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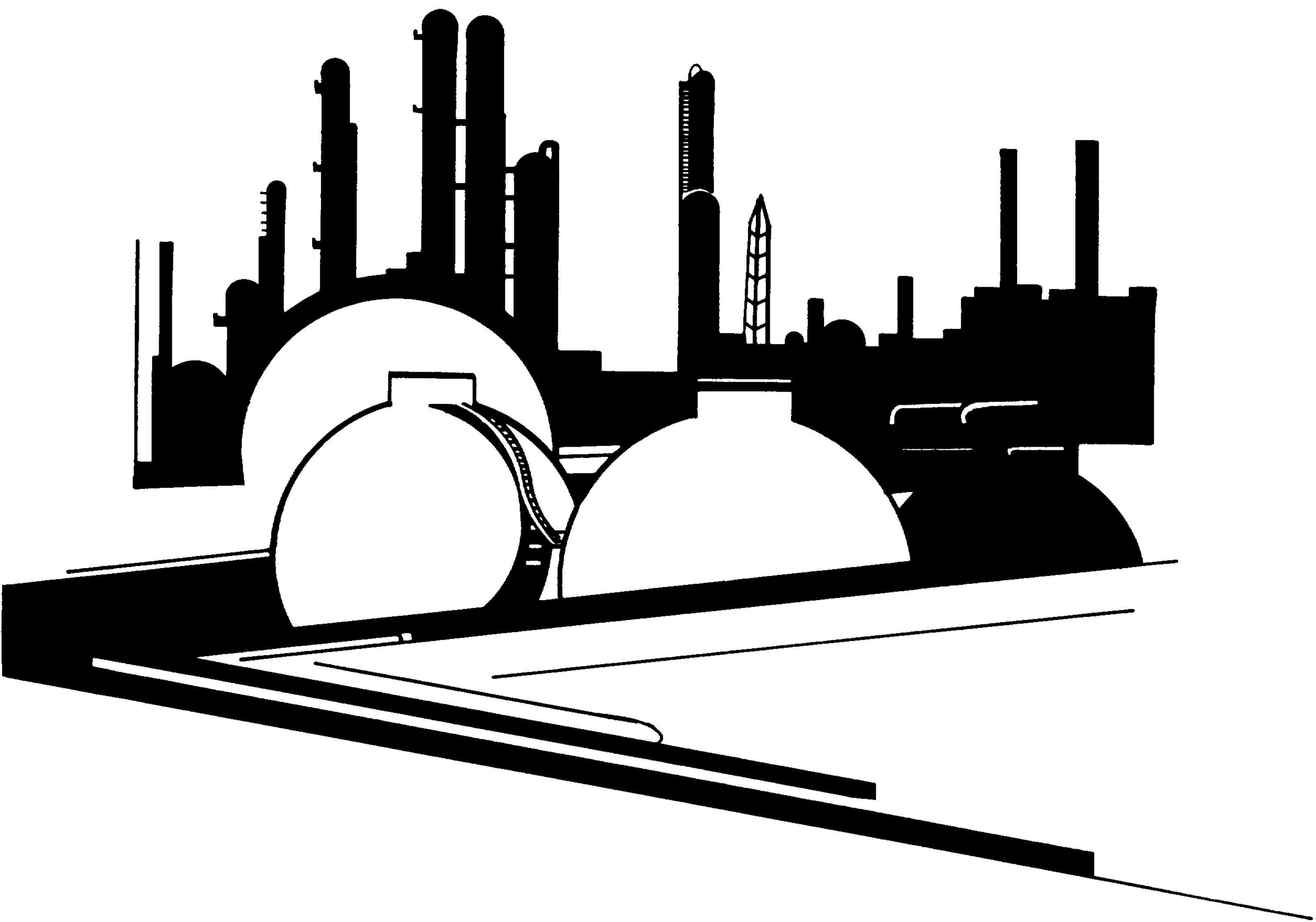
NIOSH
SPECIAL OCCUPATIONAL HAZARD REVIEW AND CONTROL RECOMMENDATIONS FOR NICKEL CARBONYL



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

SPECIAL OCCUPATIONAL HAZARD REVIEW
AND
CONTROL RECOMMENDATIONS
FOR
NICKEL CARBONYL

prepared by
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PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and safety of workers exposed to an ever-increasing number of potential hazards in their workplace. Pursuant to the fulfillment of this need, the National Institute for Occupational Safety and Health (NIOSH) has developed a reporting strategy intended to assist employers in providing personal protection for employees from exposure to carcinogenic, mutagenic, and teratogenic substances. This strategy involves the development of Special Occupational Hazard Reviews which serve to support and complement the other major criteria documentation activities of the Institute. It is the intent of a Special Occupational Hazard Review to document, from a health standpoint, the problems associated with a given industrial chemical or process and to recommend the implementation of engineering controls and certain work practices to ameliorate these problems. While Special Occupational Hazard Reviews are not intended to supplant the more comprehensive NIOSH Criteria Documents nor the less comprehensive NIOSH Current Intelligence Bulletins, they are nevertheless prepared in such a way as to be amenable to full regulatory usage if so desired. Dissemination of Special Occupational Hazard Reviews may be accomplished through appropriate trade associations, unions, industries, and members of the scientific community.

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SUMMARY AND CONCLUSIONS

Nickel carbonyl is used in the metallurgy of pure nickel (Mond Process), in nickel-vapor-plating, and in the synthesis of methyl and ethyl acrylate monomers [3]. While NIOSH estimates that no more than 500 US workers are subject to nickel carbonyl exposure from activities directly relating to these industrial operations, this number may increase by an order of magnitude when considering the possible inadvertent formation of nickel carbonyl. Such can occur with the use of nickel catalysts in hydrogenation, in coal gasification, and in petroleum refining.

Nickel carbonyl is an extremely volatile and flammable liquid (igniting spontaneously in air at room temperature) whose toxicity in the vapor form is well documented.

Toxic effects in animals have resulted from inhalation exposures of 17-70 mg nickel carbonyl/cu m (2400-10,000 ppb) for 5-30 minutes and included edema of the lungs and brain and high mortality [5]. Human effects resulting from accidental exposure to nickel carbonyl have included pulmonary edema, interstitial pneumonitis, reduced lung capacity, cardiac irregularities, liver enlargement, and in severe exposure cases, death [26-30].

In animal carcinogenicity studies, rats developed lung tumors from both long-term (inhalation of 30 mg/cu m air (4300 ppb), for 30 minutes, 3 times weekly, for 1 year) and acute (single dose of 600 mg/cu m (86,000 ppb) for 30 minutes) exposure to nickel carbonyl vapor [9,10]. Induction of malignant tumors of several organs has also been reported following intravenous injections of nickel carbonyl. From an occupational health viewpoint, those occurring following inhalation of nickel carbonyl vapor are considered of greater relevance. The nature of its biochemical interactions may support a carcinogenic potential for nickel carbonyl [14-16]. For many years the increased incidence of lung and nasal cancers occurring in nickel refinery workers was attributed to nickel carbonyl. A later analysis of these workers refuted this association. At the present time human epidemiologic data [32-38] are insufficient to either confirm or deny a causal relationship.

In view of its extreme toxicity from either acute or chronic exposure, nickel carbonyl should be designated as a highly hazardous material and regulated as a carcinogen. After a review of the existing data NIOSH supports the current US standard for nickel carbonyl of 1 ppb which approximates the least detectable level for this substance and does not recommend a change in the environmental level. The 1 ppb standard should protect workers from any carcinogenic potential which nickel carbonyl may have, as well as any of the other adverse health effects associated with nickel carbonyl exposure.

Strict control measures should be developed and enforced in all operations involving the manufacture, use, or handling of nickel carbonyl and in operations where the possibility exists for its inadvertent formation. These measures should include; installation of engineering controls (e.g., ventilation and process enclosures), use of personal protective equipment (e.g., positive pressure respirators), posting of signs which warn of the hazard, conducting medical surveillance, instituting spill-disposal procedures, and recordkeeping. In addition, environmental monitoring of nickel carbonyl work areas should be carried out. Several methods for detecting nickel carbonyl in the sub-ppb to ppm range have been developed, including two instrumental methods (Fourier Transform Infrared Spectroscopy and plasma chromatography) and one wet chemical method (colorimetric).

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