Technical Evaluation
of the
TCEQ Mixed Waste Characterization Program

Conducted at the
Texas Disposal Systems Landfill

prepared by
Robert M. Zoch, Jr., P.E.

September 8, 2004

Respectfully Submitted:

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EXHIBIT C

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1.0 Background

On October 9, 1997 a transportation accident resulted in damage to a truckload of color television cathode ray tubes (CRT) owned by Zenith Corporation (Zenith) on Interstate Highway 35 near Buda, Texas. The on-scene emergency responders were initially advised by the truck driver, an employee of Penske Truck Leasing Co., L.P. (Penske), that the resulting debris was not considered hazardous waste, and several truck loads of CRT debris were transported to the Texas Disposal Systems Landfill, Inc. (TDSL) municipal solid waste (MSW) facility near Creedmoor, Travis County, Texas. Subsequently, the owner and the transporter of the CRT waste advised the cleanup contractor and the Texas Natural Resource Conservation Commission, predecessor agency to Texas Commission on Environmental Quality (TCEQ), that the debris was, in fact, hazardous due to its lead toxicity under applicable provisions of the Resource Conversation and Recovery Act (RCRA). According to Zenith, both the leaded glass which forms the bulb of the CRT and the lead frit used to bond its components leach excessive amounts of lead, resulting in its characterization as D008 hazardous waste.

Since the TDSL site is not authorized to manage hazardous waste, upon notification of the proper waste classification, acceptance of the debris at the TDSL facility was immediately suspended, vehicles transporting the waste were sent back to the accident scene, visible remnants of the CRT waste were recovered from the landfill working face and the active area of the landfill working face which contained hazardous debris was isolated. The remainder of the hazardous accident debris, including that which could be picked from the surface of the TDSL landfill working face, was subsequently disposed at an authorized hazardous waste disposal facility.

Since October 1997, TDSL has demanded that Zenith and Penske, as the generators of the hazardous CRT debris, remove all their remaining waste materials which had been commingled with MSW and covered with protective cover soils. In February 1998, TDSL placed the commingled waste and cover soils into an isolated location in the landfill and secured the waste in a clay and plastic covered storage area. In January 2004, TDSL removed this commingled waste from storage at the landfill and placed the commingled CRT debris and MSW, along with the clay and plastic cover, into 99 plastic lined and covered "roll-off" boxes to help facilitate that disposal.

During the waste containerization activity in January 2004, Penske and Zenith contracted to sample the commingled waste, apparently in an effort to re-characterize the mixture as non-hazardous (an impermissible exercise under existing regulations). Laboratory testing of 49 composite samples obtained in this exercise was performed under the RCRA toxicity characteristic leachate procedure (TCLP) protocol. None of the TCLP test results exceeded the laboratory's Reporting Limit (RL) of 0.10 mg/l, and estimated levels below the RL were observed from only four of the samples at concentrations ranging from 0.0032 to 0.0345 mg/l. Consequently, the testing contractor concluded that the leachable lead associated with the Penske and Zenith CRT debris commingled with MSW and clay cover stored at TDSL was below the hazardous waste regulatory standard.

Unfortunately, the sampling protocol utilized for the January 2004 evaluation failed to demonstrate that the samples taken were representative of the commingled waste, largely because:

- sampling methods were developed based on the assumption that the mixed waste was homogenous;

- field notes and the project reports identified little glass in the samples and no glass which was clearly representative of CRT debris; and

- video recordings of the waste containerization and sampling activities demonstrate that portions of all waste constituents present were not included in the samples taken.

In May 2004, TCEQ issued a Notice of Violation (NOV) to Penske which alleged, among other things, that Penske had failed to make a hazardous waste determination. Previously, the TCEQ had advised TDSL that 40 CFR 268.3 prohibits dilution as a means to render a characteristically hazardous waste non-hazardous. From these TCEQ notifications, it would appear that the agency had determined that if the CRT debris at the accident site was a characteristic hazardous waste (which Penske admitted without testing), the commingled CRT/MSW in the TDSL landfill would also be considered a hazardous waste.

In spite of this apparent determination and the results of the earlier Penske testing of the mixed waste, during July 2004 the TCEQ initiated its own project to sample the commingled waste stored in the roll-off containers. This report summarizes my observations concerning that project and presents my professional opinion concerning the use of its results for regulatory decision-making purposes.

2.0 Credentials

I am a chemical engineer and a registered professional engineer in the State of Texas, having received a Bachelor of Science degree in Chemical Engineering from the University of Houston (UH) in 1968. I also attended graduate school at UH through 1971, extending my education in the fields of chemistry, civil engineering and chemical engineering. Since that time, I have attended numerous "short courses" concerning the technical aspects of groundwater protection, wastewater treatment and hazardous waste management, and have taught courses in workplace exposures to environmental hazards.

As an undergraduate, I worked for a pharmaceutical chemicals plant in Dickinson, Texas and became involved in the plant's environmental control affairs in about 1965, initially to address the provisions of its statutory permit for discharge of industrial wastewater issued by the Texas Water Pollution Control Board. Subsequently, after serving as senior plant engineer and plant manager, I became Director of Environmental Control for the parent company in 1972. In 1974 I formed Resource Engineering, an independent environmental consulting company, providing engineering and regulatory support services to a broad range of industrial clients seeking to comply with emerging environmental regulations concerning air and water pollution control and industrial waste management. Even as president and CEO of the company, I personally maintained an active consulting practice to assist clients nationwide in maintaining regulatory compliance. An important aspect of many of my project assignments during the 1970s and 1980s involved the interpretation of newly promulgated regulations and/or developing an understanding of regulatory agency interpretations of those regulations in fact specific circumstances.

After taking my company public in 1987 and changing its name to ENSR, it was sold to a German corporation in 1990. I then headed the US Division of that company's environmental research and development organization, and have since returned to consulting by forming Zoch Consultants, LLC. In my current role, I provide consulting services primarily related to contaminated site investigation, remediation and impact assessment. Through all of this experience, I am familiar with the development, implementation and enforcement of the US environmental regulations over the past 35 years, and have represented companies before the Texas Commission on Environmental Quality and its predecessor agencies for more than 40 years.

Since the early 1970s, I have performed and/or managed hundreds of projects involving solid and hazardous waste issues including:

- site selection, design and permitting of municipal and industrial waste management facilities;

- characterization of waste materials and contaminated media under various State and Federal environmental protocols, specifically including RCRA, the Texas Solid Waste Disposal Act and the Texas Waste Code.

- contaminated property site investigation and remediation; and

- liability assessment and equitable allocation of response costs under applicable provisions of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended.

Many of these project assignments have included regulatory characterizations, development of treatment methods and evaluation of disposal alternatives for lead, as a significant contaminant of concern.

A current copy of my resume is attached

3.0 TCEQ Sampling Protocol

On July 9, 2004, I attended a scoping meeting with representatives of the TCEQ at the TDSL site to participate in the development of a field sampling program to be performed under the direction of the TCEQ. TCEQ and its contractor planned to sample approximately 20 of the 99 roll-off boxes, with individual box selection to be based upon ease of access, with a preference for the low profile units. The proposed sampling sequence was to:

(1) Remove the tarp covering each box and open the internal synthetic waste isolation liner.

(2) Obtain three samples from the surface of the exposed waste and mix them to produce one composite sample for each box sampled.

(3) Split the mixed composite samples with TDSL representatives.

(4) After sampling, seal the isolation liners and replace the tarps on the boxes sampled.

(5) Test each composite sample in an approved laboratory for TCLP lead only.

At the scoping meeting, TDSL representatives expressed significant concern that the proposed sampling protocol would not be successful in obtaining representative samples and consequently suggested that the samples also be tested for total lead to evaluate individual sample representativeness. Although the TCEQ personnel present at the meeting expressed agreement with these comments, they stated that they were not authorized to alter the program to address those concerns. Opinions were expressed that the most reliable technique to create a homogeneous mixture of the waste was to pulverize and blend the entire contents of each container and then to sample each pile of pulverized waste. Those present generally concurred. Samples were obtained as originally proposed by the TCEQ the following Monday (July 12) and these were subsequently analyzed under TCEQ direction for TCLP lead only. The split samples were analyzed by the TDSL contractor for both TCLP and total lead content.

In a July 23, 2004 response to an inquiry by Texas Representative Eddie Rodriguez concerning the TDSL sampling activities, more details of the TCEQ project were presented, which were consistent with the protocol they had implemented. In addition, general considerations for obtaining representative samples for waste characterization were described. In the latter description, the TCEQ discussed issues apparently considered in developing the TDSL sampling protocol, inferring that they assumed the waste placed in the roll-off boxes was generally homogenous. The agency observed, however, that sample bias could occur, especially when waste material and non-waste material were placed into containers, resulting in a heterogeneous mixture. Under that condition the agency stated that a representative sample of the material of interest could not reasonably be obtained. Their specific evaluation of waste homogeneity was not discussed in that correspondence relative to the TDSL roll-off box sampling project.

4.0 Field Observations and Analytical Results

When 20 of the 99 commingled waste containers were opened during the July 12 sampling event, little of the waste surface was exposed. From the limited visual observations available, however, the surface material appeared to consist primarily of soil, with small amounts of wood, paper, plastic, glass and metal interdispersed. Large or bulky components were avoided in the sampling process, with about one pound of the soil-rich material extracted from each of the three surface locations per container.

After manual mixing of the three grab samples in a stainless steel bowl, two four ounce samples were obtained, one each for the TCEQ and for TDSL.

Results of the laboratory analyses are summarized by Table 1:

Table 1
Analyses of TDSL Waste Samples

Roll-Off No.	TDSL Analyses		TCEQ Analyses
	Total Lead mg/kg	TCLP Lead (mg/l)	TCLP lead (mg/l)
3200	12.4	<0.2	0.070
2407	7.2	<0.2	0.053
3137	9.3	<0.2	0.060
3338	11.2	<0.2	0.062
3062	10.0	<0.2	0.069
3006	9.9	<0.2	0.062
3295	7.7	<0.2	0.058
3175	7.6	<0.2	0.058
0002	6.5	<0.2	0.054
1129	7.2	<0.2	0.063
3297	10.6	<0.2	0.092
3331	6.7	<0.2	0.084
3067	7.2	<0.2	0.081
3103	7.0	<0.2	0.076
4299	7.5	<0.2	0.073
3322	11.0	<0.2	0.076
3196	4.8	<0.2	0.086
3232	11.3	<0.2	0.073
3103	6.9	<0.2	0.073
3113	7.7	<0.2	0.083
Avg.	8.5		0.070

5.0 Discussion of Results

The TCEQ sampling program conducted on July 12 appeared even more superficial than that previously performed by Penske earlier in 2004. In neither sampling event was any material exhibiting the obvious appearance of CRT glass debris identified in the samples obtained.

When the CRT debris was initially delivered to the TDSL site in October 1997, seven truck loads were dumped onto the landfill working face along with large amounts of municipal waste. The loads were spread and compacted into the landfill's working face along with other waste being delivered to the landfill that afternoon. After the CRT debris was declared hazardous by the generators, acceptance ceased and visible CRT debris remaining on the surface of the working face was collected. The remaining commingled waste was covered with clay soils the next day and isolated within the landfill pending disposition by Penske and Zenith. Based upon the calculated amount of CRT waste generated and the volume delivered to the TDSL landfill, the debris from at least 465 CRTs (and possibly more) was likely placed into the landfill. All but 226 of the steel band components of the 1248 CRTs involved in the accident

were recovered. Using this information as a rough material balance, it is likely that debris from at least 226 complete CRTs remain in the commingled waste, along with some portion of the glass from an additional 239 or more units. If up to 50% of the glass from the CRT debris removed from the landfill working face was recovered, and based upon a CRT unit weight of 29.7 pounds of glass, between 6,712 and 10,261 pounds of CRT glass remain in the waste. As a result, between 791 and 1209 pounds of lead in the CRT debris are present somewhere within the commingled waste. Leachate testing performed by Zenith on samples of similar material demonstrates that the CRT glass leaches up to 406 mg/l of lead and that the "frit" used to join glass parts leaches 7000 mg/l of lead, both well in excess of the hazardous waste characteristic of 5 mg/l.

The total amount of waste material and clay cover soils in the 99 roll-off boxes weighs 3,164,529 pounds. Therefore, if the material were homogeneous, it should contain between 250 and 382 ppm lead above background. Since, however, the average background concentration of lead in the clay soil is 10 ppm, essentially no CRT debris was included in the TCEQ samples identified on Table 1. Although the leachability of lead does not directly correlate to total lead content, if representative samples of the CRT debris mixture had been obtained in the sampling effort, they likely would have "failed" the leachate test.

In SW846, the EPA's published guidelines for obtaining representative samples, two types of error applicable to the TCEQ sampling protocol are described:

5.1 **Fundamental Error** – This type of error depends on the composition, shape, size distribution and chemical properties of waste constituents and is most pronounced when the target constituent is present at less than 1% in a mixture, even if it is homogenous. Care must be taken to include portions of all fragments and constituents from the material being sampled in order to minimize **fundamental** error. As described above, the target material (CRT glass) comprises approximately 0.3% of the commingled waste. The TCEQ sampling protocol did not minimize the resulting sampling bias since only surface soil samples were obtained, specifically excluding bulky components, and not visually identifying any CRT debris.

5.2 **Grouping and Segregation Error** – For the CRT waste materials, grouping and segregation of constituents is likely because of the mechanical techniques employed to place the debris into the landfill and then to remove it into the roll-off boxes. **Grouping** most likely occurred due to initial placement of CRT debris into specific locations of the landfill working face and **segregation** resulted from application of soil cover.

Under EPA guidance, these type errors can be minimized by collecting a number of small samples from each of several locations throughout the entire mass of the material sampled. From 10 to 25 such increments are suggested in the guidance, although for highly heterogeneous debris, even this number may not be sufficient.

The commingled waste in the TDSL roll-off boxes is highly heterogeneous and, from visual appearance and knowledge of the material handling process, was certainly subject to grouping and segregation of the CRT debris component within the mixture. Collection of discrete samples from only three locations on the immediate surface of the waste in each box sampled could not have succeeded in reducing these errors to acceptable levels. The total lead data obtained by TDSL in Table 1 demonstrate that no representative samples of the waste were obtained by the TCEQ during their July 12, 2004 sampling event.

6.0 Conclusions

Based upon the above analysis, it is my opinion that:

6.1 The commingled CRT debris in the 99 roll-off boxes at the TDSL site is not "generally homogeneous" as assumed in the development of the TCEQ sampling protocol.

6.2 The samples obtained by the TCEQ during July 2004 are not representative of the lead contamination introduced into the commingled waste by the CRT debris.

6.3 The heterogeneous nature of the commingled waste is not conducive to representative sampling, and reasonable alternative sampling protocols are also not likely to produce precise results.

6.4 The data obtained by the TCEQ during their sampling of the TDSL roll-off boxes is not acceptable for making waste characterization decisions and cannot be relied upon to conclude that the commingled CRT debris does not exhibit a hazardous waste characteristic.

6.5 Had representative samples of the commingled waste been obtained for leachate testing, they likely would have demonstrated that the material in at least some of the roll-off boxes is characteristically hazardous under RCRA.

RESUME

ROBERT M. ZOCH, JR.

PROFESSIONAL HISTORY

Zoch Consultants
Nukem Development
ENSR Corporation
Resource Engineering
Marathon Manufacturing Company
Mineral Oil Refining Company

EDUCATION

B.S. (Chemical Engineering) University of Houston
Graduate Study (Chemical Engineering, Environmental Engineering) University of Houston
Environmental Short Courses in Air, Water, Groundwater, and Solid Waste

PROFESSIONAL REGISTRATIONS & AFFILIATIONS

P.E. (Chemical Engineering) Texas
American Institute of Chemical Engineering
National Society of Professional Engineers
Texas Society of Professional Engineers
American Chemical Society

TECHNICAL SPECIALTIES

Mr. Zoch has over 35 years experience in process and environmental engineering related to:

- Industrial Solid and Hazardous Waste Management
- Wastewater Treatment and Disposal
- Air Pollution Control
- Superfund RI/FS Process
- Waste Disposal Site Evaluations and Closure Plans
- Radioactive Waste, PCB and Asbestos Management
- Site Remediation Design and Implementation
- Petrochemical Process Design
- Process Technology R&D
- CERCLA Response Cost Allocation

REPRESENTATIVE PROJECT EXPERIENCE

- CERCLA RI/FS Investigations - Various Sites. Technical Consultant or Project Manager on many RI/FS investigations or oversight activities under EPA protocol including responsibility for overall technical direction and content; PRP representation before EPA and Department of Justice.

- Envirosafe Services of Texas, Inc. - Hazardous Waste Air Emissions Evaluation. Development of estimation techniques for air emissions from hazardous waste processing and disposal facilities, off-site impact analysis, design of appropriate controls, and public hearing testimony.

- Richmond Tank Car Company. Design of rail car cleaning and service facility including tank and hopper car cleaning racks, wastewater management, plastic product recycle, abrasive blasting and painting facilities.

- A.B. Chance Company - Hazardous Waste Lagoon. Site evaluation, development of closure plan and supervision of closure activities for a waste galvanizing pickle liquor (K062) lagoon, including environmental agency liaison and public notification.

- Houston Lighting and Power - Parish Plant. Modeling and field monitoring verification of ambient air impacts associated with lignite coal handling and storage.

- VETCO 3-C. Monitoring of emissions and evaluation of off-site impacts in residential areas associated with oil field pipe coating activities.

- Commercial Waste Injection Well. Overall design of commercial industrial liquid waste injection well facilities and expert testimony at public hearing.

- Texaco, Inc. - Industrial Waste Landfarm Evaluation. Evaluation of waste loading and degradation rates for an existing landfarm, and recommendations for operational modifications and monitoring improvements to extend its useful life.

- Marathon Steel. Design of an integrated source/fugitive air emissions control system for an electric arc steel making furnace shop, utilizing first-of-a-kind technology to capture hot, particulate laden gases during charging and tapping operations.

- Steel Casting Shops - Particulate Emissions Compliance. Numerous projects for steel casting facilities involving design of control systems and verification of performance through source testing.

- Industrial Waste Land Disposal. Design and permitting of various industrial waste land disposal facilities under state and federal statutes including RCRA and TSCA.

- Municipal Landfill Siting/Permitting/Operating Procedures. Various projects involving landfill site selection, permitting, operation, closure and post closure care.

- Marathon Battery Company - Heavy Metal Sludge Removal. Removal of nickel and cadmium sludges from underwater river sediments, separation from dredging water return flow, and landfill in a secure repository – in settlement of litigation under 1899 Refuse Act.

- Nuclear Sources and Services, Inc. - Low-Level Radioactive Waste Facility. Design of low-level radioactive waste storage and processing facility, including preparation of operating/safety plans and participation in public hearings.

- Record Storage and Disposal, Inc. Air pollution control system design and permitting for a medical waste incineration facility, including representation at public hearing.

- Lead Products Company. Assessment of soil and water contamination from recycle of lead/acid batteries and design of corrective action program.

- Recycle Plastics. Evaluation of potential off-site impact from a fluid bed incinerator applied to plastics pyrolysis and recovery.

- Industrial Waste Surveys. Surveys of industrial waste generation and disposal practices, with projection of trends under various economic and regulatory pressures.

- Marathon - MORCO - Chemical Wastewater Treatment. Physical separation and catalytic oxidation of petrochemical wastewater, along with discharge permitting and impact analysis on receiving stream.

- Texaco, Inc. – Refinery Closure. RCRA closure plan development, approval and project management for on-site landfill of refining waste and contaminated media.

- Toshiba International. Design and permitting of a thermal incinerator system for solvent emission control from process operations.

- Richmond Tank Car Company. Design, permitting and performance verification of a catalytic incineration unit for removing solvent emissions from rail car painting facilities.

- Rohm & Haas. RCRA permitting for Texas chemical plant; investigation and closure of related on-site and off-site industrial waste disposal facilities.

- C & H Die Casting Company - PCB Lagoon Closure. The development and implementation of a closure plan for a lagoon containing regulated levels of PCB by off-site disposal.

- Steel Mill - Wastewater Control. Wastewater segregation, pretreatment, and surface discharge permitting activities for a large integrated electric arc furnace steel mill.

- Refinery - RCRA Part B Permit Applications. Regulatory and technical direction in preparation of RCRA Part B Permit Applications for several integrated refineries around the country.

- Texas Star Scrap. Design, permitting and performance verification of air pollution control equipment on a secondary metals recovery furnace.

- Hudson Oil - Inactive Refinery. Site investigation and negotiation of RCRA Corrective Action Order for an integrated petroleum refinery. Project involved site-specific, risk-based limits on carcinogenic and non-carcinogenic Polyaromatic Hydrocarbons (PAH).

- TXI. Off-site impacts assessment and waste acceptance procedures associated with hazardous waste fuels used in cement kilns for RCRA BIF permit; participation in public hearing.

- Nukem Development - Process development and international commercialization of PCB decontamination and destruction processes.

- Texas TGV – High Speed Railroad Franchise. Environmental impact assessment for proposed multibillion dollar high speed rail project, including expert testimony at hearing.

- American Ecology Environmental Services. Development of expert opinions and testimony concerning release, fate and transport of chemicals and resulting exposures in workplace and surrounding neighborhood environments.

- Juncos Landfill Superfund Site. Evaluation of responsibility for hazardous substances and development of cost allocation methodology among industrial users of a municipal landfill.

- American Premier Underwriters, Inc. – Technical support and expert testimony in insurance claim for environmental damage.

- TexTin Superfund Site – CERCLA response cost allocation among the U.S. Government, former site operators, and suppliers of recyclable metals at a WWII primary and secondary smelter (War Plant case).

- Scaltech, Inc. – Technical support in patent infringement suit concerning refinery waste processing.

- Environmental Contamination Fingerprinting – Evaluation of contaminant sources and probable age of releases based upon environmental analytical data.

- DuPont – CERCLA action for contribution to cleanup costs at 15 plants containing numerous chemical and radioactive contaminants.

- General Motors – Allocation of response costs for solvent and metals contamination at diverse manufacturing plants.

- Wood Treating Plants – Investigations and corrective action alternatives for former wood treating plants involving creosote, pentachlorophenol, or chromated copper arsenate (CCA) treatment systems.

- Maywood Chemical – Evaluation and coordination of response actions to address radioactive and chemical contamination under State of New Jersey requirements, CERCLA, and the Federal FUSRAP program for radioactive material processing facilities.

- Forensic Investigations – Evaluation of plant process conditions and operating procedures which resulted in industrial exposures or injuries.

PUBLICATIONS

Zoch, Robert M., Jr., "Causes and Control of Fires in Sanitary Landfills," presented to Annual Meeting of the Texas Association of Solid Waste Management, Houston, Texas, 1971.

Zoch, Robert M., Jr., "Removal of Heavy Metals from Industrial Wastewater," presented to the Texas Water Pollution Control Association, College Station, Texas, 1975.

Zoch, Robert M., Jr., "Technical Aspects of Environmental Permits," presented to an Institute sponsored by the State Bar of Texas, Houston, Texas, 1980.

Zoch, Robert M., Jr., "Hazardous Waste Management Alternatives for the Acid/Clay Oil Re-Refining Process," presented to the Fourth International Conference on Used Oil Recovery and Reuse sponsored by the Association of Petroleum Re-Refiners, the U.S. Department of Energy, and the National Bureau of Standards, Las Vegas, Nevada, 1981.

Zoch, Robert M., Jr., "Groundwater Contamination Issues Related to Land Disposal of Industrial Wastes," State Bar of Texas, "Environmental Law of the 80's," San Antonio, Texas, 1984.

Zoch, Robert M., Jr., "You Don't Close a Refinery by Shutting it Down," presented at the Annual Meeting of the National Petroleum Refiners Association, San Antonio, Texas, March, 1985.

Zoch, Robert M., Jr., "When an HPI Plant Shuts Down," Hydrocarbon Processing, Gulf Publishing, October, 1985.

Zoch, Robert M., Jr. & Caputo, Dennis L., "Decommissioning Old Plants," presented at 67th Annual GPA Convention, Dallas, Texas, March, 1988.

Zoch, Robert M., Jr., "Superfund Remediation/RCRA Corrective Action and the Role of Risk Assessment - The Consultant's Perspective," presented at the Environmental Law Course, Dallas, Texas, November, 1989.

Zoch, Robert M., Jr., "Emerging Environmental Issues Facing Electric Utilities," presented at the Southeastern Electric Exchange, Pensacola, Florida, October, 1993.