9. Design and Operation of the Remedial Action System (RAS)
   a. Construction details (including design sketches) and facility layout (superimposed on base map) of all components of the RAS including recovery wells, interceptor trenches, infiltration galleries, groundwater treatment units, discharge facilities, etc.;
   b. Operational characteristics and performance standards of all system components (e.g., information on recovery wells should include duration of pumping, anticipated yield, and expected radius of influence. Data on treatment units should include influent concentrations, expected effluent concentrations, and flow rates). Discussion should address such factors as effectiveness, reliability, maintenance, and safety; and
   c. Consideration of all permits and approvals required for disposal of waste materials and/or discharge of effluent.

10. Follow-up Site Monitoring and Evaluation of RAS
   a. Plan for periodic monitoring to detect changes in groundwater movement, plume geometry, and qualitative characteristics of the plume and to assess site response to disposal of effluents; and
   b. Plan for continuing re-evaluation of the effectiveness of the RAS in accomplishing objectives established under item 8.

THE IMPACT OF ALTERNATIVE FUELS ON HAZARDS IN THE WORK PLACE

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Introduction

This paper takes an in-depth look at the work place hazards which arise with the growing use of alternative transportation fuels. This shift in emphasis toward alternative fuels has been predicted upon provisions of the 1990 U.S. Clean Air Act, as well as on some state-level initiatives, for instance in California. The Act establishes tailpipe emissions standards, which in most cases cannot be met by vehicles running on diesel fuel or gasoline. However, use of these fuels may be hazardous to maintenance and refueling personnel if proper precautions are not taken.

The Clean Air Act is still in conference committee, with the Senate Bill (S. 1630) differing from the House version (H.R. 3030). It is clear, however, that the regulated emissions levels for 1994 will include 1.3 g/bhp-hr of reactive hydrocarbons, and 15.5 g/bhp-hr of carbon monoxide. These standards were effective in 1987, and have by and large been met with current engine and fuel technology.

However, an 83% reduction in emissions of particulate matter over the period 1989-91 will be required for urban buses. The 1991 bus standard is 0.1 g/bhp-hr. Heavy duty trucks are subject to an interim standard of 0.25 g/bhp-hr for 1991. In 1994, the bus and trucks standards converge to 0.1 g/bhp-hr. Nitrogen oxide emissions are to be reduced by 53% over the period 1989-1991 from 10.7 g/bhp-hr to 5.0 g/bhp-hr. The fuels and engines which meet emissions standards and cost criteria in the transit industry will most likely be candidates for use in the trucking industry.

Discussion of Alternative Transportation Fuels

The alternative fuels in the study are methanol, ethanol, compressed natural gas (CNG), and liquefied petroleum gas (LPG). Some thirty fleets which currently utilize alternative fuels vehicles were identified and their experiences were analyzed. These fleets are primarily transit bus operations and utility company service fleets. Many fleets are conducting performance tests with engine manufacturers or fuel suppliers.

Comparisons of the delivered wholesale prices and energy density of each fuel are noted, relative to diesel fuel. Along with required engine modifications and additional vehicle fuel tank costs, the alternative fuels are not found to be cost effective when compared with diesel fuel vehicles. Aggregate demand for these alternative fuels is not large, and their distribution and supply is limited in many regions. However, several non-economic benefits have enticed transit bus operators and utility companies toward greater use of alternative transportation fuels.

The primary advantage for transit operators is that the alternative fuels offer the greatest promise of meeting the 1991 standard for urban bus emissions. In fact, methanol is the only fuel which has proven, in field demonstrations, that it can meet all 1991 tailpipe standards in a two-cycle heavy duty engine. With these environmental benefits come significant issues involving industrial hygiene and work place safety.

Hazards in the Work Place

Managers are well as maintenance shop workers must understand and take seriously the potential hazards inherent in the various alternative fuels.

The alternative fuels which are liquids pose a significant hazard if ingested. For methanol, studies suggest that permanent blindness may be caused by ingestion of two teaspoonfuls, with death occurring from ingestion of about four teaspoonfuls. Methanol toxicity through eye contact or prolonged skin exposure is also documented. Toxic inhalation levels for all four fuels are discussed, including the need for improved passive and mechanical ventilation.

The risks of fire and explosion are well known with the gaseous fuels, CNG and LPG. However, the flash points for methanol and ethanol are lower than gasoline or diesel fuel. Also, methanol and ethanol vapors are within their ignition limits at normal atmospheric pressure and temperature. Fire fighting and fire prevention procedure, including the elimination of all ignition sources in the shop or refueling area, are critical. The reader is referred to several National Fire Protection Association codes.

Work place health and safety may also be compromised as a result of a fuel leak or spill. Fuel storage tanks and dispensing and transfer equipment must meet hazard-class specifications. Some widely-used materials are incompatible with some of the fuels. The hazards are compounded when alternative fuels are present.

Training Plan

It will be necessary to implement a multi-step training plan to reduce workers' exposure to potential hazards in the maintenance shop and refueling areas. The elements of a suggested training plan are:

1. Introduce properties of the fuel and the engine
   a. Flammability/luminosity/combustion/explosion
   b. Typical ignition sources, fire suppression devices
   c. Toxicity: skin, eyes, ingestion, inhalation
   d. Vapors and ventilation requirements
   e. Incompatible materials
   f. Electrical wiring safety requirements
2. New equipment operations
3. Securing all combustibles in the shop
4. Fuel-specific fire fighting techniques
5. Establish and monitor proper shop ventilation
6. Required protective clothing and equipment
7. Inventory, mileage, and maintenance record-keeping
8. Differences in driving and maintaining vehicles
9. Changes in facility design if necessary

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