



## REPORT OF FINDINGS

PURDUE UNIVERSITY  
ELECTRICAL VAULT  
INVESTIGATION

File No: 5840607

Prepared For:  
**STUART & BRANIGIN**

Attention:  
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## TABLE OF CONTENTS

<b>I. PURPOSE</b> .....	1
<b>II. INTRODUCTION</b> .....	2
Overview	
Condition of The Body	
Chronology of Events	
Weather Information	
Condition of the Electrical Vault Exterior Entrance	
<b>III. COMPLIANCE WITH APPLICABLE CODES</b>	
I Conclusions .....	10
II Observations .....	12
Electrical Equipment	
Applicable Codes	
III Analysis.....	14
Electrical Code	
General Administrative Rules	
<b>IV. MEANS OF ENTRY INTO THE VAULT</b>	
I Conclusions .....	16
II Observations .....	17
General Configuration	
Exterior Door to Electrical Vault	
Interior Door to Electrical Vault	
FBI Examination of the Exterior Hardware-Set	
Rimkus Examination of the Exterior Hardware-Set	
University Accounts	
III Analysis.....	22
Overview	
Interior Door Access	
Key Access to the Exterior Door	
Defeating the Exterior Lock with Physical Force	
Exterior Door Inadequately Latched and/or Unlocked	

<b>V. POSITION OF THE BODY INSIDE THE VAULT</b>	
I Conclusions .....	25
II Observations .....	26
Overview	
Position of the Body	
Lighting	
Autopsy Report	
III Analysis.....	29
Contact with High Voltage Electricity	
Position of the Body	
Intoxication	
<b>VI. SUMMARY OF CONCLUSIONS</b> .....	32
<b>VII. BASIS OF REPORT</b> .....	34
<b>VIII. ATTACHMENTS</b> .....	38
Curriculum Vitae	

## Section I PURPOSE

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On January 13, 2007, freshman student Wade Steffey was reportedly electrocuted in an electrical vault at Owen Hall on the campus of Purdue University in West Lafayette, Indiana. His body was later discovered on March 19, 2007. Rimkus Consulting Group was retained by Stuart & Branigin, general counsel for Purdue University, to conduct an investigation into specific forensic considerations related to the death of Wade Steffey. These considerations are as follows:

1. Compliance of the electrical vault with applicable codes.
2. Wade Steffey's means of accessing the electrical vault.
3. The manner in which Wade Steffey's body came into its final position.

This report was prepared for the exclusive use of Stuart & Branigin, and is not intended for any other purpose. Our report is based on the information available to us at this time (June 4, 2007) as described in **Section VII, BASIS OF REPORT**. Should additional information become available, we reserve the right to determine the impact, if any, of the new information on our opinions and conclusions, and to revise our opinions and conclusions if necessary and warranted.

## Section II

### INTRODUCTION

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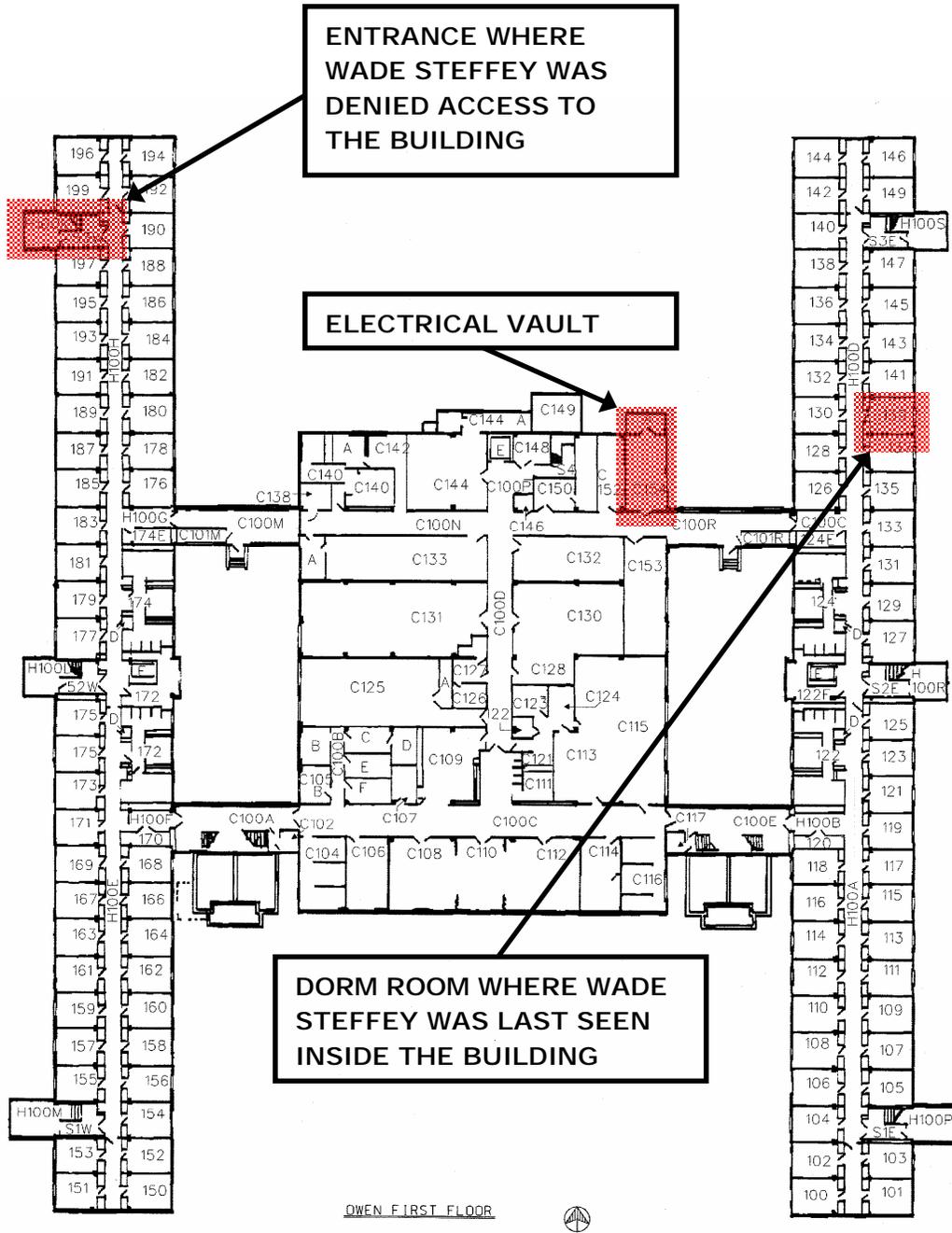
#### OVERVIEW

Wade Steffey was enrolled as a freshman student in the College of Technology at Purdue University; he began the course of study in the fall of 2006. He was reported missing on Tuesday, January 16, 2007, and was last seen on January 13, 2007. After searches were conducted by various police agencies, Team Adam (a national missing child rapid response organization), the University and members of the community, Wade Steffey's body was discovered in the electrical vault in Owen Hall on March 19, 2007. After the discovery, the University collected and organized information from a variety of sources. Much of the background contained in this report was obtained from that body of information.

Owen Hall was a four-story dormitory building on the north end of the campus. It was configured in the shape of an 'H', with the two north-south wings containing dorm rooms. The center of the building contained functions that are common to the two wings, including the electrical vault. The vault was located on the north side of the center portion, and faced into a service yard/parking lot.

The vault was accessible from the exterior via a pit surrounded by concrete walls; there was a metal railing surrounding the pit, and no means of pedestrian access. The exterior doors were intended to be used to remove or install large equipment, in lieu of transporting it through the building.

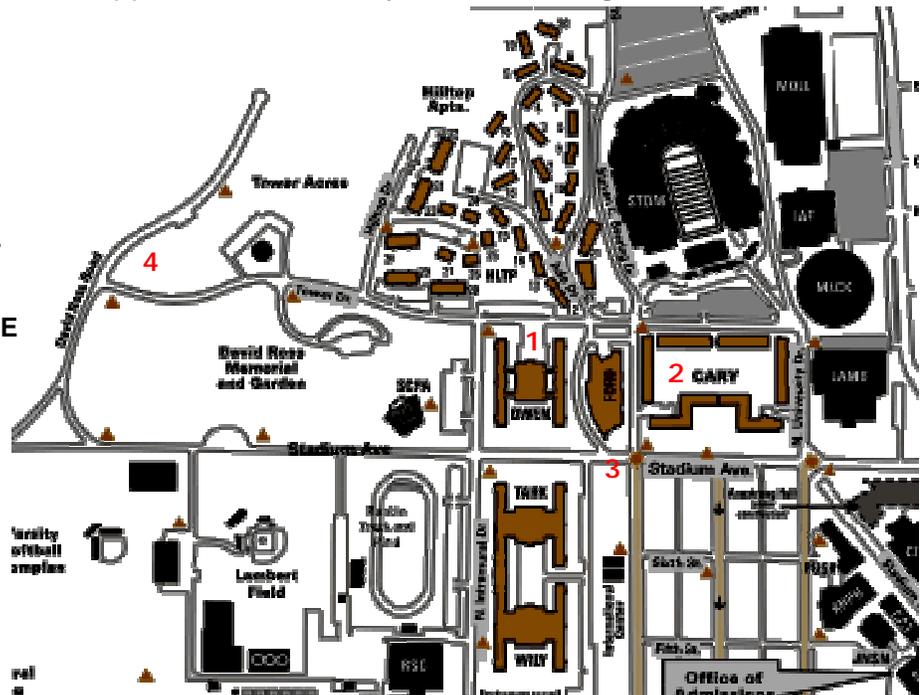
There were six high-voltage transformers inside the vault. They converted incoming high voltage into lower voltage power as required for the operation of electrical systems and lighting.



**GROUND LEVEL FLOOR PLAN OF OWEN HALL**

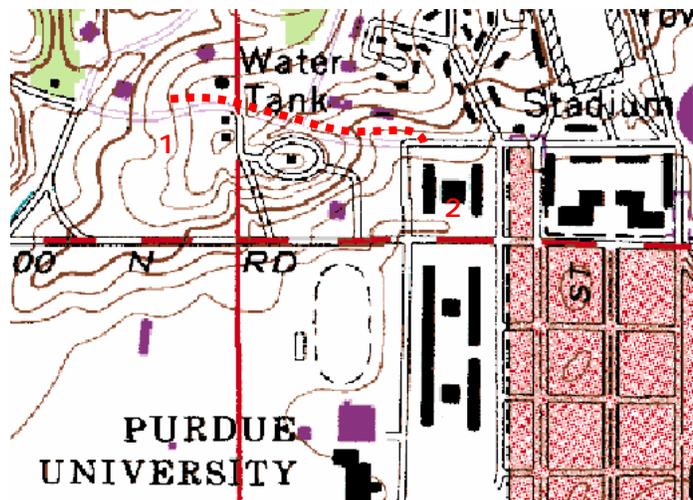
Owen Hall was located near the north end of campus, and was adjacent to several of the sites Wade Steffey reportedly visited on January 12<sup>th</sup> and 13<sup>th</sup>. Wade Steffey lived in Cary Quad West, a dormitory complex directly east of Owen Hall. He had visited the Ford Dining Hall earlier in the evening on the day of his disappearance, and had also attended a party at the Phi Kappa Theta Fraternity House that night .

- 1 OWEN HALL
- 2 CARY QUAD WEST
- 3 FORD DINING HALL
- 4 PHI KAPPA THETA FRATERNITY HOUSE



The most direct path from the fraternity house to Owen Hall was approximately ½ mile long, and required the negotiation of a 5-6% grade (downhill when returning to Owen Hall).

- 1 FRATERNITY HOUSE
- 2 OWEN HALL



## **CONDITION OF THE BODY**

Wade Steffey was approximately 5'-10" tall and weighed 150 pounds. He was reportedly involved in sporting activities which included pole-vaulting and martial arts. Photographs and the autopsy report indicated that he was of a slender build and was physically fit.

The autopsy performed by Allen Griggs, M.D., JD on behalf of the Tippecanoe County Coroner's Office indicated that the cause of death was accidental electrocution:

### **Cause of Death**

**High voltage electrocution**

### **Manner of Death**

**Accidental**

The autopsy further indicated there were no significant deforming blunt force or penetrating injuries. There was an electrical entrance wound on his left ring-finger where high voltage electricity entered his body, and electrical exit wounds in his left arm and left thigh.

A separate toxicology examination was performed by Jeff Wetz of Witham Toxicology Lab. The report indicated that at the time of his death, Wade Steffey's blood-alcohol content (BAC) was between the legal and lethal limits:

**The BAC was elevated, above the legal limit of 0.08%, but not a lethal level.**

Wade Steffey was wearing a light button-down shirt, blue jeans, a leather belt and socks at the time of his contact with high-voltage electricity. One of his shoes was found in the outside pit, and the other was found in the northeast corner of the vault. His room key and fabric lanyard cord were located under his left foot. In his pockets were a wallet, and the cell phone he had used earlier in the evening.

## CHRONOLOGY OF EVENTS

According to witness accounts contained in the material furnished to us, the following events occurred on the day before Wade Steffey's disappearance:

**January 12, 2007**

**9:53 A.M.** An online PayPal transfer for the amount of \$15.99 was made on Wade Steffey's account.

**11:30 A.M.** Wade Steffey was observed in class by a friend.

**4:30 P.M.** Wade Steffey and another student attended an appointment to view an apartment for the 2006-2007 school year at 214 Marsteller.

**5:00 P.M.** Two students joined Wade Steffey. They proceeded to the Stewart Center to conduct an online search for an apartment. Wade Steffey later left to return to his dorm.

**5:00 P.M.** A fellow student called Wade Steffey to ask whether he wanted to meet for dinner. He declined.

**7:20 P.M.** Wade Steffey's student I.D. indicated he entered Ford Dining Hall.

**8:00 P.M.** Wade Steffey telephoned a fellow student. He inquired about plans for the evening.

**8:24 P.M.** Wade Steffey withdrew \$50.00 from the ATM at Ford Dining Hall.

**8:30 P.M.** Wade Steffey arrived at a dorm room in Owen Hall. The room was occupied by several people. Wade Steffey was observed consuming alcohol. There were conflicting statements about who was there (in addition to Wade Steffey).

**9:30 P.M.** Wade Steffey left Owen Hall with a group walking to a party at the Phi Kappa Theta fraternity house.

**10:00 P.M.** Wade Steffey arrived at the party located at 900 David Ross Road at the Phi Kappa Theta Fraternity house. Several friends and acquaintances observed him at the party.

There were no witnesses who stated they saw Wade Steffey consuming alcohol at the party. There were no reports of altercations or disturbances. There were no witnesses located who saw him leave the party.

According to witness accounts contained in the material furnished to us, the following events occurred on the day of Wade Steffey's disappearance:

**January 13, 2007**

Wade Steffey made several cell phone calls including the following:

**12:00 A.M.** Last seen at the fraternity house party.

**12:20 A.M.** Called a friend and inquired about what he was doing.

**12:27 A.M.** Called a resident of Bloomington, Indiana. She stated that the male caller wanted someone to open the front door. She didn't recognize the caller and assumed it was a wrong number. She later learned Wade Steffey was a high school classmate of her son.

**12:28 A.M.** Called a fax machine. Its location was not identified in reports.

**12:29 A.M.** Called a resident of Ellettsville, Indiana. She assumed the call was a wrong number as she did not recognize the caller. She later determined she had met Wade Steffey in the past.

**12:29 A.M.** There was no information about this call in the reports.

**12:31 A.M.** Called an Owen Hall resident's cell phone, but there was no answer.

**12:30 A.M.** An Owen Hall resident observed a male believed to be Wade Steffey attempting to gain entry to Owen Hall. She stated the male appeared to be intoxicated. She refused to let him enter the key card-controlled door after she entered.

**12:30 A.M.** An Owen Hall resident observed a male believed to be Wade Steffey near the entrance to Owen Hall. She stated that he was talking on a cell phone and appeared to be intoxicated.

## WEATHER INFORMATION

Forensic analysis of the weather on the night of Wade Steffey's disappearance was performed by CompuWeather, Inc., as follows:

### HOURLY ANALYSIS

Below is a summary of the approximate hourly sky cover, rainfall (inches), temperature (degrees F), visibility (miles), wind direction, wind speed (mph), and wind gusts (mph) during the period from 10:00 PM EST on January 12, 2007 to 4:00 AM EST on January 13, 2007.

Time	Sky Cover	Rain	Temp	Visibility	Wind Direction	Wind Speed	Wind Gust
10 PM	M/cloudy/fog	0.14"	43	4	Northwest	7	None
11 PM	M/cloudy/fog	0.09"	42	5	Northwest	6	None
12 AM	M/cloudy/fog	0.05"	41	5	Northeast	5	None
1 AM	M/cloudy	0.07"	40	8	North	6	None
2 AM	M/cloudy/fog	0.05"	40	5	North	6	None
3 AM	M/cloudy	0.09"	39	7	Northeast	7	None
4 AM	M/cloudy	0.04"	39	8	North	7	None

### MOONRISE/MOONSET

Astronomical data for the moon was examined for West Lafayette, Indiana on January 13, 2007. On this date, the moonrise occurred at 3:04 AM EST and moonset occurred at 12:53 PM EST. The phase of the moon was waning crescent with approximately 30% of the moon's visible disk illuminated.

The period of time during which Wade Steffey disappeared can be characterized by temperatures near 40°F, light rain, and light winds from the north/northeast. The waning lunar phase, coupled with significant cloud cover, would have provided minimal ambient illumination.

## CONDITION OF THE ELECTRICAL VAULT EXTERIOR ENTRANCE

The information provided to us included interviews with members of the maintenance and high-voltage staff. The following information was obtained from those accounts:

- |                   |  |
|-------------------|--|
| June 12, 2006     | University staff performed maintenance on the Owen Hall high voltage vault. Exterior doors were not opened. Power was not shut off.  |
| June 20, 2006     | University engineering staff inspected Owen Hall vault to take field measurements. They think they were accompanied by other staff members but there is some confusion about this. The exterior doors were open at the time of their inspection.   |
| July 26, 2006     | Scheduled power outage for connection of circuits at Tarkington and Owen Halls. Vault was entered by University staff. None recalled opening exterior door.  |
| August 12, 2006   | The exterior pit was cleaned by a maintenance staff member. He stated he always checked the door when he performed this task and always found the door to be locked.   |
| November 10, 2006 | The exterior pit was cleaned by the same maintenance staff member as above. He stated he always checked the door when he performed this task and always found the door to be locked.   |
| January 18, 2007  | University staff members checked the Owen Hall vault during the search for Wade Steffey. They unlocked and opened the interior door, turned on the light, and looked into the room. They did not enter the vault. They noticed nothing unusual.  |
| January 20, 2007  | A community member and an unidentified helper were involved in the search for Wade Steffey. They found a shoe in the exterior pit and reported it to a police officer. The shoe was not recovered at that time, and the exterior door was not checked.   |
| January 23, 2007  | The shoe in the pit was found by a maintenance worker and recovered by a University police officer. There was no evidence at the time that indicated the shoe belonged to Wade Steffey. The exterior door was not checked.   |
| February, 2007    | A maintenance staff member (different from the one cited above) cleaned the exterior pit on an unknown date after the shoe was recovered. He did not check the door.   |
| March 19, 2007    | The body of Wade Steffey was discovered in the Owen Hall vault.  |
| March 19, 2007    | A University police officer was investigating the scene. He was instructed by another officer to determine whether the exterior door was unlocked. He stated that he noticed the lock keyway was in a horizontal (normal) position in the door knob. He moved the knob and found it moved slightly from side to side. He then applied more force, at which time the knob turned completely, allowing the door to open. |

## Section III

### COMPLIANCE WITH APPLICABLE CODES

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#### CONCLUSIONS

1. The electrical installation was well maintained and no electrical maintenance issues were observed.
2. The electrical installation code in force at the time of building construction was the 1945 Indiana Electrical Rules and Regulations (the Code) which references the 1940 National Electrical Code (NEC).
3. The design and construction of the transformer vault complied with applicable codes and standards in force at the time of construction.
4. The Code required guarding of live parts which is addressed by having a room accessible only to qualified persons. Providing locked doors having keys with controlled access satisfies this requirement.
5. The Code contained requirements for vault doors which included the requirements that entrance doors be equipped with locks, that doors be kept locked, and that access be allowed only to authorized persons.
6. The Indiana Building Rules and Regulations, which were in force at the time of construction, did not contain a requirement for access to electrical vaults.

7. The General Administrative Rules of the State of Indiana, which contain ongoing requirements for the maintenance of code-compliant conditions, was applicable to the subject electrical vault.
8. Requirements of the Occupational Safety and Health Administration (OSHA) apply only to employees, and are not relevant to this investigation.

## **OBSERVATIONS**

### **ELECTRICAL EQUIPMENT**

The electrical vault was located in the basement of Owen Hall. The nominal system voltage to Owen Hall was 5KV. Three-phase, 4.16KV entered the vault at the northwest corner via cabling passing through an underground service lateral to a fused disconnect switch. The cabling was routed to porcelain insulators installed along the east and west walls and secured to the insulator using insulated copper wire.

The primary cables located along the walls were manufactured by General Electric and were rated 5KV in trade size 500 MCM. We inspected each cable and did not observe any signs of deterioration, arcing or dielectric failure of the cable insulation. The copper wire used to hang the 5KV cable was securely affixed to each standoff insulator.

Three transformers are installed on the floor along the east wall for lighting and three transformers are installed along the west wall for power. All transformers were installed in front of the primary wiring running along the wall. The transformers were manufactured by Allis Chalmers, type SB, rated 100 KVA, having consecutive serial numbers 305-4757 through 305-4762. Wade Steffey's body was located behind transformer serial number 305-4760 (designated transformer #2) which is the middle transformer for lighting circuits.

Each transformer was connected to two of the three 4.16KV cables routed along the wall by means of a tap splice connection that was covered with insulating tape. The end of the tap conductor terminated at a porcelain bushing with a knob for hand-tightening the conductor to the bushing. The primary voltage between phases was 4,160 volts and the voltage between any phase to ground is 2,400 volts. The secondary output of each transformer is 120 volts to ground. Cables were connected to the transformer output and were routed to a wire raceway located above the transformer. The raceway terminated in an adjacent room at the switchgear.

Each bushing was examined and found to be unremarkable except for the north bushing on Transformer #2. The tap connector was intended to have its insulation

jacket removed allowing the bare conductor to be inserted into one end of the bushing and tightened in place. The other end of the bushing was open and there was accessibility to the bare primary electrical conductor. The north bushing on Transformer #2 showed evidence of physical contact at its end.

## **APPLICABLE CODES**

The Indiana Electrical Code provides the following requirements with regard to access of electrical vaults:

**1112. Guarding of Live Parts.** Except as elsewhere required or permitted by this code, exposed live parts of electrical equipment operating at 50 volts or more shall be guarded against accidental contact by enclosure or by locating the equipment as follows:

a. In a room or enclosure which is accessible only to qualified persons;

And:

c. **Locks.** Entrance doors shall be equipped with locks, and doors shall be kept locked, access being allowed only to authorized persons. If spring or other automatic locks are used, they shall be so arranged that they may be readily and quickly opened from the inside.

The current version of the General Administrative Rules of the State of Indiana provides the following ongoing requirement:

**675 IAC 12-4-9 Maintenance of buildings and structures**

Authority: IC 22-13-2-13

Affected: IC 22-12-6-6; IC 22-13-2-2; IC 22-13-2-8; IC 36-8-17-13

Sec. 9. (a) All buildings and structures, and any part of the permanent heating, ventilating, air conditioning, electrical, plumbing, sanitary, emergency detection, emergency communication, or fire or explosion systems, and all parts thereof, shall be maintained in conformance with the applicable rules of the commission, or applicable rules of its predecessor agencies, in effect when constructed, installed, or altered.

## ANALYSIS

### ELECTRICAL CODE

The design and construction of the room 1-Owen-C154 conformed to the 1945 Indiana Electrical Rules and Regulations which were in effect at the time of Owen Hall's construction.

The Purdue Plant and Facilities Department conducts annual inspections of all transformer vaults. Other than routine cleaning and transformer oil replacement, no maintenance on the cabling and transformers had been done within the last five years. Our examination of the primary and secondary cabling, electrical connections and transformers did not reveal any conditions that required maintenance.

Factory Mutual (FM) conducts a safety audit every three years. At no time was the Owen Hall electrical vault cited for safety defects.

The north bushing on Transformer #2 showed signs of physical contact on the exposed end of the conductor. The other eleven bushings on the transformers did not have any indication of physical contact. The north bushing on Transformer #2 is the point of contact where Mr. Steffey accessed the 2,400 volt primary service.

The 1945 Indiana Electrical Rules and Regulations codifies the 1940 National Electrical Code. Article 1112 of the 1940 NEC requires guarding of live parts. This requirement is satisfied by providing locked doors to the vault having keys with limited and controlled access to authorized personnel. Purdue maintains a key control program which identifies persons having access to the Owen Hall transformer vault. Key number 545542 was identified as the key to open the vault doors. Only persons authorized to enter the vault were issued keys.

## **GENERAL ADMINISTRATIVE RULES**

Wade Steffey was not qualified to enter the electrical vault. Based on our investigation and testing, the exterior door to the electrical vault was most probably not adequately secured. The General Administrative Rules of the State of Indiana required ongoing compliance with the codes that were in force at the time of construction.

**Section IV**  
**MEANS OF ENTRY INTO THE VAULT**

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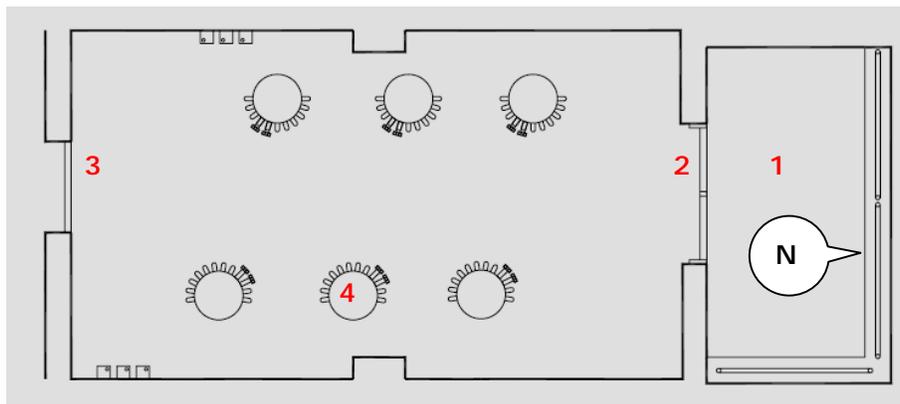
**CONCLUSIONS**

1. Wade Steffey entered the electrical vault through the exterior door on the north side of the room.
2. The configuration of the exterior entrance to the electrical vault was obviously not intended for access to the building by residents or the public.
3. The concrete walls and metal railing surrounding the pit did not prevent Wade Steffey from gaining access to the electrical vault door.
4. The exterior door to the electrical vault was most probably unlatched and/or unlocked at the time of Wade Steffey's entrance.
5. In the condition cited in #4 above, the exterior door did not prevent entrance by Wade Steffey.

## OBSERVATIONS

### GENERAL CONFIGURATION

The doors leading from the exterior to the electrical vault were surrounded by a concrete wall and a metal railing. The bottom of the pit was 46 inches below the surrounding grade, and the top of the guardrail was 42 inches above the surrounding grade. There were no permanent exterior accommodations for accessing the pit except for climbing over or through the railing.



Plan view of electrical vault

- 1. Exterior Pit
- 2. Exterior Door
- 3. Interior Door
- 4. Transformer 2

At the time of Wade Steffey's access to the electrical vault, there were three ladders chained to the upper railing in the southwest corner of the pit. These ladders extended from the top of the railing to the floor of the pit. They were stored at such an angle that they could have been used to ascend or descend to the pit level.

### EXTERIOR DOOR TO ELECTRICAL VAULT

The entrance had a pair of doors – the left-side door was an 'inactive' leaf. The inactive leaf did not have door hardware on the exterior, and was affixed at the top and bottom with flush-bolts that extended into the threshold at the bottom and the door frame at the top. The right-side door was intended to be secured to the edge of the left-side door with a latching mechanism that included a strike plate, strike cover, and hardware-set. The hardware-set was referred to as an 'office function'. It was operated with a door-knob on both sides. The exterior knob, when locked, could only be opened with a key,

and the hardware-set was only lockable with a push-button on the interior knob. When the interior knob was rotated, the hardware-set would be automatically unlocked. If the door was locked, closing it would not cause it to become unlocked.

The exterior doors and all associated hardware were reportedly installed at the time of the building's original construction. At the time of our inspections of doors leading to electrical vaults at Wiley and Tarkington Halls, which were built at the same time and in the same configuration, the hardware-sets were in a condition that prevented the bolts from fully engaging every time they were closed and locked, because of internal 'sticking' of the mechanism, slight misalignment of the bolt and strike plate, or minor obstructions that prevented the door from closing completely.

The campus police officer who investigated the door at Owen Hall stated that it was unlocked on the day Wade Steffey was found.

#### **INTERIOR DOOR TO ELECTRICAL VAULT**

The interior door of the electrical vault opened onto a public corridor across from a student laundry facility. The interior door had a single heavy steel leaf, and was locked with a dead-bolt device. In the locked position, the door would not have allowed access from either side without a key. The Purdue staff member who opened the door during the original search stated that it was locked at that time.

#### **FBI EXAMINATION OF THE EXTERIOR HARDWARE-SET**

The Federal Bureau of Investigations (FBI) took the subject hardware-set into custody in early April, and examined it for evidence of tampering or damage. They also examined Wade Steffey's dorm key, which was found with his body, to determine if it could have been used to open the vault door. They concluded that:

## **RESULTS OF EXAMINATIONS**

The Q1 door knob assembly and the Q2 and Q3 metal plates were examined for evidence of surreptitious bypass, and none were observed. This includes an examination of the Q1 pin and tumbler locking assembly.

The Q4 key fits into and operates the Q1 lock assembly. The Q1 lock assembly functioned normally when using the Q4 key. The Q5 key is not designed to fit into and will not operate the Q1 lock.

## **FBI DESIGNATIONS**

Q1	HARDWARE-SET
Q2	STRIKE PLATE
Q3	STRIKE COVER PLATE
Q4	ELECTRICAL VAULT KEY PROVIDED BY UNIVERSITY
Q5	DORM ROOM KEY FOUND WITH BODY

## **RIMKUS EXAMINATION OF THE EXTERIOR HARDWARE-SET**

After examination by the FBI, the hardware was returned to the University Police and then to Rimkus Consulting Group. We re-assembled and re-installed the hardware-set in its original location and configuration on the Owen Hall electrical vault door for testing. We found that the hardware-set did not fully engage unless the door was closed forcefully, and that when it was not fully engaged the exterior knob could appear to be locked when the door was not secure.

We tested the hardware to determine the amount of force that would be required to pull it open while it was locked and the bolt was fully engaged in the strike, and the flush-bolts in the inactive leaf were both fully engaged. We also tested it with one and then the other flush-bolt disengaged.

Prior to conducting these tests, we concluded that the maximum force which could have been exerted by Wade Steffey at the time of access was approximately 150 pounds. We tested the locked door in each of three conditions to a force greater than 200 pounds:

<b><u>CONDITION</u></b>	<b><u>POUNDS OF FORCE APPLIED</u></b>
Both flush-bolts engaged	214
Top Flush-bolt disengaged	209
Bottom Flush-bolt disengaged	221

Additionally, we pulled on the knob with as much force as we were able to produce. Under no circumstances were we able to defeat the mechanism when it was in a locked and latched condition.

## **UNIVERSITY ACCOUNTS**

The information provided to us included details of the following conditions with regard to the security of the exterior door:

- |                   |   |
|-------------------|---|
| November 10, 2006 | The exterior door was checked during routine cleaning of the pit and was found to be locked. Proper latching of the door was not verified at that time. |
| January 18, 2007  | The interior door was found to be locked at the time of the original search of the room.  |
| March 19, 2007    | On the day Wade Steffey's body was found, the exterior door was found to be unlocked.   |

## **ANALYSIS**

### **OVERVIEW**

Wade Steffey most probably entered the pit by either climbing over or under the guardrail, or by climbing down the ladders that were stored alongside it. Once access to the pit was gained, the door was the only impediment to accessing the electrical vault.

Based on information in the OBSERVATIONS section, the contribution of the doors to Wade Steffey's access to the electrical vault must be characterized as one of the following:

1. Wade Steffey gained access through the interior door.
2. The exterior door was locked and latched. Wade Steffey used a key to gain access.
3. The exterior door was locked and latched. Wade Steffey defeated the locking mechanism through the application of force.
4. The exterior door was not locked or was not securely latched. Wade Steffey gained access through the application of a normal amount of force.

These four options are discussed in detail, as follows:

### **INTERIOR DOOR ACCESS**

There was no key present when Wade Steffey was found that would have operated the deadbolt on the interior door. Additionally, the University staff person who performed the initial search of the room stated that it was locked at that time. Other evidence discussed in this report is consistent with entrance through the exterior door.

## **KEY ACCESS TO THE EXTERIOR DOOR**

The electrical vault was searched after Wade Steffey was found. He was found to be in possession of a dorm room key, which was attached to a lanyard cord. No other keys were found in the vault, and we verified by testing and visual inspection that the dorm room key could not have been used to unlock the vault door. Additionally, we searched the room during our site inspection on May 7, 2007 and found no artifacts that were not equipment maintenance-related.

## **DEFEATING THE EXTERIOR LOCK WITH PHYSICAL FORCE**

The exterior hardware set, if locked, could potentially be defeated in two ways:

Applying sufficient torque to the exterior knob would have produced evidence of damage inside the lock. The pins inside the lock cylinder would have been either bent or sheared, and there was no indication of such damage either as reported by the FBI or as observed during our inspection/re-assembly of the hardware-set.

The hardware could potentially have been defeated by pulling on the door with enough force to cause the bolt to slip past the strike. To determine if this occurred, we re-attached the door hardware to the exterior doors of the vault, and pulled on the handle to forces greater than 200 pounds. Examination of the relevant literature indicates that, for a handle positioned at a height similar to the subject door knob, the average pulling force from a general population of adult males is 90 pounds, with a standard deviation of 28 pounds. A range of two standard deviations encompasses 95% of the population; a conservative value for the maximum pulling force that Wade Steffey could have exerted would have been 150 pounds. If the exterior door was properly latched and locked, the vault would not have been accessible to Wade Steffey through the application of force.

## **EXTERIOR DOOR INADEQUATELY LATCHED AND/OR UNLOCKED**

The account of the University staff member who indicated that the door was locked in November of 2006 does not suggest that the door was securely latched. The observed conditions of the three hardware-sets at Wiley, Tarkington and Owen Halls indicated that the appearance of a locked condition did not necessarily indicate a securely latched condition.

There were two ways that Wade Steffey could have accessed the electrical vault through the exterior door: either the door was unlocked, or the door was locked, but not securely latched. On the day Wade Steffey's body was found, the exterior door was unlocked. However, normal twisting of the interior knob could cause the lock to disengage, which could have occurred when the door was pulled closed. The latched and locked condition of the door hardware cannot therefore be determined. If the door was locked, but the bolt was not fully engaged in the strike, force could have been used to defeat the hardware-set. Due to the mechanical 'sticking' noted in the examination of the hardware-sets at Owen, Tarkington, and Wiley Halls, this possibility cannot be ruled out.

In either of the two possible scenarios, the exterior door on the electrical vault at Owen Hall was not secured in a manner that would prevent entry by a person such as Wade Steffey.

**Section V**  
**POSITION OF THE BODY INSIDE THE VAULT**

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**CONCLUSIONS**

1. Wade Steffey got behind the transformer from the south side by either going over or under the cable running from the wall to the transformer.
2. He was pointed in the direction of the exterior door at the time of his contact with high-voltage electricity.
3. Wade Steffey was electrocuted when he inserted his left ring-finger into a recessed, exposed conductor within a bushing attached to Transformer #2.
4. Wade Steffey was under the influence of alcohol at the time of his death.

## **OBSERVATIONS**

### **OVERVIEW**

Earlier in the evening of January 12, 2007, Wade Steffey met with some friends in a dorm room at Owen Hall. Reportedly, Wade Steffey left his jacket in the room when the group left to go to a fraternity party located west of Owen Hall on Tower Drive. According to witness statements, Wade Steffey was observed at the party before midnight, but no one noticed him at the party afterwards. He is assumed to have left the party around midnight.

In an interview with an Owen Hall resident, it was stated that an individual believed to be Wade Steffey was observed outside of the north entrance door to the west wing of Owen Hall sometime between 12:00 AM and 12:30 AM when the resident entered the building. Reportedly, Wade Steffey attempted to enter the building after the resident, but was denied access. The resident stated that Wade Steffey had red stains on the front of his shirt and was intoxicated.

In an interview with another Owen Hall resident, it was noted that an individual who was believed to be Wade Steffey was seen outside the same door to Owen Hall. The individual seen was a white male who appeared to be intoxicated and was not wearing a coat. The individual was observed for around 20 minutes, during which time he walked around the area of the exit and made various telephone calls. This observation occurred at approximately 12:30 AM.

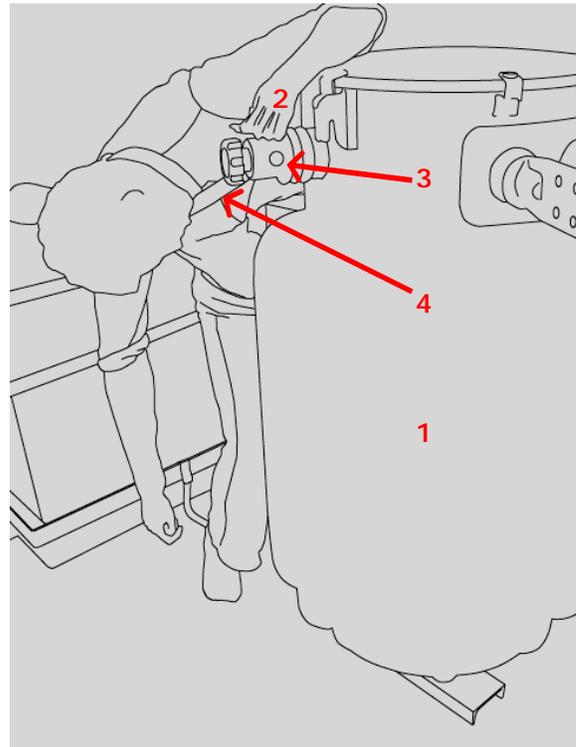
Telephone records show a series of calls from Wade Steffey's cellular telephone between 12:20 AM and 12:31 AM. A total of six calls were made, including two that were placed to friends, one to a fax machine, and two to individuals over 90 miles away. During one of these calls Wade Steffey asked to be let into the building. Both recipients assumed that the calls were wrong numbers. All calls were under 32 seconds in length.

Between 12:00 AM and 1:00 AM, light rain (0.05-0.07 inches/hour) was falling in the area around Owen Hall. The temperature was between 40°F and 41°F. A light wind of 5 to 6 miles per hour was also present. There was no awning or other covering outside of the entrance door where Wade Steffey was observed, so he would have been exposed to the elements.

## POSITION OF THE BODY

The body of Wade Steffey was found in the transformer vault of Owen Hall on March 19, 2007. When his body was found, his shirt had brown dust/dirt on it and a red stain on the front, he was not wearing shoes, there was a tear noted on the back of the shirt near the right shoulder, and his belt was half twisted (worn incorrectly, such that the back of the belt was facing forward when inserted into the buckle). The body was found behind the middle transformer along the east wall of the transformer vault, and was facing north.

His body was positioned such that the transformer was to his left, three routing electrical cables attached to the wall via standoffs were to his right, a cable running from one of these routing electrical cables to the transformer at about thigh to chest height was behind him, and another cable from the routing electrical cable to the transformer at about chest height was in front of him. The body was found draped over the north cable and transformer, with the left hand positioned just above the bushing that attaches this cable to the transformer.



View of transformer 2 looking southeast

- 1. Transformer 2
- 2. Left Hand
- 3. Point of Contact
- 4. Electrical Cable

The area where he was found was about 13.5 inches at its narrowest (between the transformer and the 3 cables attached to the wall) and about 2 feet between the north and south cables. The hole in the bushing had a diameter of 0.88 inches.

## **LIGHTING**

At the time of day when Wade Steffey was believed to have entered the vault there would have been limited illumination. There was some light coming through the louvers on the exterior doors, light at the perimeter of the interior door, and light from a louvers on the east wall of the room. There were interior lights in the room, but the lights were off when the body was found. The switch for the light is near the interior door, and is a non-traditional type (vertical plunger).

## **AUTOPSY REPORT**

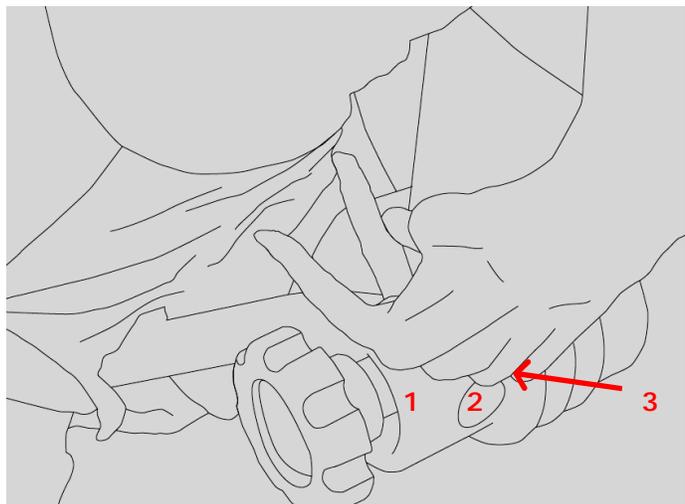
The autopsy report states that Wade Steffey suffered an accidental electrocution, with the electrical entrance wound on the tip of his left ring-finger, and electrical exit wounds on the left upper arm, left lower arm, and the left thigh. According to the toxicology report, Wade Steffey had an elevated blood alcohol content level above 0.08%, but not a lethal level.

## ANALYSIS

### CONTACT WITH HIGH VOLTAGE ELECTRICITY

As mentioned in Section III, the north bushing on Transformer 2 showed signs of physical contact on the exposed end of the conductor. The other eleven bushings on the transformers did not have any indication of physical contact. Also, his left ring-finger, described as the electrical entrance point in the autopsy, was found directly above this bushing.

The hole that led to the exposed end of the connector had a diameter of 0.88 inches, which is larger than the diameter of the tip of the ring finger on a 70 inch tall, 150 pound male. All of the physical evidence, along with the autopsy report, indicates that this was the point of electrocution.



View of ceramic bushing and left hand

1.Ceramic Bushing

2.Hole with Exposed High Voltage

3.Left Ring-Finger

Given the limited illumination in the room, Wade Steffey's ability to see any details in the room was severely

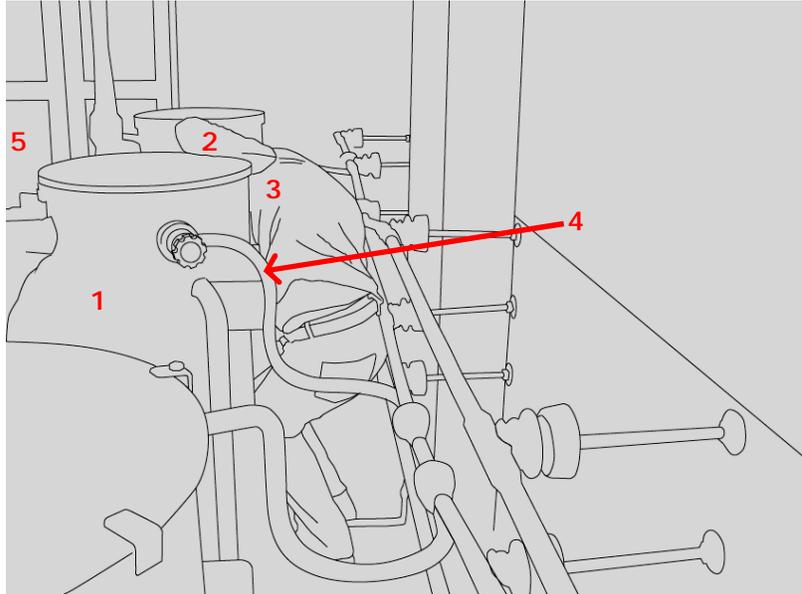
impaired. Both the interior and exterior doors, and the louver between the two southern transformers on the east wall, would be visible due to some light coming through them. In this light the general position of the transformers could likely be seen, and possibly the three cables along the wall below the louver. The cables from the wall to the transformer would have been less visible.

## POSITION OF THE BODY

The most probable way that Wade Steffey positioned himself behind the transformer was by accessing this area from the south, by either going under or over the cable running from the wall to the transformer. Illumination would have been greater in this area, making it a more likely point to attempt entry.

Dust disturbances on the top of the transformer and surrounding areas indicate

that he did not come from on top of the transformer. To come from the north side he would have had to squat down and contort himself underneath the cable that ran from the transformer to the wall while facing away from the transformer. While this would have been possible to do, it would have been quite difficult, and this difficulty would be exacerbated by intoxication. Once positioned behind the transformer, Wade Steffey placed his hand on the northern bushing, with his ring-finger contacting the exposed conductor leading to electrocution.



View of electrical Vault Looking North toward Northeast corner

- 1. Transformer 2
- 2. Left arm
- 3. Left shoulder
- 4. Electrical Cable
- 5. Exterior Doors

## **INTOXICATION**

The evidence reviewed supports the conclusion that Wade Steffey was intoxicated at the time of his death. Primarily, the toxicology report states that the blood alcohol content was above the legal limit, but was not at a lethal level. Effects of intoxication vary, but at any level above 0.08% body coordination difficulties, poor judgment, shortened attention span, and difficulty with fine motor control are present. Additionally, two witness statements and other evidence suggest that Wade Steffey exhibited behavior consistent with intoxication. A series of telephone calls after 12:20 AM were made from his cellular telephone. Within those telephone calls, Wade Steffey contacted a fax machine and two people who were not in the vicinity of the Purdue University campus, yet asked one of the individuals to let him into the building. He was not wearing either shoe, and his belt was in a half-twisted condition.

## Section VI

### SUMMARY OF CONCLUSIONS

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#### COMPLIANCE WITH APPLICABLE CODES

1. The electrical equipment and vault were in compliance with the Indiana Building Rules and Regulations and the Electrical Rules and Regulations, which were in force at the time of their construction. Compliance with later editions of the codes was not required.
2. The Code contained requirements for vault doors which included the requirements that entrance doors be equipped with locks, that doors be kept locked, and that access be allowed only to authorized persons.
3. The Indiana General Administrative Rules, required that buildings be maintained in a code-compliant condition.
4. Requirements of the Indiana Occupational Safety and Health Administration (IOSHA) do not apply to the incident under investigation.

#### MEANS OF ENTRY INTO THE VAULT

5. Wade Steffey entered through the exterior door on the north side of the vault.
6. The condition of the pit surrounding the exterior door did not prevent Wade Steffey from gaining access to the electrical vault door.
7. The exterior vault door was most probably not securely latched, or it was unlocked, at the time of the incident.
8. The condition of the door at the time of the incident did not prevent Wade Steffey from gaining access to the electrical vault.

## **POSITION OF THE BODY INSIDE THE VAULT**

9. Wade Steffey got behind the transformer from the south side by either going over or under the cable running from the wall to the transformer; he was pointed in the direction of the exterior door of the room.
10. Wade Steffey was electrocuted when he inserted his left ring-finger into a recessed, exposed conductor within a bushing attached to Transformer #2.
11. Wade Steffey was under the influence of alcohol at the time of his death.

## Section VII

### BASIS OF REPORT

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1. We reviewed numerous documents provided to us to assist in our investigation.
2. We inspected the site on the following dates:

April 10, 2007	Brief inspection of exterior door at Owen Hall
April 16, 2007	Retrieve door hardware-sets from Wiley and Tarkington Halls Briefly enter electrical vault at Owen Hall
April 24, 2007	Review of areas on campus related to the incident – Briefly enter electrical vault at Owen Hall Discussions with Purdue University Police Department
May 8, 2007	Inspection of Owen Hall electrical vault (power to the transformers was turned off to enable our inspection)
May 15, 2007	Re-installation of Owen Hall hardware-set for evaluation and testing.

3. We met with members of the Purdue University staff to discuss some of the information provided to us.
4. We reviewed the hardware inspection report prepared by the FBI on April 16, 2007.
5. We reviewed the autopsy/toxicology report prepared by E. Allen Griggs, MD, JD on March 19, 2007.
6. We met with representatives from the Indiana Department of Homeland Security and the Indiana Department of Labor to review requirements that were relevant to the investigation.
7. We designed a testing device for use in evaluating the hardware-set after re-installation at Owen Hall.

8. We reviewed the following documents:

Human Factors Design Handbook, 2<sup>nd</sup> edition, 1992.

Authors: Wesley E. Woodson, Barry Tillman, Peggy Tillman  
McGraw-Hill, Inc., New York.

The Influence of Some Handle Designs and Handle Height on the Strength of the Horizontal Pulling Action

David M. Fothergill, Donald W. Grieve, and Stephen T Pheasant  
Ergonomics, 1992, Vol. 35, No. 2, pgs. 203-212.

Static Force Exertion in Postures with Different Degrees of Freedom

Brechtje J. Daams  
Ergonomics, 1993, Vol. 36, No. 4, pgs. 397-406.

Horizontal Push and Pull Forces Exertable when Standing in Working Positions on Various Surfaces

K.H. Eberhard Kroemer  
Applied Ergonomics, 1974, Vol. 5, No. 2, pgs. 94-102.

The Effects of Arm Elevation, Direction of Pull and Speed of Pull on Isokinetic Pull Strength

Sheik N. Imrhan and Umesh Ramakrishnan  
International Journal of Industrial Ergonomics, 1992, Vol. 9, pgs. 265-273.

The ABCs of BAC: A Guide to Understanding Blood Alcohol Concentration and Alcohol Impairment

US Department of Transportation, National Highway Traffic Safety Administration  
DOT HS 809 844, February 2005

Blood Alcohol

Author: Jan Nissl  
Web MD article, July 13, 2004

Short-Term Effects of Alcohol

West Virginia University Community Health Promotion's Alcohol Awareness Site

8. Continued:

1945 Indiana Building Rules and Regulations in force at the time of the construction of Owen Hall.

1945 Indiana Electrical Rules and Regulations in force at the time of the construction of Owen Hall.

2006 Indiana Administrative Rules, which are currently in force in the State of Indiana.

**Section VIII**  
**ATTACHMENT A**

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**Curriculum Vitae**



**FRANK MULLEN, A.I.A  
FORENSIC ARCHITECT  
SENIOR CONSULTANT**

Mr. Mullen has been practicing architecture for 17 years. He is a 1989 graduate of Ball State University with a Bachelor of Architecture and Environmental Design (1988) and is registered in Illinois, Indiana, Kentucky, Louisiana, Michigan and Ohio. He is certified by the National Council of Architectural Registration Boards.

Mr. Mullen's area of expertise is premises liability, construction claims and defects, accessibility issues and building failure analysis. His experience is in planning and design, construction drawing, specification writing, and historic preservation.

**EDUCATION AND PROFESSIONAL ASSOCIATIONS**

Bachelor of Architecture – Ball State University, 1989  
Bachelor of Environmental Design – Ball State University, Muncie, IN, 1988  
Herron School of Art, Indiana University, Indianapolis, IN, 1986  
U.S. Army, Defense Mapping School, Fort Belvoir, VA, 1980

Member: American Institute of Architects (AIA), 1994  
National Council of Architectural Registration Boards (NCARB), 1994

Continuing Education Courses and Related Training:

Safety Inspections – National Safety Council (Chicago, IL, 2006)  
Pedestrian Slip Resistance – William English, PE (Los Angeles, CA, 2006)  
Inspection and Evaluation of Residential Roofing – Haag Engineering Co. (2006)  
Commercial Roofs Damage Assessment – Haag Engineering Co. (2006)  
Certified English XL Technician – 2006  
Walking/Working Surfaces – National Safety Council (Indianapolis, IN, 2007)  
Introduction to OSHA – National Safety Council (Chicago, IL, 2007)

**EMPLOYMENT HISTORY**

2005 - Present	Rimkus Consulting Group, Inc.
2004 - 2005	Robson Forensic, Inc.
2000 - 2004	Axis Architecture & Interiors
1996 - 2000	Ratio Architects
1993-1996	Sirny Architects
1991-1993	Ellerbe Becket
1990-1991	Wold Architects
1988	Daniel Wheeler Architects

HOUSTON DALLAS/FT. WORTH AUSTIN SAN ANTONIO CORPUS CHRISTI MC ALLEN NEW ORLEANS  
LAFAYETTE ATLANTA CHICAGO LAS VEGAS PHOENIX TAMPA ORLANDO FT. LAUDERDALE JACKSONVILLE  
DENVER BALTIMORE JACKSON CHARLOTTE LOS ANGELES ZURICH MADRID KUWAIT CITY NEW YORK  
PENSACOLA INDIANAPOLIS

**FRANK MULLEN, A.I.A**

**DETAILED PROFESSIONAL EXPERIENCE:**

**RIMKUS CONSULTING GROUP, INC.**

**2005 – PRESENT**

Consultant / Forensic Architect

Provide technical investigations, analyses, reports and testimony toward the resolution of commercial and personal injury claims and litigation involving premises safety, codes and standards, building and building system failures, construction claims, construction materials failures, and designer professional practice.

**ROBSON FORENSIC, INC.**

**2004 - 2005**

Forensic Architect

Investigated, analyzed and reported on litigated construction and premises liability claims.

**AXIS ARCHITECTURE & INTERIORS**

**2000-2004**

Project Manager/Project Architect

Responsible for project design, construction documents, project specifications, construction administration, and budget forecasting for civic, industrial, and office buildings and interior renovations. Evaluated feasibility of office/industrial and historic building projects.

**RATIO ARCHITECTS**

**1996-2000**

Associate and Project Manager

Responsible for project design, management, construction documents, construction administration and budget forecasting for medical office facilities, university housing, religious structures and multi-family housing projects; historic preservation experience includes conversion of historic structures, complying with national and state preservation guidelines.

**SIRNY ARCHITECTS**

**1993-1996**

Project Manager

Responsible for project design, management, construction documents, construction administration and budget forecasting for hospitality and commercial facilities, including renovations of and additions to existing clubhouses and restaurants and historic buildings

**ELLERBE BECKET**

**1991-1993**

Graduate Architect

Site documentation of historic university buildings including accessibility code analysis and identification of issues requiring correction; project design and construction

**FRANK MULLEN, A.I.A**

document team on new university and hospitality facilities including hotels and classroom/lecture hall buildings.

**WOLD ARCHITECTS**

**1990-1991**

Graduate Architect

Responsible for project design and participation in construction document teams on primary, secondary and technical school facilities.

**DANIEL WHEELER ARCHITECTS**

**1988**

Intern Architect

Documented designs for conversion of historic structures into single-family residences, and documented buildings for interior renovation projects.



**ROBERT W. MILLER, P. E., CFEI  
SENIOR CONSULTANT**

Mr. Miller is a 1969 graduate of the New York University School of Engineering and Science with a Bachelor of Engineering in Electrical Engineering degree and a 1965 graduate of New York City Community College with an Associate in Applied Science degree in Electrical Technology. He has taken graduate studies in Polymer Chemistry and Electrical Engineering from the New York Polytechnic Institute. He has had a 32 year career with Underwriters Laboratories Inc (UL) conducting safety evaluations on materials, products and systems, until retiring in 2001 as a Vice President.

His professional experience includes the testing and evaluation of plastic materials used as electrical insulation and enclosures of electrical products and devices. He has extensive experience evaluating electrical appliances, electric tools, medical & dental products, radio & television products, telecommunications equipment, material flammability, Electromagnetic Compatibility (EMC), evaluation of lightning damage, electrical shock hazards, equipment grounding and consumer products. He has authored over 20 papers on flammability and product safety. Mr. Miller is a licensed Professional Engineer in Alabama, California, Illinois, Indiana, Louisiana, New York, North Carolina, Michigan, Minnesota and Wisconsin and is a Certified Fire and Explosion Investigator.

He has extensive standards development experience and was past Chair of ASTM Committee D-20 on Plastics. He has participated in the standards development activities of ASTM D-9 on Insulating Materials and F-15 on Consumer Products. He has been a USTAG member for the International Standardization Organization (ISO) Committee TC-61 for Plastics and the International Electrotechnical Commission Committees TC15 on Insulating Materials and TC 89 on Fire Hazard. He is a member of UL's Standards Technical Panel for Leakage Current in Appliances and has been designated as a Technical Expert by ANSI in their Accreditation Program for Certification Bodies.

**EDUCATION AND PROFESSIONAL ASSOCIATIONS**

A.A.S. – New York City Community College, 1965

B.E.E.E. – New York University, 1969

Registered Professional Engineer – Alabama (Lic 28082-E), California (Lic. SF3335), Illinois (Lic.062-056014), Indiana (Lic. 10504949), Louisiana (Lic. 31102), Michigan (Lic. 6201051781), Minnesota (Lic. 44298), New York (Lic. 051191), North Carolina (Lic. 032370), and Wisconsin (Lic. 36733).

Certified Fire and Explosion Investigator (CFEI Reg. No.9394-4072)

Professional Associations: ASTM International

National Fire Protection Association

National Association of Fire Investigators

International Association of Arson Investigators

International Association of Electrical Inspectors

HOUSTON DALLAS/FT. WORTH MC ALLEN SAN ANTONIO CORPUS CHRISTI AUSTIN NEW ORLEANS ATLANTA CHICAGO  
TAMPA FT. LAUDERDALE ORLANDO LAS VEGAS DENVER PHOENIX LAFAYETTEBALTIMORE LOS ANGELES ZURICH  
MADRID KUWAIT

**ROBERT W. MILLER, P. E., CFEI**

**EMPLOYMENT HISTORY**

2003 – Present	Rimkus Consulting Group, Inc.
2001 – 2002	Robert W. Miller, P.E.
1969 – 2001	Underwriters Laboratories Inc.

**DETAILED PROFESSIONAL EXPERIENCE:**

**RIMKUS CONSULTING GROUP, INC.**

**2003- PRESENT**

Senior Consultant

Provide litigation support for attorneys and corporate counsel, as well as claims investigation and evaluation for insurance companies in situations involving electrical systems and products. His experience includes failure analysis on electrical products and equipment.

**ROBERT W. MILLER, P.E.**

**2001 - 2002**

Consultant

Provided consulting and forensic engineering services to attorneys and insurance companies. Projects involved the disciplines of electrical, mechanical and plastics engineering, materials and product testing. Issues addressed all aspects of product safety analysis.

**UNDERWRITERS LABORATORIES INC.**

**1969- 2001**

Vice President of Technology Marketing

Directed and coordinated global marketing technical support activities. Developed specifications of new service products based upon market direction, customer input, regulatory issues, and developing technology.

Vice President of Programs and Services

Held responsibility for the development of program-related policies, procedures, and practices. Provided strategic direction for expanding technology changes, particularly in the areas of EMC, medical devices, and telecommunications. Directed International Compliance Services, factory certification surveillance, and the ISO 9000 Registration program.

Vice President of Technology Services

Evaluated several acquisition possibilities and held responsibility for the acquisition of a West Coast Electromagnetic Compatibility (EMC) facility. Coordinated construction of five EMC facilities at existing corporate office sites

## **ROBERT W. MILLER, P. E., CFEI**

### Vice President and General Manager

Served as general manager of a 170,000 square foot test and office facility located in Silicon Valley. Oversaw all operations in three local engineering service centers in southern California. Held operational responsibility for 850 engineers and support staff, conducting product safety and certification activities at one of the company's full service facilities. Established local engineering services sites in Portland, San Diego, Granada Hills and Brea in order to provide local service support.

### Managing Engineer

Held responsibility for the regional operations of the fire protection division, directing 80 engineers and support staff in the areas of chemical and casualty hazards, burglary protection, signal devices, heating and air conditioning, refrigeration and fire protection.

### Associate Managing Engineer

Oversaw 30-person section in the Electrical Department. Covered plastics and electrical insulation, electric tools, and household food preparation equipment.

### Project Engineer and Engineering Group Leader

Conducted individual project evaluations, managed a group of engineers and support staff, and was involved with the evaluation of radio and television, medical devices, and insulating materials and systems.



**MARK SWEIGART, Ph.D.  
PROJECT CONSULTANT**

Dr. Sweigart completed his Ph.D. in Bioengineering at Rice University, where his research area was orthopedic tissue characterization, repair, and regeneration. Prior to his Ph.D., Dr. Sweigart received his Bachelor's of Science in Mechanical Engineering from Rose-Hulman Institute of Technology. Dr. Sweigart's primary areas of consulting expertise include injury causation biomechanics, accident reconstruction and medical device failures. Dr. Sweigart performs biomechanical analysis on cases involving low and high speed accidents, slip and falls, falling objects, amusement rides and other injury accident/incidents.

Dr. Sweigart's prior experience has included multiple aspects of the orthopedic and cardiovascular fields, including mechanical, biological, and structural characterization of orthopedic tissues, design, development, and FDA approval of a cardiovascular stitching device, tissue engineering, and development of a textbook on materials used in medicine.

**EDUCATION AND PROFESSIONAL ASSOCIATIONS**

Ph.D. Bioengineering – Rice University, Houston, Texas

B.S. Mechanical Engineering – Rose-Hulman Institute of Technology, Terre Haute, Indiana

Registered Engineer in Training – Indiana, 1999

**EMPLOYMENT HISTORY**

2007 – Present	Rimkus Consulting Group, Inc.
2005 – 2006	Rice University
1999 – 2005	Rice University
1998 – 1999 (intern)	Sutura, Inc.

HOUSTON DALLAS/FT. WORTH AUSTIN SAN ANTONIO CORPUS CHRISTI MC ALLEN NEW ORLEANS  
LAFAYETTE ATLANTA CHICAGO LAS VEGAS PHOENIX TAMPA ORLANDO FT. LAUDERDALE JACKSONVILLE  
DENVER BALTIMORE JACKSON CHARLOTTE LOS ANGELES ZURICH MADRID KUWAIT CITY NEW YORK  
PENSACOLA INDIANAPOLIS – SAN FRANCISCO

**DETAILED PROFESSIONAL EXPERIENCE:**

**RIMKUS CONSULTING GROUP, INC.**

**2007 - PRESENT**

Project Consultant

Provides human motion analysis and/or injury potential/causation as a result of various accidents, including motor vehicle collisions, vehicle collisions with pedestrians/cyclists, and impact due to falls or falling objects. Evaluates medical device failure and malfunctions. Provides vehicle accident analysis, including computer-aided vehicle accident reconstruction.

**RICE UNIVERSITY**

**2005 – 2006**

Post-Doctoral Research Scientist

Assisted in the creation of a textbook entitled *Biomaterials: The Intersection of Biology and Materials Science*. Specific responsibilities included development of problems for each chapter to quiz the students on their knowledge of the subject, verifying technical information for various portions of the text, drawing schematics to illustrate technical concepts, consolidating the various contributions from the authors and other collaborators, completing a working version of the textbook for testing in a classroom setting, and assisting in the response to various critiques of this draft from both students and professionals in the field. In addition to work on the textbook, the cytotoxicity of biodegradable polymers for use as tissue engineering scaffolds was performed.

**RICE UNIVERSITY**

**1999 – 2005**

Doctoral Research Scientist

Conducted research to characterize the rabbit knee meniscus structurally, mechanically, and chemically. Determined the response of cells from the rabbit knee meniscus to a polymeric material. Authored several papers and spearheaded a grant for tissue engineering of the knee meniscus. Assisted in several studies examining other cartilages and joints, including the temporomandibular joint (TMJ). Assisted in several human total knee replacements at the University of Texas Health Science Center at Houston

**SUTURA, INC.**

**1998 – 1999**

Device Design and Manufacturing Intern

Contributed to the development of the manufacturing components, manufacturing instructions, and manufacturing process of a cardiovascular medical device. Assisted with FDA paperwork for 510(k) approval of a cardiovascular medical device. Designed and built a prototype handle for a cardiovascular medical device

**PUBLICATIONS**

- Sweigart, M.A., and Athanasiou, K.A. (2005) Tensile and compressive properties of the medial rabbit meniscus. Proceedings of the Institution of Mechanical Engineers Part H: Journal of Engineering in Medicine, 219(5), pp. 337-47.
- Sweigart, M.A., and Athanasiou, K.A. (2005) Biomechanical characteristics of the normal medial and lateral porcine knee meniscus. Proceedings of the Institution of Mechanical Engineers Part H: Journal of Engineering in Medicine, 219(1), pp. 53-62.
- Sweigart, M.A., Zhu, C.F., Burt, D.M., deHoll, P.D., Agrawal, C.M., Clanton, T.O., and Athanasiou, K.A. (2004) Intraspecies and interspecies comparison of the compressive properties of the medial meniscus. Annals of Biomedical Engineering, 32(11), pp. 1569-79.
- Sweigart, M.A., AufderHeide, A.C., and Athanasiou, K.A. (2003) Fibrochondrocytes and their use in tissue engineering of the meniscus. In: Topics in Tissue Engineering. Eds. N. Ashammakhi and P. Ferretti, e-book: [www.tissue-engineering-oc.com](http://www.tissue-engineering-oc.com).
- Sweigart, M.A., and Athanasiou, K.A. (2002) Chapter 12: Biodegradable scaffolds for meniscus tissue engineering. In: Tissue engineering and biodegradable equivalents: scientific and clinical applications. Eds. KU Lewandrowski, DL Wise, DJ Trantolo, JD Gresser, MJ Yaszemski, and DE Altobelli, New York: Marcel Dekker, pp. 225-236.
- Sweigart, M.A., and Athanasiou, K.A. (2001) Toward tissue engineering of the knee meniscus. Tissue Engineering, 7(2), pp. 111-129.