevent leakage or explosive mixtures.

Suspected leak points of equipment, vessels, or lines (eg, flanges, valves, pump shafts) containing toxic materials shall be individually monitored as appropriate for early leak detection.

Means shall be provided to shut down a process area safely in case of equipment failure.

Equipment shall be designed, located, controlled, or otherwise engineered to limit employee exposure to noise. The NIOSH recommended noise limit is 85 dBA for a continuous exposure of 8 hours. For other durations of exposure, see Chapter 14.

In areas of potentially high exposure, a procedure or an area shall be provided to protect the worker in the event of any dangerous emergency situation. Nonwork areas in which employees can eat or rest during breaks shall be designed to exclude contaminated air.

Where feasible, thermal barriers shall be installed around hot equipment or piping to protect employees from burns.

Flares used for disposal of gases shall be equipped with a pilot and an automatic alarm to signal pilot failure. Flare stacks shall be designed to minimize the emission of particulate matter or of uncombusted hydrocarbons.

(c) Work Practices

A preventive maintenance and inspection program shall be developed and implemented to maximize equipment reliability.

During maintenance, means shall be provided for the isolation of process components or integral units of equipment from the rest of the process. Before work in or on any tank, line, or equipment is commenced, provisions shall be made for the prevention of inadvertent entry of inert or toxic materials into the work area. Isolation blinds on valves shall be installed before employee entry. Where there are no valves, lines shall be disconnected or blinded. During startup, all flange bolts (on equipment, vessels, or lines) that had previously been opened shall be cold torqued and the flanges observed for leakage.

Process equipment and connecting lines handling toxic gases, vapors, or liquids shall be flushed, steamed, or otherwise purged before being opened. Liquids so flushed shall be safely disposed of by diversion to sealed drains, storage vessels, or other appropriate collecting devices. Toxic gases shall be safely disposed of by incineration, flaring, return to process, or by other effective means.

Tanks, process equipment, and lines shall be cleaned, maintained, and repaired only by properly trained employees under responsible supervision. When practical, such work shall be performed from outside the tank or equipment. Entry into confined spaces such as tanks, pits, and process vessels shall be controlled by a permit system. Such permits must be signed by an authorized

representative of the employer and shall certify that preparation of the confined space, precautionary measures, and personal protective equipment are adequate and that prescribed procedures have been followed. No employee shall enter any tank or vessel that does not have an entrance large enough to allow free entry and exit to an employee equipped with safety harness, lifeline, and appropriate respiratory equipment. Employees entering contaminated tanks or vessels shall wear full-bodied protective clothing and appropriate safety equipment until inspection and testing have established that safe conditions exist. Confined spaces which have contained toxic gases shall be inspected and tested before and during entry for oxygen deficiency, presence of toxic gases, and flammable or explosive gas mixtures; shall be thoroughly ventilated, cleaned, neutralized, and washed, as necessary; shall be sealed off from adjacent spaces or vessels prior to entry by employees; and shall be mechanically ventilated during entry. Employees entering confined spaces where they may be exposed to toxic gases shall wear appropriate respiratory protective equipment if mechanical ventilation may not be adequate to maintain safe concentrations of released toxic gas. In confined spaces, supplied-air respirators shall be operated only in the positive pressure continuous-flow or pressure-demand mode and shall have an auxiliary self-contained air supply sufficient to permit escape.

When employees are working in confined spaces where hazardous conditions could develop, they shall also wear suitable harnesses with lifelines tended by an employee outside the confined space who shall also be equipped with the appropriate respiratory protective equipment. The two workers shall be in constant communication by an appropriate means and shall be under the surveillance of a third person equipped to take appropriate action to rescue them if necessary.

Confined spaces in which work is in progress shall be ventilated to keep the concentration of any toxic gases below their permissible exposure limits and to prevent oxygen deficiency.

The accumulation of hazardous material on work surfaces, equipment, and structures shall be minimized, and spills and leaks of hazardous materials shall be cleaned up as soon as possible. Employees engaged in cleanup operations shall wear suitable respiratory protective equipment and protective clothing. Cleanup operations shall be performed and directly supervised by employees instructed and trained in procedures for the safe decontamination or disposal of equipment, materials, and waste. All other persons shall be excluded from the area of the spill or leak until cleanup is complete and until safe conditions have been restored.

In any process area where there is a potential for the contamination of surfaces with tar or tar oil, such surfaces shall be pretreated to facilitate contaminant removal. After contaminant removal has been accomplished, the selected treatment shall be reapplied to the affected surface. Materials contaminated with tar or tar oil shall be treated or disposed of in such a manner that employees will not inhale, ingest, or otherwise come into contact with such materials, and water supplies will not be contaminated.

Employers shall designate as regulated areas all areas in which there is potential exposure to tar or tar oil. Only authorized personnel shall be allowed to enter such areas.

Facilities with adequate ventilation shall be provided for cleaning tools and equipment.

Procedures for sampling process lines or equipment containing toxic materials shall include the employment of local exhaust ventilation at sampling ports or the use of appropriate respiratory and full-body protective equipment, or other means to limit employee exposure to toxicants.

Washroom facilities, eyewash fountains, and emergency showers shall be provided at locations readily accessible from all areas where hazardous materials may contact the skin or eyes of employees. Employees shall be encouraged to wash their faces, necks, and hands as necessary during the workshift to remove contamination.

Contamination from process residues shall be prevented in eating areas. Before entering such areas, employees shall remove contaminated hardhats, gloves, and other protective equipment. Washing facilities shall be readily available.

Employers shall develop emergency plans and procedures, and take necessary steps to ensure that all employees are adequately trained in their effective implementation. Emergency procedures shall be reviewed periodically with employees, and written descriptions of the procedures shall be made available in work areas. Appropriate emergency equipment, including protective devices for rescue, shall be located adjacent to areas in which exposure to hazardous materials might occur. During emergencies, all employees shall be evacuated from the area except trained and properly equipped emergency personnel.

Each employee shall be instructed and trained in safe work practices and in the proper use of operational equipment and protective devices. Each employee shall participate in refresher sessions and drills, at least annually, in safe work practices and emergency procedures. Each employee shall be informed of the locations of all emergency and first-aid equipment and supplies in the work area and shall be informed of the requirement to report to responsible supervisory personnel any emergency, hazardous exposure, or injury.

(d) Workplace Monitoring

Existing Federal occupational exposure limits shall be enforced except where NIOSH has recommended a reduction in the existing Federal limit, or where there is no existing Federal limit, in which cases applicable NIOSH recommendations shall be complied with.

Area and personal monitoring for respirable particulates shall be conducted at least monthly in the following unit process areas: coal storage and preparation, coal feeding, and ash removal and disposal. The frequency of area and personal monitoring for respirable particulates may be reduced to a quarterly basis if six consecutive monthly determinations show that the concentrations of respirable particulates do not exceed the workplace exposure limit.

(e) Medical Surveillance

Medical surveillance shall be made available, as specified below, to all employees occupationally exposed in coal gasification plants. As applicable, NIOSH medical surveillance recommendations in criteria documents for workplace exposure to other hazardous substances shall also be considered.

Preplacement medical examinations shall include the following:

(1) Comprehensive medical and work histories, with special emphasis on the identification of preexisting disorders of the skin, respiratory tract, liver, and kidneys.

(2) A physical examination giving particular attention to the oral cavity, skin, and respiratory system. This shall include posteroanterior X-ray films (14 x 17 in) of all employees.

(3) Pulmonary function tests, including forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV 1.0) shall be offered as part of the medical examination of employees who may be exposed. Other tests, such as sputum cytology, urinalysis, urine cytology, electrocardiogram, and multiple serum chemistry tests shall be performed as deemed necessary by the responsible physician. Audiometric examinations shall be given to all employees who may be exposed to noise.

(4) An evaluation of the employee's ability to use positive-pressure respirators shall be made.

(5) Employees or prospective employees with medical conditions that may be directly or indirectly aggravated by work in a coal gasification plant shall be counseled regarding the risks associated with employment in such plants.

Periodic examinations shall be made available at least annually. These examinations shall include interim medical and work histories and a physical examination, as outlined above.

On termination of employment, a physical examination following the same protocol as that of the periodic examination shall be made available if no such examination has been performed within the preceding calendar year.

Employee medical records should also include records of workplace exposures. Pertinent medical records shall be retained for 30 years after an employee's last occupational exposure in a coal gasification plant. These records shall be made available to the designated medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, of the employer, and of the employee or former employee.

(f) Personal Protective Clothing and Equipment

Employers shall provide, and shall instruct employees to wear, suitable clothing to prevent skin contact with tar and tar oil where the potential for exposure exists. These garments shall be made of materials resistant to penetration by tar and tar oil.

Gloves shall be used that are impervious to process residues. Nondisposable gloves shall be capable of withstanding cleaning.

Protective clothing for maintenance employees shall be selected for effectiveness in providing protection from the hazards associated with the specific work area involved. In all cases, documented work procedures shall designate the minimum protective clothing and equipment requirements for these employees.

Eye protection as required by 29 CFR 1910.133 shall be provided. Cup-type chemical safety goggles shall be worn by employees engaged in activities in which hazardous materials may come in contact with the eyes. In addition, full-length plastic face shields (8 inch minimum) shall be worn in areas where contact with tar or tar oil is likely, except when full-facepiece respirators are being worn.

Engineering controls shall be used when needed to keep the concentrations of airborne toxicants at or below the workplace exposure limits. Respirators may be used only during the time

necessary to install or test the required engineering controls and for nonroutine operations or during emergencies when brief exposures at concentrations exceeding these limits may occur.

When use of respirators is permitted as stated above, such respirators shall be selected and used in accordance with the following requirements:

(1) Employers shall establish and enforce a respiratory protective program, according to the requirements of 29 CFR 1910.134.

(2) Based on the toxicants to be protected against, employers shall provide respirators and shall ensure that employees use the respirators properly when the concentrations of toxicants exceeds the workplace exposure limits. The respirators shall be those approved by NIOSH or the Mine Safety and Health Administration (MSHA). The standard for approval is specified in 30 CFR 11. Employers shall institute practices and procedures to ensure that respirators are properly fitted, cleaned, maintained, and stored when not in use.

(3) Emergency respirators for a given area shall be NIOSH- or MSHA-approved for specific protection against the process gases that may be present in that area. Emergency equipment shall be located at well-marked and clearly identified stations and shall be adequate to protect personnel during escape from the area or other emergency operations.

(4) Employers shall ensure that all protective equipment is regularly inspected and maintained and that damaged items are repaired or replaced.

(g) Sanitation

Employers shall provide clean change rooms equipped with storage facilities for street clothes and separate storage facilities for work garments, protective clothing, and protective equipment. "Clean" and "dirty" change rooms separated partially by a shower facility and partially by one-way doors should be installed in areas of high risk. Lockers should be provided on the "clean" side for each occupationally exposed employee. Facilities should be made available on the "dirty" side for storage of workboots, hardhats, and other safety equipment.

Employers shall ensure that, at the completion of a workshift, all protective clothing is removed only in the appropriate change rooms and that contaminated protective clothing that is to be drycleaned, laundered, or disposed of is placed in closed, labeled containers.

Protective clothing, respirators, goggles, and other personal protective gear that has been contaminated by hazardous substances shall be thoroughly cleaned before reuse. Persons who launder or dryclean contaminated protective clothing, or who clean contaminated protective equipment, shall be advised of the hazards associated with handling such clothing or equipment and of safe handling procedures. Contaminated shoes shall be decontaminated or discarded in a safe manner. Clothing which cannot be thoroughly decontaminated shall be discarded in a safe manner.

The presence, consumption, or dispensing (including vending machines) of food and beverages shall be discouraged in areas with a potential for exposure to tar and/or tar oil. The use of tobacco and chewing gum, and the application of cosmetics, shall also be discouraged in these areas.

Employees shall be instructed to wash their hands thoroughly with soap or mild detergent and water before using toilet facilities or eating.

To avoid enhanced dermal absorption of hazardous materials, employers shall instruct employees not to use chemical solvents for removing these materials from the skin.

Any employee whose clothing or person becomes contaminated with hazardous substances shall, as appropriate, wash, shower, shampoo, and/or change into clean work clothing promptly.

(h) Labeling and Posting

All signs and labels shall be kept clean and readily visible at all times.

All warning signs shall be printed both in English and in the predominant language of non-English-reading employees. All employees shall receive information regarding hazardous areas and shall be informed of the instructions printed on labels and signs.

During the performance of regulated functions such as maintenance, start-up, and shutdown, the immediate work area shall be secured and the following warning sign shall be posted at entrances:

CAUTION

RESTRICTED AREA

AUTHORIZED PERSONNEL ONLY

In all regulated areas the following sign shall be posted in readily visible locations at or near all entrances and on or near all equipment used for handling or containing these materials:

DANGER
CANCER HAZARD

AUTHORIZED PERSONNEL ONLY
WORK SURFACES MAY BE CONTAMINATED
PROTECTIVE CLOTHING REQUIRED
NO SMOKING, EATING OR DRINKING

In all areas where there is a potential for exposure to toxic gases, signs shall be posted in readily visible locations at or near all entrances. As a minimum, the signs shall contain the following information:

CAUTION

TOXIC GASES MAY BE PRESENT

AUTHORIZED PERSONNEL ONLY

In any area where emergency situations may arise from accidental skin, eye, or other exposures, the signs prescribed above shall be supplemented, where applicable, with additional information, such as emergency and first-aid instructions and procedures; the location of first-aid supplies and emergency equipment, including respirators; and the locations of emergency showers and eyewash fountains.

In areas where respiratory protection is required, the following statement shall be added to the signs prescribed above:

RESPIRATOR REQUIRED

Process vessels shall be labeled to warn employees that they contain toxic materials, as in the following:

CAUTION

(NAME OF CONTENTS)

CONTAINS TOXIC MATERIALS

All vessels, lines, or other equipment containing hazardous materials shall be identified by labeling, coding, or other effective means. Process samples and contaminated equipment intended for repair shall be identified, such as with colored tags.

(i) Informing Employees of Hazardss

At the beginning of employment or assignment for work, employers shall inform each employee of the potential hazards of such employment and of the possible adverse health effects resulting from such employment. Employees shall be instructed in the proper procedures for safe handling and use of raw materials, products, and by-products in coal gasification plants, in the operation and use of protective systems and devices, and in appropriate emergency procedures.

Employers shall institute a continuing education program, conducted by persons qualified by experience or special training, to ensure that all employees have current knowledge of job hazards, proper maintenance procedures, cleanup methods, and the correct use of personal protective equipment. The instructional program shall include a description of the medical and workplace surveillance procedures and the advantage of participating in these procedures.

(j) Recordkeeping

Records of workplace and personnel monitoring shall be retained for the duration of employment and for at least 30 years after the employee's last occupational exposure in a coal gasification plant. These records shall include the dates and times of measurements, job function and location within the workplace, methods of sampling and analysis used, types of respiratory protective devices in use at the time of sampling, concentrations of indicator or other hazardous substances found, and identification of exposed employees. Employees shall be allowed to obtain information on their own exposures. Workplace monitoring records and entry rosters shall be made available to designated representatives of the Secretary of Labor and of the Secretary of Health, Education and Welfare.

Signed work permits shall be kept on file for 1 year after the date of use.

Specific Unit Process Recommendations

(a) Coal Storage and Preparation

Coal storage piles shall be appropriately stacked to prevent oxidation and reduce the potential for ignition, and coal bins shall be designed to reduce coal oxidation and to prevent the accumulation of flammable gases.

Conveyor belts or elevators used for transporting coal shall be designed to minimize the dispersion of coal dust. Each transfer point shall be provided with an effective means of reducing dust emissions.

Coal bins directly attached to gasifiers shall be emptied before gasifiers or lockhoppers are taken out of service for extended periods.

An area emergency deluge system shall be located at points where high dust concentrations may result in fire or other hazardous conditions. Activation of the deluge system for an area shall automatically shut down equipment in that area.

Employees who may be exposed to coal dust should wear long-sleeved shirts, close fitting at the neck and cuffs, with trousers that overlap the top edge of the work boots. Employees shall be required to wear safety glasses, safety boots, gloves, and hardhats.

(b) Coal Feeding

A positive differential pressure shall be maintained between the coal-feed lockhopper and the gasifier in order to prevent the escape of gases from the gasifier through the lockhopper. Pressurizing gas not returned to the process shall be disposed of by flaring, incineration, or other appropriate means.

The section between the top of the coal-feed lockhopper and the coal feedbin shall be designed to minimize toxic gases and coal dust from entering the workplace.

An area emergency deluge system shall be located at points where high dust concentrations may result in fire or other hazardous conditions. Activation of the deluge system for an area shall automatically shut down equipment in that area.

(c) Coal Gasification

The start-up gas shall be flared, incinerated, or disposed of by an equivalent method.

During start-up, measures shall be taken to prevent the development of explosive mixtures in the gasifier or gasifier start-up vent during the first few minutes of operation with air. The same measures shall be repeated after switching to oxygen operation.

The gasifier shall be fitted with alarms and automatic equipment designed to facilitate safe shutdown in the event that any of the major operating parameters are exceeded.

Relief valves shall be designed and installed in such a manner that they will not become blocked.

(d) Ash Removal and Disposal

Ash-lockhopper systems shall be fitted with alarms and interlocking systems designed to allow operation only if operating parameters are within specified limits.

In any system in which dry ash dumping is necessary, employees shall wear respirators approved by NIOSH or MSHA for particulate matter, and appropriate protective equipment to prevent burns.

All potential leak points (flanges, valves, etc) shall be visually examined at least once per shift for evidence of water or steam leaks.

(e) Gas Quenching and Cooling

Piping or vessels with high erosion or corrosion rates shall be inspected at least annually and appropriate maintenance undertaken.

Whenever a failure occurs in the recycle system for the quench liquor, interlocking devices or equivalent means shall automatically activate a flush system. Whenever this system fails, the gasifier shall be taken off stream.

(f) Gas-Liquor Separation

Lines used for the removal of expansion gases shall be designed to prevent blockages.

Gas-liquor flow between the high- and low-pressure sections shall be effectively controlled in order to prevent gas breakthrough into the low-pressure section.

(g) Shift Conversion and Gas Cooling

Lines and vessels shall be monitored to indicate leakage due to hydrogen embrittlement, hydrogen blistering, corrosion, or erosion.

A dust-suppression system shall be available for use during catalyst loading and unloading procedures.

Gases resulting from the regeneration of catalysts shall be incinerated or safely disposed of in an appropriate manner.

(h) Gas Purification (Rectisol)

A system shall be provided to receive, transport, and store the methanol from all tanks, heat exchangers, pumps, and other equipment during emergencies and during maintenance operations.

(i) Methanation

Where nickel catalysts are used, an interlock system or its equivalent which is designed to safely dispose of any gas containing nickel carbonyl shall be incorporated.

Lines and vessels shall be monitored to indicate leakage due to hydrogen embrittlement or hydrogen blistering.

Start-up procedures for catalytic methanation units using nickel catalysts shall be designed to prevent the introduction of carbon monoxide into the unit before reactor temperatures exceed 260 C (500 F). During reactor shutdown procedures, all carbon monoxide shall be removed from the reactor before the temperature falls below 260 C.

Section 2 - Recommended Standard for Low- or Medium-BTU Gasification Utilizing Bituminous Coal or Lower Ranked Feedstocks

All general process requirements stated in Section 1, subparts (a)-(j), shall be met.

All specific unit process requirements stated in Section 1, subparts (a)-(f) shall also be met, as shall the following additional requirements:

(a) Coal Feeding

The sections between the top of the coal feed lockhopper and the coal feedbin and between the top of the coal feedbin and the coal storage bin shall be designed and constructed to prevent the escape of toxic gases and coal dust into the workplace.

(b) Coal Gasification

Pokeholes shall be designed to prevent the escape of toxic gases and vapors into the work area.

Section 3 - Recommended Standard for Low- or Medium-BTU Gasification Utilizing Anthracite Feedstock or Very High Temperatures

All general process requirements stated in Section 1, subparts (a)-(i), shall be met.

All specific unit process requirements stated in Section 2 shall be met with the exception that for processes which produce no tar and tar oil, those sections pertaining to tar and tar oil shall not apply.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon that were prepared to meet the need for preventing occupational diseases and physical injuries arising from employment in commercial coal gasification plants. The criteria document fulfills the responsibility of the Secretary of Health, Education and Welfare, under Section 20(a)(3) of the Occupational Safety and Health Act of 1970 to "...develop criteria dealing with toxic materials and harmful physical agents and substances which will describe...exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."

The National Institute for Occupational Safety and Health (NIOSH), after a review of data and consultation with others, formalized a system for the development of criteria upon which standards can be established to protect the health and provide for the safety of employees exposed to hazardous chemical and physical agents. The criteria for a recommended standard for the coal gasification industry should enable management and labor to develop better work practices and engineering and administrative controls that will result in a healthful work environment in this industry. This document is intended as a starting point for the development of superior controls, and simple compliance with the recommended standard should not be regarded as the final goal.

These criteria and the recommended standard for coal gasification plants are part of a continuing series of documents developed by NIOSH. The recommended standard for commercial coal gasification plants encompasses the entire coal gasification process, including all emissions from the primary gasification unit and from those auxiliary units that are unique to coal gasification processes. It is intended to (1) protect the health of, and prevent injury to, workers in coal gasification plants and (2) be attainable with existing technology.

The development of these criteria involved a worldwide literature survey and evaluation, visits to and evaluations of operational coal gasification facilities in the United States and abroad, and review of occupational safety and health practices and records in coal gasification plants. Data from operations and facilities with analogous exposures, such as coke ovens and coal liquefaction plants, were also considered in identifying potential hazards to workers in coal gasification plants. The health effects literature for specific regulated substances that might be present in coal gasification plants was not reevaluated. Permissible exposure limits cited in this report are either those already enforced by the Federal government or recommended previously by NIOSH.

To facilitate the development of the recommended standard, coal gasification processes were examined on the basis of unit operations, each of which is described herein as a separate entity. Specific exposure points, potential hazardous emissions, engineering controls, and specific safety procedures are discussed in relation to each unit operation. Control strategies were developed for each unit operation expected to exist in the commercial coal gasification plant.

The US Energy Research and Development Administration (now a part of the US Department of Energy) has estimated that by the year 2000 coal gasification products will be supplying 8.6 quadrillion BTU/year of our national energy needs [1], at which time the coal gasification industry may employ as many as 140,000 workers. Current coal gasification technology was developed largely before and during World War II. However, the Federal government and private industry are investigating various other approaches to coal gasification at the theoretical, bench-scale, and pilot-plant stages. It has been estimated that these "second generation" technologies will not be in commercial use before 1985 [2].

The scope of this document has been deliberately limited to commercial coal gasification technologies that will likely be operational in the US within ten years. On the basis of the nature and severity of potential occupational exposures these technologies may be considered under the following categories:

1. High-BTU coal gasification;
2. Low- or medium-BTU coal gasification utilizing bituminous or lower ranked feedstock; and
3. Low- or medium-BTU coal gasification utilizing anthracite feedstock or very high temperatures.

In the course of the development of the recommended standard, several areas requiring further research were identified. Comprehensive, reliable industrial hygiene evaluations are needed to quantify worker exposures to hazardous agents in coal gasification plants. Control technology assessments and the development of effective engineering controls to prevent hazardous exposures should be accomplished simultaneously with the development of the coal gasification industry. Retrospective morbidity and mortality studies of workers who have left the coal treatment and coal conversion industries should be performed. The accuracy and utility of the indicator monitoring concept in identifying hazardous concentrations of airborne toxic chemicals in workplace air should be verified.