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July 24, 2007

Jim Hart  
Williams Kherkher Hart Boundas, L. L. P.  
8441 Gulf Freeway, Suite 600  
Houston, Texas 77017

**Re:** Cause No.22949; *Oran A. Whittington, III, et al, vs. Bayer MaterialScience, LLC; et al*, In the 253<sup>rd</sup> Judicial District of Chambers County, Texas.

**Please be advised that this report contains confidential information subject to the Protective Agreement and is not releasable, and as such must be sealed when filed with the court.**

Dear Mr. Hart:

As requested, I am providing this report which represents my professional opinion regarding workplace safety BAYER MATERIALSCIENCE, LLC facility in Baytown, Texas as it relates to the above referenced case. My professional opinion is based upon my education, experience and detailed review of documents provided by you. My experience includes 30 years working with the Occupational Safety and Health Administration during which time I have gained expertise in process safety management and OSHA regulations. I served as an OSHA compliance officer for 6 years, a Supervisory Safety Specialist for 3 years, a Supervisory Industrial Hygienist for 9 years and as Area Director in the Houston South Area Office for 12 years. In each of the above listed positions I investigated numerous fires, explosions, and chemical releases for the purpose of determining compliance with OSHA regulation and to issue citations for violations of OSHA regulations in an effort to prevent future occurrences. One such investigation included the worst catastrophe in the chemical industry that has occurred in modern times, the October

23, 1989 Phillips Petroleum Company fire and explosion in which 23 workers lost their lives and countless others suffered injuries. During my tenure with OSHA I was assigned the task of initiating and managing OSHA's only Process Safety Management Team in the Nation. I managed this Team for 12 years and was responsible for investigation, development and presentation of some of the Nation's highest profile cases including petrochemical investigations. I was also responsible for the training of OSHA solicitors nationally in the area of Process Safety Management. During my tenure with OSHA as the Area Director of the Houston South Area Office, the Agency realized a significant decline in fires, explosions, and chemical releases in the Area Offices' jurisdiction, which includes the Nation's largest concentration of chemical plants and refineries. My vast experience in the chemical and refining industry was utilized in reviewing the documents provided and served as the basis for my professional opinion in the present case. Materials reviewed in reaching my opinion include the following:

- Baytown TDI-II Incident Report dated September 26, 2006;
- National Transportation Safety Board Safety Recommendation March 12, 2001;
- OSHA Inspection Report;
- Bayer Document Index
- Failure Analysis Report of Buffer Tank;
- English Translation and German Report;
  - 04/10129-Thermal Testing on Storage of TDI Residue Concentrate BA12 and Determination of Flash Point,
  - 4/10310-Thermal Testing on Drying of TDI Residue Concentrates.
- Depositions and Exhibits:
  - Robert Wayne Norris;
  - John Canada;
  - Charles L. Wallace;
  - Chad Edmonds;
  - Edwardo Pasillas;
  - Roy Alton Lamont Brown;
  - Carl Lynell Lewis;
  - Terry Tolley;
  - Paul Burke;
  - Reno Escalona;
  - Rene Quinones;
  - Willy Carter;
  - Richard Morran;
  - Carlton Holt;
  - Earl Louis;
  - Tim Cowart.
  - John Gish, Jr.;
  - Clarence Blue;
  - Cheryl Kridler;
  - Michael Leakey;
  - William Adams.

### **Summary of the Incident:**

The incident, which forms the basis of the instant litigation, occurred on September 26, 2006, during the operation of the TDI-II Unit at BAYER MATERIALSCIENCE, LLC Facility in Baytown, Texas. The unit was experiencing some operational problems which caused the facility to utilize the residue Buffer Tank and trailer loading operation in order to keep the TDI Production on-going. The Buffer Tank, however, experienced loss of flow and began to experience elevated temperature and pressure and had to be shutdown. Ultimately, the Buffer Tank failed due to overpressure and ruptured at approximately 11:25 AM on September 26, 2006. Reportable quantities of hazardous material ammonia and ortho-dichlorobenzene were released. Numerous individuals were injured.

### **My Opinion Follows:**

The following OSHA Standards were applicable and were violated by BAYER MATERIALSCIENCE, LLC:

- **OSHA's General Industry Standards, 29CFR 1910 are applicable.**
- **OSHA's Standards regarding Process Safety Management of highly hazardous chemicals are applicable, 29CFR 1910.119.**
- **29CFR 1910.119 (d) (1) (vi) requires the employer to make sure the process safety information pertaining to the highly hazardous chemicals in the process contains the thermal and stability data.**  
BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when BAYER MATERIALSCIENCE, LLC failed to sufficiently analyze the thermal and chemical stability as it relates to decomposition properties of Toluene Diisocyanate residue.
- **29CFR 1910.119 (d) (3) (i) (D) requires the employer to make sure that the process safety information pertaining to the equipment in the process contains relief system design and design basis.**  
BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when they had not compiled written data and/or calculations for venting/relieving mixed phase chemical compositions being used in process equipment. The Toluene Diisocyanate residue tank that ruptured relieved to a two (2) inch vacuum vent header.
- **Or in the alternative to the above standard: 29CFR 1910.119 (d) (3) (i) (E) requires the employer to make sure the process safety information contains the ventilation system design and design basis.**  
BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when they had not compiled written data and/or calculations

for venting/relieving mixed phase chemical compositions being used in process equipment. The Toluene Diisocyanate residue tank that ruptured relieved into a two (2) inch vacuum header.

- **29CFR 1910.119 (e) (1) requires employers to conduct process hazard analysis that is appropriate to the complexity of the process and to identify evaluate and address the controls of the hazards involved in the process.**  
BAYER MATERIALSCIENCE, LLC violated this standard on/or about September 26, 2006 when BAYER MATERIALSCIENCE, LLC failed to identify and control the hazards of pump failure and loss of circulation and cooling of the TDI residue in the Buffer Tank and potential for decomposition of the Toluene Diisocyanate residue.
- **29CFR 1910.119 (f) (1)(i) requires the employer to develop and implement written operating procedures that provided clear instructions for safety conducting activities in each covered process consistent with the process safety information and which addressed the elements listed in 29CFR 1910.119 (f) (1) (i) through (f) (1) (v).**  
BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when they failed to develop a written operating procedure with clear instructions for Nitrogen feeding Toluene Diisocyanate residue through the process lines including steps for each operating phase.
- **29CFR 1910.119 (f) (1) (ii) requires the employer's written operating procedures to address the operating limit for the process.**  
BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when the written operating procedures for TDI Residue Buffer Tank failed to list the operating limits for temperature and pressure.
- **29CFR 1910.119 (f) (1) (ii) (A) requires the employer's written operating procedures to address the consequences of deviation from the operating limits.**  
BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when BAYER MATERIALSCIENCE, LLC failed to list the consequences of exceeding the operating limits of temperature and pressure for the TDI Residue Buffer Tank as caused by the thermal decomposition of Toluene Diisocyanate residue.
- **29CFR 1910.119 (f) (1) (ii) (B) requires the employer's written operating procedure covering the operating limits address the steps required to correct or avoid deviations beyond such limits.**  
BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when their written operating procedure failed to address the actions to take when the operating limits for level, temperature, and pressure were exceeded.

- **29CFR 1910.119 (f) (1) (iii) (E) requires the employer's written operating procedures address special or unique hazards.**  
BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when their written operating procedures failed to adequately address the hazards posed by solidification and thermal decomposition of Toluene Diisocyanate residue.
- **29CFR 1910.119 (f) (4) requires the employer to develop and implement safe work practices to provide for the control of hazards during operations such as lockout/tag out, confined space entry, opening process equipment or piping and control over entrance into a facility by maintenance, contractor, laboratory, or other support personnel or Section (5)(a)(1) of the OSHA Act in the Alternative.**  
BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when Bayer maintenance personnel and contractor personnel were issued master tags to go into the TDI-II Unit to perform work while TDI residue was in the Buffer Tank that was stagnant due to loss of circulation. This tank had also loss cooling and was at a high temperature. It is considered the industry practice to minimize the number of personnel in a unit during start-up and shut-down.
- **29CFR 1910.119 (g) (1) (i) requires employers to train each employee presently involved in operating a process be trained in an overview of the process and in the operating procedures as specified in paragraph (f) of this section.**  
BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when operators, shift supervisors and day technicians were exposed to process hazards of over-pressuring the TDI Residue Buffer Tank and they had not been trained regarding the operating limits of temperature and pressure, the consequences of exceeding the operating limits of temperature and pressure, and how to avoid or correct deviations from the operating limits. Additionally, not all employees were aware of the fact that blocking a vent valve isolating pressure relief of the TDI Residue Buffer Tank, containing a reactive material that is not circulating and is hot, poses an extremely serious risk of rupturing the TDI Residue Buffer Tank.
- **29CFR 1910.119 (j) (5) requires the employer to correct deficiencies in equipment that are outside the acceptable limits, as defined by the Process Safety Information, before further use or in a safe and timely manner when necessary means are taken to assure safe operation.**  
BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when the vent valve, which was not shown on the P&ID and should have been designed to be car sealed open, was closed isolating the TDI Residue Buffer Tank from its relief. Additionally, when BAYER MATERIALSCIENCE, LLC personnel filled the residue Buffer Tank to the 90%

level and attempted to empty it into a tank truck trailer after the residue Buffer Tank level indicator was no longer functioning properly.

➤ **29CFR 1910.119 (I) (1) requires the employer to conduct a management of change when changes are made to process chemicals, technology, equipment and procedures, and facilities that affect a covered process.**

BAYER MATERIALSCIENCE, LLC violated this standard on or about September 26, 2006 when an operator closed a vent valve isolating the TDI Residue Buffer Tank from venting to the atmosphere. No management of change was conducted considering the impact of the change on Safety and Health.

### **Conclusion**

It is my belief that the evidence establishes that the cause of the September 26, 2006 tank rupture was not only negligence, but gross negligence. Specifically, based on thermal stability data showing an extremely low decomposition temperature of TDI residue available to the public and its own studies, when viewed objectively from Bayer's stand point, by and through its management, the acts and /or omissions of Bayer in this matter involved an extreme degree of risk considering the probability and magnitude of the potential harm to those company and contractor employees that were injured. Bayer, by and through its management, had actual subjective awareness of the extremely low decomposition temperature of TDI residue and the risks involved with a TDI thermal decomposition, but nevertheless proceeded with conscious indifference to the rights, safety and welfare of those who were injured. BAYER MATERIALSCIENCE, LLC knew fully well that their own employees as well as contractor employees were exposed to dangerous working conditions on September 26, 2006 as evidenced by the following:

- ❖ BAYER MATERIALSCIENCE, LLC knew that TDI is a reactive chemical and must be handled with care.
- ❖ BAYER MATERIALSCIENCE, LLC by its own studies knew as early as April 2004 that mixtures of TDI, TDI residue and ODB demonstrated a potentially dangerous exotherm at as low as 110 degrees C.
- ❖ BAYER MATERIALSCIENCE, LLC knew that the thermal decomposition temperature of pure TDI is 176.67 degrees C. and that temperatures above this temperature may cause polymerization with evolution of gas and heat.
- ❖ BAYER MATERIALSCIENCE, LLC knew that when thermal decomposition of TDI occurs it releases large quantities of gases which can lead to dangerous levels of pressure in a closed tank or vessel.

- ❖ BAYER MATERIALSCIENCE, LLC knew that pure TDI can react with itself due to exposure to temperature levels >176.67 degrees C. which can result in decomposition with the release of large quantities of gases.
- ❖ BAYER MATERIALSCIENCE, LLC knew fully well that the industry practice and their own Procedure S-009 is to never block a vessel containing hazardous chemicals, including TDI, from its source of relief except under very carefully controlled conditions.
- ❖ BAYER MATERIALSCIENCE, LLC knew that their last compliance audit required by the OSHA 29CFR 1910.119 (o) Standard was conducted in 2004 and was referenced as Exhibit 46 in the depositions. This audit reflected that SOPs were deficient.
- ❖ BAYER MATERIALSCIENCE, LLC knew that their SOPs had to meet the requirements Procedure S-50, which is referenced as deposition Exhibit 42, in order to comply with company policy.
- ❖ BAYER MATERIALSCIENCE, LLC knew that OSHA had previously issued citations to the company for deficient SOPs in citation issued 11/30/2005.
- ❖ BAYER MATERIALSCIENCE, LLC knew that their management had recertified SOPs affecting the Buffer Tank and that those procedures were still deficient and not in compliance with Bayer Policy S-50 and the OSHA PSM Standard.
- ❖ BAYER MATERIALSCIENCE, LLC knew that SOPs 16H and 16I
  - Did not include operating limits.
  - Did not list the consequences of deviation.
  - Did not list the means to correct or avoid exceeding the operating limits.
  - Did not address emergency shut down as necessary and whose responsibility it was to perform ESD.
- ❖ BAYER MATERIALSCIENCE, LLC knew that the TDI Buffer Tank's instrumentation was not adequate in that it had no direct reading for pressure in the control room.
- ❖ BAYER MATERIALSCIENCE, LLC knew that the Buffer Tank containing TDI residue and that the tank lost circulation, lost cooling, the temperature in the tank was at 200 degrees C. and that the tank was potentially dangerous as the hot TDI residue was self reacting and generating a large volume of gases through thermal decomposition.
- ❖ BAYER MATERIALSCIENCE, LLC knew they were violating their company policy and OSHA rules by blocking in a vent valve isolating the Buffer Tank containing the TDI residue while using nitrogen to pressure the contents out of the tank that had TDI residue at 200 degrees C. (hot > 177 degrees C. decomposition temperature).
- ❖ BAYER MATERIALSCIENCE, LLC knew by its own studies that when the results of the March, 2006 samples were received that TDI residue from the Baytown Site self reacts under certain conditions and that one continuous exotherm was experienced for each run. The as received sample exhibited the first exotherm at approximately 109 degrees C;

whereas in the thermally aged sample the first exotherm was detected at approximately 103 degrees C. (Deposition Exhibit 151).

- ❖ BAYER MATERIALSCIENCE, LLC knew that they had made Baytown personnel, supervisors, and management aware of the results of their own studies relating that TDI residue self reacts under certain conditions, but made no changes in their SOP's for the Buffer Tank prior to the incident.
- ❖ BAYER MATERIALSCIENCE, LLC knew that their Baytown facility utilized personnel to conduct PHA's of the TDI-II Unit who were not familiar with the thermal stability of TDI and these personnel used an erroneous temperature for the decomposition temperature for TDI.
- ❖ BAYER MATERIALSCIENCE, LLC knew that the Baytown Facility's Manufacturing Expert for TDI-II deliberately excluded the critical temperature for the Buffer Tank from the operating procedures for TDI-II Unit.
- ❖ BAYER MATERIALSCIENCE, LLC knew that TDI residue was reactive at certain temperature in the dryer where it solidified, generated carbon dioxide and energy in the form of heat, yet failed to apply this information to the Buffer Tank.
- ❖ BAYER MATERIALSCIENCE, LLC knew that if thermal decomposition were to occur during the time the Buffer Tank was blocked, over-pressurization of the vessel was possible with subsequent rupture of the tank.
- ❖ BAYER MATERIALSCIENCE, LLC knew that management ordered Bayer maintenance employees as well as contractor employees to be issued master tags permitting them to perform work in the TDI-II Unit during shut-down knowing fully well that the Buffer Tank was in a dangerous state: no flow, loss of cooling and the tank was above the thermal decomposition temperature.

The above referenced twenty (21) factors clearly reflect that BAYER MATERIALSCIENCE, LLC was aware of the existence of the potential over-pressurization of the Buffer Tank, yet took no action to minimize the presence of company personnel and contract personnel in the TDI-II Unit. In fact, BAYER MATERIALSCIENCE, LLC issued master tags permitting personnel to go into the unit while the Buffer Tank was still above the critical 177 degree C. temperature for pure TDI and 110 degrees C. for TDI residue mixtures within one and one half hours from the rupture of the Buffer Tank. The employees' injuries from the Buffer Tank rupture were the result of their proximity to the ruptured Buffer Tank and other equipment affected by the event.

It is my belief that the deleterious effects of this incident could have been entirely avoided if BAYER MATERIALSCIENCE, LLC would have complied with its own policies, industry standards, and OSHA Regulations by preventing the over pressuring of the Buffer Tank which was not only foreseeable, but entirely preventable. The following actions on the part of BAYER MATERIALSCIENCE, LLC would most likely have prevented the incident which happened on September 26, 2006:

- ✓ Analyzed the thermal stability of TDI residue and included that information in the Process Safety Information.
- ✓ Verified the relief system design and design basis was adequate for venting /relieving the TDI/ODB residue mixed phase chemical composition in the Buffer Tank.
- ✓ Conducted a process hazard analysis that accounted for the Buffer Tank's loss of flow, loss of cooling, plugging, and potential decomposition of TDI residue using the latest thermal stability data, as well as acted on the recommendation of the PHA with respect to these conditions.
- ✓ Developed and implemented written operating procedures that provided clear instructions for each operating phase, including operating limits, consequences of deviation, steps required to correct or avoid deviation, special or unique hazards such as solidification, and safe work practices controlling the entry of maintenance and contract workers into process units.
- ✓ Trained employees in the up to date written operating procedures as noted above.
- ✓ Assured a valve on a vent line isolating the Buffer Tank from its relief was car sealed open at all times when reactive chemical is in the Buffer Tank.
- ✓ Conducted a management of change on the closed vent valve and considered the impact of this change on Safety and Health.

**Other Concerns and Considerations:**

On October 16, 2006, just 19 days after the catastrophic event of September 26, 2006 an e-mail, Deposition Exhibit 87, was sent from Dr. Karl R. Sittkus from the Corporate office of BAYER AG to Cherrie Kridler, the PSM Representative at the BAYER MATERIALSCIENCE,LLC Baytown facility indicating that the “new design” criteria considered the following factors:

The material (residue feed with no and up to 30% ODB) starts to decompose under CO<sub>2</sub> generation with 1KW/Kg at 100 degrees C. to 110 degrees C. and 60 degrees C. this reaction is very slowly (and therefore no safety problem in an open, recycling system) and below 60 degrees C. no exothermic decomposition can be detected in a long-time DTA)--Max. temperature in tank=60 degrees C. ( If the material is recycled with the pump, it can be left in the tank with no time limit, but the viscosity will go up very slowly)...

The e-mail states further that the decision was agreed to last Thursday, which was October 12, 2006. It is reasonable to ask the questions, how long did BAYER

MATERIALSCIENCE, LLC know about this critical decomposition temperature information? Was this information known prior to the catastrophic events of September 26, 2006?

On March 12, 2001 the **National Transportation Safety Board** published its safety recommendation regarding an event that happened on February 18, 1999. A railroad tank car containing TDI residue (matter wastes) was loaded in the Olin Corporation Facility in Lake Charles, Louisiana and shipped to the Essroc Cement Corporation Facility near Clymers, Indiana on or about 12:05 AM on February 18, 1999. The rail car sustained a sudden and catastrophic rupture that propelled the tank car's tank about 750 feet over multistory storage tanks causing damage and lost production estimated at nearly \$8.2 million. The event was caused by over-pressurization of the tank car from the chemical self-reaction and expansion of the TDI residue (matter wastes). The cement company was involved in off loading the TDI residue to be used for fuel for the kilns. Their normal procedure was to heat the TDI residue and send it to a blending tank for mixing with solvents prior to shipment to the kilns; however, problems with the blending tank caused the cement company to use the direct injection process. The TDI residue was heated to a temperature higher than was recommended by Olin Corporation, which recommended a range from 130 degrees F to 140 degrees F. Apparently, the cement company believed that the TDI residue could be safely heated to 200 degrees F. The event occurred after the application of heat, which did not involve nitrogen sparging causing agitation and even heating, and did not use low pressure steam in a slow heating process. The safety recommendation emphasizes a maximum safe temperature range of 130 degrees F. to 140 degrees F. for heating TDI residue (matter wastes). This is equivalent to 54 degrees C. to 60 degrees C.

**Since this safety recommendation published by the National Transportation Safety Board received wide spread coverage, it would be extremely difficult to believe that any and all of the TDI manufacturers in the United States were not aware of this safety recommendation.** The NTSB stated that a press release goes out each time a safety recommendation is issued; and furthermore, industry receives notice in a wide variety of Safety and Trade Publications, which cover the NTSB's safety recommendation. The NTSB further stated many industries are subscribers and get notices of safety recommendations directly and from other publications. Industry also makes wide spread use of the NTSB website.

**Apparently, the maximum safe temperature of 60 degrees C. has been widely known to industry at least since March 12, 2001 and was made available to the public, to industry, trade journals, safety magazines, etc. by the NTSB's Office of Public Affairs.** With this in mind, it is not understood why BAYER MATERIALSCIENCE LLC waited until a catastrophic event occurred in order to adopt and implement the well known, well publicized safe operating limit.

The most troubling is information that was reported by BAYER Test report 04/10129 which is entitled "Thermal Testing on BA12 Storage of TDI Residue Concentrate and Determination of Flash Point," presumably published in April, 2004 approximately 2 1/2

years prior to the catastrophic event of September 26, 2006. This report indicates the following:

- TDI Residue diluted with 10% ODB is somewhat more thermally stable with a measurable exothermic beginning at above 110 degrees C and the undiluted TDI concentrate has a measurable exothermic beginning at 100 degrees C.
- “No concerns exist regarding the critical exothermic behavior of the residue concentrate being stored until incineration (Max. 3 days) at a maximum of 60 degrees C.”
- “The required protective measures are to be specified in a safety publication.”

With this in mind one would ask BAYER the following questions:

1. Why was this information regarding the exothermic reactions of TDI Residue not incorporated into written SOP's as an operating limit for the TDI-II Unit prior to the catastrophic event of September 26, 2006?
2. Why did BAYER MATERIALSCIENCE LLC not publish the information regarding the exothermic reactions of TDI Residue in a Material Safety Data Sheet (MSDS) prior to the catastrophic event of September 26, 2006?
3. Why did BAYER MATERIALSCIENCE LLC not publish the information regarding the exothermic reactions of TDI Residue in a MSDS as of the date of this report, thirty-nine (39) months after BAYER MATERIALSCIENCE LLC printed test report 04/10129 and nine (10) months after the catastrophic event of September 26, 2006?

Had BAYER MATERIALSCIENCE LLC developed and implemented standard operating procedures for the TDI-II unit which set 60 degrees C. as the maximum operating limit, which was not to be exceeded, the event of September 26, 2006 would have never occurred.

*The opinions expressed in this report are subject to modification based upon by review of additional information. I retain the right to supplement this report based upon my review of additional material.*

Sincerely,

Raymond L. Skinner