Howroyd

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TECHNICAL GUIDE FOR ESTIMATING FUGITIVE DUST IMPACTS FROM COAL HANDLING OPERATIONS

By
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ABSTRACT

The use of coal at power plants and other fuel-burning installations can result in fugitive dust emissions generated by the handling and storage of coal. At some installations, the storage and handling of fly ash and limestone can also result in fugitive dust emissions. To aid analysts, planners, and managers in evaluating the significance of fugitive dust emissions, a Technical Guide has been developed.

The development of the Technical Guide was based on a comprehensive review of existing literature on fugitive dust emission sources and emission control measures. From this review, recommended emission factors were developed for 13 different emission source categories. To account for the use of dust controls, the Technical Guide recommends ranges of control efficiencies that can be expected for the many types of control methods appropriate for the suppression of fugitive dust emissions.

The Technical Guide makes specific recommendations on modeling analysis procedures that take into account such factors as the size and configuration of the emission source, meteorological variations, and dust settling and deposition. These dispersion analysis techniques are applied to a realistic example problem as an aid to the Technical Guide user. The example problem is first assessed by a conservative screening method using diagrams contained in the Technical Guide. The example problem is also considered through a more elaborate modeling approach so that the Technical Guide user can gain an understanding of the procedures involved when detailed modeling is preferred or required.

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1.0 INTRODUCTION

The use of large quantities of coal at a coal-fired power plant or other major fuel burning installation can result in the emission of significant quantities of the criteria pollutants sulfur dioxide (SO_2), particulate matter (PM), nitrogen oxide (NO_x), carbon monoxide (CO), and hydrocarbons (HC). Most of these emissions are associated with the combustion of the coal and, in general, combustion emissions are reasonably easily quantified by calculations and/or through the use of emission factors derived from actual in situ stack measurements at similar facilities. Furthermore, the analysis of combustion related stack emissions in terms of their predicted impact on ambient concentrations of those pollutants can be made with reasonable accuracy using widely accepted dispersion models developed specifically for applications of this type.

In addition to stack emissions resulting from coal combustion, there will also be fugitive dust emissions generated by the handling and storage of coal on-site. These emissions are known to cause a certain amount of degradation of air quality in the vicinity of power plants and similar facilities, primarily in the form of increased concentrations of suspended particulates (in all size ranges including inhalable sizes), ground level deposition of airborne coal dust, and the nuisance aspect of visible emissions in areas surrounding the facilities in question. An assessment of the degradation of the air quality resulting from these fugitive dust emissions is often required by state and/or federal regulatory agencies as part of a permitting process for the construction of a new facility, the conversion of an existing facility to coal-fired operation, or for the expansion of operating or production capacity at an existing facility. There are, however, two principal difficulties which must be overcome before a reasonably accurate assessment of the impact(s) of fugitive coal dust emissions can be made.

First, a reliable quantitative specification of the amount of fugitive emissions cannot presently be made. A substantial amount of

information exists in this area, most of which illustrates that significant differences are present in published results of up to several orders of magnitude for typical emission factors for a given aspect of coal storage/handling operations. In light of these uncertainties it is evident that there exists a need to consolidate this information and to determine the most representative emission factors for various aspects of the coal handling process. This would then at least establish a consistent basis upon which one could estimate the quantity of fugitive emissions associated with coal handling operations at a specific facility which will be converted to coal. The use of a consistent approach would enable one to make relative comparisons of the emissions and/or the impacts thereof between alternative design or operating scenarios.

The second difficulty has to do with the accuracy of the dispersion models. The dispersion models that are generally used in the estimation of fugitive dust impacts are generally considered to predict, reasonably well, the ambient PM concentrations downwind of the source provided the characteristics of the release are adequately specified. The problem then becomes one of deciding whether or not the fugitive emissions would be best modeled as a point, line, area, or volume source, as well as the height above ground at which the emissions are released. Additional difficulties are also encountered such as the determination of the rate of gravitational settling of particles within the fugitive dust plume and the resuspension of particles downwind of the source. Once again it appears that it would be beneficial to consolidate the results of previous modeling studies and to perform additional modeling studies of a comprehensive nature. Specific recommendations could then be developed which would provide the basis for a consistent approach to the specification of emission characteristics for use in dispersion modeling analyses of fugitive emissions at coal-fired power plants.

To summarize, it appears evident that the need for the development of a fugitive dust modeling protocol is based primarily on the lack of

a consistent definitive approach to the quantification of fugitive emissions and the predictive analysis of those emissions using dispersion modeling. Furthermore, there needs to be an accounting for the reliability of the estimates of fugitive emissions and their resulting ambient impacts so as to provide a relative index for the accuracy of the predicted impacts.

The principal objective of this project has been to develop a reference document that can be used as a technical guide/handbook to facilitate the identification and, to the extent possible, the quantification of fugitive dust emissions and their associated ambient air quality impacts resulting from the on-site storage and handling of coal at power plants and other major fuel burning installations. The need for this type of work has arisen as a direct result of the Department of Energy's (DOE) responsibility under the Fuel Use Act (FUA) to identify existing power plants that could most readily convert from the use oil or natural gas to coal. DOE's experience with the conversion of several facilities to coal burning operation has indicated that the issue of fugitive dust resulting from the on-site storage and handling of coal is often one of major public concern. This project was designed to specifically address this concern and to provide additional quantitative information upon which to base future estimates and projections.

Because of the many uncertainties associated with an investigation of this type, together with the large volume of literature available on the subject of fugitive dust generation and control, a phased approach to this project was undertaken. The scope of work was subdivided into four phases, as follows:

1. Initial literature search and technical analysis of the literature;
2. Dispersion modeling analysis;
3. Integration of results and preparation of a technical support document;

4. Development of a guide/handbook for estimating fugitive dust impacts from coal handling facilities.

This report represents the end result of this project - A Technical Guide for Estimating Fugitive Dust Impacts from Coal Handling Facilities. This document was developed to provide analysts, planners, managers, and other potential users with a common reference for estimating the air quality impacts of fugitive dust emissions resulting from the handling and storage of coal at coal-fired power plants and other major fuel burning installations.

2.0 REVIEW OF LITERATURE

The first phase of this project was to perform an intensive literature search and to develop a comprehensive library of material relative to fugitive dust emissions from coal handling operations, their control, and the estimation of their ambient impacts. Because there has been a very large volume of material published on these subjects, a computerized literature search was performed. This was done using the DIALOG Information Retrieval System. The DIALOG system is a continuously updated information system designed specifically for the type of literature search to be performed here. The use of this system enables one to scan the abstracts of millons of documents for the presence of key words that are relevant to a particular project. The DIALOG system also enables the user to scan the abstracts of documents contained in logically categorized subject oriented data bases. The data bases which were scanned as part of this review are listed below:

NTIS - The entire library of documents maintained by the National Technical Information Service.

COMPENDEX - A computerized version of the Engineering Index.

INSPEC - The Science Abstracts family of abstract journals, indexes, and title bulletins.

METEOROLOGICAL AND GEOPHYSICAL ABSTRACTS - Current citations for the most important meteorological and geophysical research publications.

TRIS - Transportation research board information library.

ENERGYLINE - Energy related material from Environmental Abstracts (1971-1975) and Energy Information Abstracts (1976-present).

DOE ENERGY - Department of Energy related projects.

Ei-ENGINEERING MEETINGS - Published proceedings of engineering and technical conferences.

ENERGYNET - Directory type information on organizations and people in energy-related fields.

ELECTRIC POWER - Project Summaries of R&D projects of interest to utility industry (produced by the Electric Power Research Institute).

CA Search - Condensed version of Chemical Abstracts.

ENVIROLINE - Abstracts and citations from Environmental Abstracts.

POLLUTION ABSTRACTS - Computerized version of Pollution Abstracts.

APTIC - Formerly published as Air Pollution Abstracts and now maintained by the U.S. Environmental Protection Agency. APTIC covers all aspects of air pollution, its effects, prevention, and control.

ENVIRONMENTAL BIBLIOGRAPHY - Current contents of periodicals dealing with the environment.

Each of these data bases was scanned using the DIALOG system for the presence of the following key words (and several combinations thereof) in the abstract or key word list for each document:

fugitive dust
fugitive emission
coal-fired
coal pile
power plant
dispersion model
particulate
plume
coal particle
dust control
particle deposition
particle fallout
dust deposition

The execution of this computerized literature search resulted in the eventual acquisition of approximately 2000 abstracts (with complete bibliographic reference). These abstracts were obtained and individually reviewed for applicability to the fugitive dust issue and the objectives of this project. As a result, approximately 125 documents were initially identified as being potentially relevant and a copy of each was obtained for more detailed review. The purpose of this preliminary review was to further screen each document for usefulness to the project. As a result of this preliminary screening review, an "inventory" of the available information was obtained. This facilitated the identification of those documents that would be most

applicable and which would require a more intensive review. As part of this preliminary review, the reference list for each document was also reviewed and any additional potentially relevant documents were obtained. Approximately 50 additional documents were obtained as a result of this preliminary review.

Once the preliminary screening of the documents was completed, a more comprehensive subjective review of each document was made. Although fugitive dust can be generated as a result of many coal handling activities at a coal-fired power plant, the comprehensive literature review was subdivided into three primary coal handling/activity categories, as follows:

1. Coal unloading operations.
2. Coal conveying, transfer, and handling operations.
3. Storage piles and related activities.

The objective of this review was to highlight and isolate that information which could be useful in quantifying the emissions and the resulting air quality impacts associated with coal handling and storage operations at coal-fired power plants. Of particular interest were experimentally observed emissions, the subsequent development of emission factors, emission factor verification, emission factor reliability, observed ranges of efficiencies of various dust control systems and methods, specification of emission characteristics (physical dimensions, etc.), particle size distribution measurements, information on particle deposition and gravitational settling, dispersion models applicable to fugitive dust, and dispersion model verification studies. Also of interest was information on factors which could affect the quantity and characteristics of fugitive emissions such as wind speed, coal moisture, coal size, and coal type.

The Phase I literature review as described above was largely completed (i.e., approximately 90 percent) prior to the initiation of the other phases of the project. An interim summary report of the Phase I review was prepared and submitted to DOE on March 21, 1983 (Dames & Moore, 1983). It should be noted, however, that throughout