WTC $PM_{2.5}$ were derived from settled dust collected at several locations around Ground Zero on September 12 and 13. Chemical analysis showed high levels of calcium sulfate and calcium carbonate. Aspirated samples of WTC $PM_{2.5}$ induced mild to moderate degrees of pulmonary inflammation one day after exposure, but only at a relatively high dose (100 micrograms). This response was not as great as that caused by 100 μg $PM_{2.5}$ derived from residual oil fly ash (ROFA) or Washington DC ambient air PM (NIST 1649a). However, this same dose of WTC $PM_{2.5}$ caused airway hyperresponsiveness to methacholine aerosol comparable to NIST 1649a and to a greater degree than ROFA. Mice exposed to lower doses by aspiration or inhalation exposure did not develop significant inflammation or hyperresponsiveness. These results show that a high dose of WTC $PM_{2.5}$ can promote mechanisms of airflow obstruction in mice. Airborne concentrations of WTC $PM_{2.5}$ which would cause comparable doses in people are high but conceivable in the immediate aftermath of the collapse of the towers. We conclude that a high-level exposure to WTC $PM_{2.5}$ could cause pulmonary inflammation and airway hyperresponsiveness in people. The effects of chronic exposures to lower levels of WTC $PM_{2.5}$, the persistence of any respiratory effects, and the effects of coarser WTC PM are unknown and were not components of these studies. Degree of exposure and respiratory protection, individual differences in sensitivity to WTC $PM_{2.5}$, and species differences in responses are important elements in the health risk assessment of WTC $PM_{2.5}$. [This abstract does not necessarily reflect USEPA policy.]

## 288 APPROACHES TO EVALUATION OF POTENTIAL HUMAN EXPOSURES AND HEALTH IMPACTS ASSOCIATED WITH AIRBORNE CONTAMINANTS FROM WORLD TRADE CENTER COLLAPSE/FIRES.

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The 9/11/01 World Trade Center (WTC) attack resulted in dispersal of numerous potentially toxic materials in the dust/smoke cloud that enveloped lower Manhattan and extended over other New York City (NYC) areas. The US Environmental Protection Agency (U.S. EPA) worked quickly with numerous other Federal, State, and local government agencies to mobilize emergency response efforts. This included cooperative actions to expand rapidly monitoring capabilities by which to measure environmental contamination derived from the 9/11 attack, the collapse of WTC buildings, the ensuing WTC Ground Zero fires, and WTC rescue/recovery operations. Environmental sampling was also carried out by others, e.g., academic investigators sponsored by various government agencies. This paper will mainly illustrate approaches employed, under challenging circumstances and time constraints, to evaluate potential human exposures to WTC-derived airborne pollutants and possible associated human health impacts, based on integrating information derived from: (a) analyses of composition of dust deposited from collapse of WTC buildings and associated toxicity testing of such dust; (b) data from ambient air monitoring at WTC Ground Zero, its immediate perimeter, and at sites in lower Manhattan and elsewhere in NYC metropolitan area; (c) preliminary results of meteorologically-based modeling of WTC plume movement/dispersal; (d) comparison of monitored or estimated concentrations against historical pollutant levels in NYC or other US urban areas; and (e), for those substances discernibly elevated above typical background levels, comparison against health benchmark values judged to be indicative of low risk for adverse health effects due to acute and/or prolonged exposures. [This abstract does not necessarily reflect USEPA policy.]

## 289 INDOOR AIR ASSESSMENT FOR THE WORLD TRADE CENTER SITE: SELECTING CONTAMINANTS OF POTENTIAL CONCERN AND SETTING HEALTH-BASED BENCHMARKS.

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As the clean-up and ambient air monitoring of the World Trade Center site comes to an end, health and environmental agencies are directing resources to evaluate the indoor environment for the presence of pollutants that might pose long-term health risks to local residents. Based on historical knowledge of building collapses/fires and review of both outdoor and limited indoor sampling data, six contaminants of potential concern (COPCs) were identified: lead, dioxin, PAHs, asbestos, fibrous glass and crystalline silica. Health-based benchmarks for indoor air and settled dust for each of these COPCs were developed to serve as clearance criteria. Existing environmental standards were utilized where appropriate. The Housing and Urban Development (HUD) standard for lead in settled dust (40 $\mu g/ft^2$) and the National Ambient Air Quality Standard (1.5 $\mu g/m^3$) were employed in this manner. In the absence of existing standards, risk-based clearance levels were developed employing IRIS verified toxicity factors and a residential exposure scenario (30 year duration). Health-based benchmarks for asbestos, dioxin and PAHs were developed in this way. Finally, for substances lacking a widely recognized environmental toxicity assessment, occupational standards with added safety factors were employed. Clearance criteria for fibrous glass and crystalline silica were derived by adding a safety factor of 100X to existing occupational standards.

## 290 DERMAL EXPOSURE LEADING TO RESPIRATORY TRACT SENSITIZATION AND DISEASE: A TRIVIAL OR CRITICAL LINK?

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Exposure to allergens resulting in respiratory tract sensitization has classically been considered to occur by inhalation. Increasing evidence from epidemiological and clinical studies and data from animal models support the hypothesis that dermal exposure may lead to respiratory sensitization and resultant alterations in pulmonary function. Permeation studies have demonstrated the potential for proteins as well as low molecular weight chemicals to penetrate the skin and mechanistic studies have demonstrated the skin to be a permissive site for the induction of Th2 responses. Animal models have been used to demonstrate specific and non-specific increases in airway hyper-reactivity following dermal exposure to allergens. Using latex allergy, chronic beryllium disease and allergy to low molecular weight chemicals as examples, these presentations will lay the ground-work for a discussion of the relevant clinical and experimental data and the mechanistic basis for the role of skin contact in the development of respiratory sensitization. Only by understanding the mechanisms of sensitization can effective intervention strategies be implemented to protect against respiratory allergens.

## 291 INFLUENCE OF DERMAL EXPOSURE ON THE DEVELOPMENT OF SENSITIZATION OF THE RESPIRATORY TRACT TO CHEMICAL ALLERGENS.

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Many chemicals are able to cause skin sensitization and allergic contact dermatitis. Fewer in number have been shown to cause allergic sensitization of the respiratory tract; among these being certain diisocyanates, acid anhydrides, reactive dyes and platinum salts. It is often assumed that sensitization of the respiratory tract to chemical allergens is induced exclusively following inhalation exposure. However, an argument can be made on the basis of theoretical considerations, experimental data and anecdotal clinical evidence that this is not necessarily the case. Allergy, by definition, requires the stimulation of a specific immune response and there is reason to suppose that the responses which result in allergic sensitization will normally be systemic in nature. In theory, therefore, dermal exposure to a chemical respiratory allergen may provoke the vigor and quality of immune responses necessary for effective sensitization of the respiratory tract. The results of experimental studies support this argument since it has been shown for instance that topical or intradermal exposure of guinea pigs to a known chemical respiratory allergen is able to sensitize animals such that subsequent inhalation challenge with an aerosol of the same chemical will provoke a respiratory hypersensitivity reaction. Taken together, the available evidence suggests that in certain circumstances respiratory sensitization to chemical allergens may be achieved by dermal exposure.

## 292 DERMAL EXPOSURE TO TRIMELLITIC ANHYDRIDE (TMA) POWDER INDUCES AIRWAY SENSITIZATION IN AN ANIMAL MODEL.

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TMA is a low-molecular-weight chemical used as a dry, fine powder by industry. Specific IgE and subsequent occupational asthma have been reported in exposed workers. The respiratory tract is considered to be a major route of TMA exposure, but dermal exposure is also possible. The role of exposure route in the development of TMA asthma is not known. The present study investigated the potential role of dermal exposure to dry TMA powder in both immunological sensitization and subsequent pulmonary responses to TMA inhalation challenge using the Brown Norway rat. Various doses of TMA were applied to the back (hair clipped carefully with scissors) on day 0, 7, 14 and 21, occluded with surgical tape and washed away after overnight, or after 5 hours of non-occluded exposure. Sera were collected on day 0, 7, 14, 21, 28 and 35 for specific IgE test. Exposed skin was also taken for morphologic study. TMA aerosol challenge was performed on day 35 and respiratory parameters including enhanced pause (Penh) recorded overnight.