MIFACE INVESTIGATION: #05MI024

SUBJECT: Owner Of Excavating Company Dies When Excavator Overturns Into Water/Mud of Gravel Pit.

Summary

On February 18, 2005, a 49-year-old male excavating company owner died when the excavator he was operating overturned into a gravel pit pond. After digging one exploratory hole to determine soil content and finding its contents unacceptable, he backfilled the hole. He told his workers he intended to go to the other side of the pit to dig another exploratory hole. His two coworkers left to explore the area. Instead of using the road that circled the top of the pit, he drove the excavator on the 20-degree sloped bank along the water's edge with the bucket somewhat elevated and the excavator's cab door toward the water. Snow and ice on the bank was approximately four inches deep. (See Figure 1) As he was traveling, the bank sheared away, causing the excavator to tip over. The cab was completely submerged in the mud and water. His coworkers returned and found excavator overturned in the mud and water. Coworker #1 entered the water/mud, found the victim trapped in the cab and to attempted to rescue him. Failing in this rescue attempt, he called 911. Coworker #2 called for a wrecker service to raise the excavator. By the time emergency response arrived, three public service answering points (PSAPs) had become involved in the rescue attempt. After approximately one hour, the excavator was raised and the victim was taken to a local hospital where he was declared dead.

Figure 1. Excavator as being lifted from the water in gravel pit

RECOMMENDATIONS

Primary Prevention

- Ground conditions should be visually inspected and evaluated to ensure stability prior to moving/positioning mobile equipment.
- When traveling across slopes, keep bucket position in the uphill direction and in the lowest position possible.
- Keep hazard exposure to cab side at a minimum.
- Ensure health and safety program includes emergency preparedness issues, such as access for emergency personnel to remote sites.

Key Words: Machine-related, Excavator, Gravel Pit

Response Activities Recommendations

- Wrecker companies involved in heavy equipment recovery should ensure that their tow truck operators are appropriately trained and that equipment, such as booms and chains have been weight-certified.
- Employers should determine if their employee-issued wireless cellular handsets/communication devices have global positioning system (GPS) technology.
- County and local public service answering points (PSAPs) meet to identify the nearest emergency responders based upon potential emergency call locations.

INTRODUCTION

On February 18, 2005, a 49-year-old male excavating company owner died when the excavator he was using overturned into a gravel pit pond. On February 22, 2005, MIFACE investigators were informed by the Michigan Occupational Safety and Health Administration (MIOSHA) personnel who had received a report on their 24-hour-a-day hotline, that a work-related fatal injury had occurred on February 18, 2005. On August 30, 2005, MIFACE interviewed the co-owner of the business. During the course of writing the report, the police report, medical examiner's report, MIOSHA file and citations were reviewed. MIFACE talked with members of the responding fire department, listened to the initial 911 call, heard dispatch instructions, reviewed photographs taken at the scene, and was given a general tour of the area of the gravel pit location to illustrate the difficulty in gaining faster access to the pit. All pictures used in this report were obtained from the responding fire department.

The company that the victim co-owned performed municipal utility installations, dug and inspected drain fields and septic systems, sewer and water line installations and repair, site development and demolition and other construction services. It employed 18 individuals and had been in business for 19 years. The victim usually started work around 7:30 a.m. The firm had a written health and safety program and used an insurance-provided consultant to assist them in health and safety issues. The company did not have a health and safety committee. It had monthly safety meetings with employees. The victim had been operating excavating machines for many years and was a very experienced operator.

MIOSHA issued one Other citation to the company for failing to report the death of the employee on February 18, 2005 within 8 hours to the Michigan Department of Labor and Economic Growth, Michigan Occupational Safety and Health Administration, in violation of the Recordkeeping and Reporting of Occupational Injuries and Illnesses, Part 11, Rule 1139(1).

INVESTIGATION

The Hitachi excavator was purchased in new condition in 1994. The Model EX300-LC-3 excavator weighed 73,000 pounds, was hydraulically controlled, and was equipped with

the operator's and maintenance manual. All maintenance was performed according to manufacturer specifications.

The incident site was a gravel pit located about one-quarter mile away from a main road. The ground was covered with snow and ice. The temperature was below freezing, and it was snowing. The ice on the water in the pit was approximately three inches thick. A dirt road was located on the perimeter of the pit's upper bank that permitted vehicles to gain access to the excavated pit. The gravel pit owner was considering the pit area as a potential construction site and thus had to determine the pit area soil composition. The victim's company was hired to dig test holes in various pit locations to ascertain the pit area soil composition.

The victim was a member of a three-person crew. The victim and Coworker #2 arrived at the gravel pit with the excavator at approximately 11:00 a.m. The victim and Coworker #2 unloaded the excavator from the trailer. At approximately 11:20 a.m., Coworker #1 arrived, and while coworkers #1 and #2 watched, the victim dug an exploratory (test) hole, approximately 15 feet deep and one bucket wide, to determine what kind of soil was present. The terrain was fairly flat in the location of the test hole. The test hole revealed stone as its contents. Since stone was unacceptable, the victim stated to his coworkers that he would backfill this hole and drive the excavator to the other side of the pit to dig a second test hole. His coworkers left in a truck, traveled around the top of pit via the road, and then drove up a nearby hill to see if there was another road going in that direction.

Figure 2. Excavator tracking along water edge toward wall to ascend

While his coworkers were gone, the victim backfilled the hole. Instead of tracking the excavator to the road at the top of the pit, he tracked the excavator around the water's edge, presumably to ascend the hill prior to the pond curve (See Figure 2). The excavator had traveled approximately 100 yards from the digging point, tracking closely to the edge of the water. The severity of bank slope started to increase as he tracked toward the hill. The slope at the location of the incident was estimated at approximately 45 degrees. The boom was placed in the direction of travel, elevated, and not facing uphill; thus the cab and its door faced the water surface. The ground surface supporting the track of the excavator next to the gravel pit sheared away. As a result, the excavator tipped in the direction of the water in the pit and resulted in the cab being submersed in the water and mud.

The victim's coworkers were gone five to ten minutes. Upon their return, they did not immediately see the excavator. Eventually, Coworker #2 saw the excavator on its side

and the cab submerged. After seeing the excavator overturned into the water, both coworkers jumped out of the truck they were in and attempted to rescue the victim. Coworker #1 took off his coat and jumped into the gravel pit water. The water was up to his knees. The bottom of the pond was mud/dirt. He found the excavator cab completely submerged to the piston. (See Figure 3) He asked Coworker #2 to get a hammer out of the truck so he could try to break the cab windows, but found that the cab windows were already broken. Meanwhile Coworker #2 went back to the truck to get a hose to see if they could supply the cab with air. Coworker #1 reached into the small window by the boom and grabbed onto the victim's coat. He attempted to pull the victim up out of the water/mud but could not.

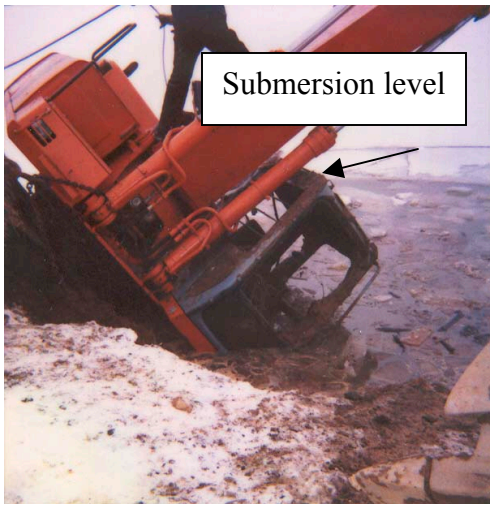

Figure 3. View of cab as excavator being lifted from mud

Coworker #2 called for a wrecker service that the company had used in the past to come to the scene. Coworker #1 directed Coworker #2 to take the truck and drive back to the intersection of the road leading back to the incident site and the main road to help emergency response locate the incident site. Coworker #1 got out of the water and, using his wireless phone, called 911. The gravel pit was located in County A. The closest cell phone tower to his location picked up the signal, and routed the emergency call to the nearest public service answering point (PSAP), which was located in a different county (County B). A PSAP is defined as a facility equipped and staffed to receive 911 calls (Reference 1). MIFACE listened to and transcribed Coworker #1 911 call, and County A and County B PSAP communication with each other courtesy of the responding fire department (from County C).

The sequence of events as transcribed from the 911 emergency call is as follows:

- County B PSAP (County B) received the 911 emergency call from Coworker #1.
    - Coworker #1 provided his name, company name, and precise information about the emergency (name of gravel pit, description of incident, name of cross streets, county of incident site)
    - County B initiated County B sheriff and ambulance response
        - Ambulance over 15 miles away from the incident site
- County B called County A PSAP (County A) with Coworker #1 on the call
    - County B told County A that a large piece of machinery had fallen into a "pond" with a man trapped inside. County B gave crossroads and that the location was a gravel pit
    - Coworker #1 gave County A name of gravel pit
- County A wanted to confirm incident location because of incident site proximity to County C.
    - County B gave distance of the gravel pit from the nearest cross street

    - County B confirmed the incident site was in County A
- County B asked County A if water rescue in County B should be initiated
    - Water rescue located in County B approximately 15 miles away
    - County A agreed
- County A asked Coworker #1 to confirm location and how to enter the pit area.
    - Coworker #1 responded
- County B (while County A was on the line) asked Coworker #1 what type of equipment was in the water
    - Coworker #1 identified the equipment as an excavator.
    - County B confirmed that the wrecker service called by Coworker #2 was en-route to the gravel pit
- County A asked Coworker #1 to stay on the line with County B while County A called County C PSAP to initiate a fire department response
- County A called County C PSAP
    - County A asked County C PSAP to send a specific fire department/ambulance, and gave a specific road intersection. County A stated that they were still trying to figure out incident location.
    - County A indicated that a subject was pinned in a *vehicle*, underwater, in a gravel pit.
- County C notified the volunteer fire department indicated by County A – this was the closest emergency responder to the incident site (less than one mile away). The fire department, including its dive rescue team, was dispatched by County C to the intersection as described by County A. Approximately 10 minutes had elapsed from Coworker #1 initial call.
    - County C fire department was advised that the location was a gravel pit, and that a subject was pinned in a vehicle, underwater.
    - The fire department, upon hearing it was a gravel pit, knew the location and arrived at the scene approximately nine minutes after the notification to respond.
- County B called County C PSAP asking to have the same fire department water rescue/dive team dispatched.
- County B's sheriff's department arrived first. The sheriff and Coworker #1 jumped into the water/mud to attempt again to extricate the victim, but could not.
- *En-route to the scene*, County C PSAP advised County C fire department personnel that it was an *excavator* that rolled over into the gravel pit, with the operator trapped in the cab of the excavator, underwater.
    - County C's fire department requested assistance from a local wrecker service to dispatch heavy recovery wrecker service trucks (50-ton, boom/chain-certified) and their trained operators to the incident scene to assist in the rescue.

County C fire personnel arrived at the incident site nine minutes after dispatch by County C PSAP. One of the fire department divers entered the water and sank into the mud past his knees. He was able to grab hold of the victim's arm, but was unable to remove him from the cab.

The initial responding wrecker truck was the truck called for by both Coworker #2 and County B PSAP. The wrecker service parked their truck on the road at the top of the embankment. This truck did not have a certified boom and chains. County C fire department divers hooked the chains to the raised excavator track but the wrecker was unable to extricate the excavator from the mud. The heavy recovery wrecker trucks arrived and parked on the road above the pit. The divers hooked up the heavy recovery wrecker chains and cables to the excavator boom to raise it from the water to access the victim. (See Figure 4) As the upright operation was occurring, the uncertified chain broke and flew past the wrecker trucks into the woods located behind the trucks. An additional excavator was needed excavate around the cab in the mud and water because the cab was so deep in the mud. It took approximately one hour to upright the excavator. The upright operation was stopped when the cab of the excavator was out of the mud and water. The victim was removed from the cab and resuscitative efforts were initiated at the scene. The victim was taken to a local hospital via ambulance where he was declared dead.

Figure 4. Divers hooking cables to excavator

At approximately 1:15 p.m. during the rescue operation, the incident commander (fire department captain) asked Coworker #1 if he could put a time as to how long the victim had been under the water and/or immersed in the mud. Coworker #1 could not guess. The incident commander asked if he had remembered hearing the noon siren. Coworker #1 replied yes, but did not realize what the sound was. He thought at the time it was an odd sounding emergency siren. Coworker #1 then stated he heard the noon siren while he was on the phone with 911.

After the incident, the fire department from County C conducted an inquiry, talking with County B and County A PSAPs to determine why the department was instructed to respond to a situation so different from the actual circumstance. It is important to note that the fire department has a contract to provide emergency response services to the township where the incident occurred, because of their proximate location and dive team capabilities.

It is unknown why the victim took this route to the other side of the gravel pit. According to the company co-owner, this incident was not indicative of the victim's usual work practices. He stated the victim always followed safe work practices. Thus it was unusual that he traveled along the edge of the pit with the cab facing the water instead of on the road above, traveled with the bucket in the air, and did not recognize the "dead end", i.e. forty feet further the bank would have been too steep for the excavator to navigate. The victim also made no attempt to spin the cab around to try to allow a way out of the cab when the excavator was overturning.

CAUSE OF DEATH

The cause of death as indicated on the death certificate was cardiac arrest due to or as a consequence of hypothermia. Toxicology indicated the victim had a blood alcohol level of 0.023%.

The effects of alcohol intoxication are greatly influenced by individual variations, such as weight, gender, age, or the presence of other medications or drugs. Typical effects at the victim's BAC (0.023%) are described as a mellow feeling, slight body warmth, less inhibited, relaxation, no loss of coordination, and no apparent depressant effects (References 2 and 3).

RECOMMENDATIONS/DISCUSSION

Primary Prevention

- Ground conditions should be visually inspected and evaluated to ensure stability prior to traveling and/or positioning mobile equipment.

The responding fire department hypothesized that the victim may have decided to take the most direct route - to go around the water and "drive" up the embankment before it became too steep - instead of taking the road around the upper edge of the pit.

MIOSHA adopted the provisions of 29.CFR.600 to 1926.606 as revised in December 1, 1998 as Construction Safety Standard Part 13, Mobile Equipment (Reference 4). 1926.602 pertains to material handling equipment and the first section, section (a) describes the general requirements for earthmoving equipment. Rule 1926.602(a)(3)(i) states "no employer shall move or cause to be moved construction equipment or vehicles upon any access roadway or grade unless the access roadway or grade is constructed and maintained to accommodate safely the movement of the equipment and vehicles involved".

Heavy equipment operators must be extremely cautious when working near embankments and/or water. The work/travel area should be evaluated to ensure no tip-over hazards exist, such as weak or wet embankments and if the machine can safely operate on the soil. It is unknown if the victim visually inspected the travel area to identify possible ground condition hazards, such as the stability of the ground near the drop off/edge of the embankment prior to operating the excavator along the gravel pit slope. When traveling across slopes, keep bucket position in the uphill direction and in the lowest position possible.

Although it was not required in this incident, the operator traveled across the gravel pit slope instead of along the existing roadway around the gravel pit. Although not recommended, it is sometimes necessary for an excavator operator to travel across a slope instead of uphill or downhill. Operators should keep the bucket in the lowest position

possible on the uphill side when it is necessary to travel across a slope. This maintains the center of excavator's center of gravity on the uphill side, and helps to prevent an overturn to the downhill side of the slope.

- Keep hazard exposure to cab side at a minimum.

The victim, by traveling with the cab door on the downhill slope side, exposed himself to an additional hazard – water – on the exit side of the cab. Operators should plan their travel route to ensure that the opportunity for cab exit is possible in the case of an emergency.

- Ensure health and safety program includes emergency preparedness issues, such as access for emergency personnel to remote sites.

Contractors often face both remote and unknown site conditions. To address this circumstance the contractors Accident Prevention Program should include provisions to identify hazards present, properly train employees regarding those hazards, and, assure emergency access to worksites. Although the site could be accessed from a main road, it was a distance back from the road, and the PSAP asked if the emergency responders could get to the incident scene in a patrol car or if a 4-wheel drive vehicle would be necessary. Pre-planning in case of an emergency is the best way to ensure that if an emergency situation arises that all information necessary is readily available for an employee. Emergency response access to remote sites can, and has been, an issue for many emergency situations.

Response Activities Recommendations

- Wrecker companies involved in heavy equipment recovery should ensure that their tow truck operators are appropriately trained and that equipment, such as booms and chains have been weight-certified.

Heavy equipment retrieval requires specialized skills in incident assessment, rigging, and recovery. The Towing and Recovery Association of America (TRAA) (Reference 5) offers a National Driver Certification Program to promote consistency and quality in towing and recovery services. There are three levels of testing described on the TRAA website (http://www.towserver.net/certification.htm). Level 2 is Medium and Heavy Duty Truck Towing and Recovery (over 10,000 gvwr) and Level 3 is Specialty Heavy Duty Recovery (air cushions/specialty equipment, underwater recovery, recovery of airplanes, HAZMAT, etc). Tow truck operator training is imperative,

Figure 5. Tow truck operators watching extrication activities prior to their repositioning

not only to keep others safe, but also to ensure the safety of the tow operator him/herself. The tow company called by the victim's coworker had operators who were standing between the truck and the excavator. The fire department chief had to "threaten" the tow operators with police escort to move from their position to a safer observation area (See Figure 5). The broken chain flew past where they were standing, and according to the fire chief, the chain would likely have hit the operators as it flew past.

- Employers should determine if their employee-issued wireless cellular handsets/communication devices have global positioning system (GPS) technology.

Employers should not assume in the event of an emergency that a wireless carrier-based 911 call would be answered by an operator who is be able to identify the location of the call. A PSAP may not be equipped with the technology to determine the location of the call or if the handset is an older model, it is not capable of transmitting automatic location information (ALI) because it does not have GPS technology.

When a 911 wireless call occurs, the closest cell tower picks up the call and sends the signal to the PSAP that services the area the tower is located in. In rural areas, there may be a problem in routing the calls. The towers may not directly serve a county. As what happened in this incident, the wireless call was "picked up" by the nearest tower that routed the emergency call to County B, who had to rely upon the caller's described location to determine the location. After dispatching an ambulance from County B, County B called County A. County A, after determining that the closest emergency responder was in County C, called County C.

In Michigan, all PSAPs are in compliance with Phase 1 implementation (providing a call-back number in case the call is dropped, but no location information), but at the time of the incident, not all were compliant with Phase II. Phase II allows the emergency operator to receive both the caller's wireless phone number and their location information, using either global positioning system (GPS) on the headsets or via tower triangulation to give latitude and longitude locators.

At the time of the incident, according to the Michigan State Police Emergency Telephone Service Committee (ETSC) website, the PSAP that initially received the coworker's emergency 911 wireless call (County B) was compliant with Phase I implementation, but did not have Phase II implementation.

Companies should determine if the wireless handsets are GPS capable. To assist PSAPs that do not have Phase II implementation technology in place, employers should ensure workers specifically know where they are working, and how to direct emergency services to the location in case of an emergency.

- County and local public service answering points (PSAPs) meet to identify the nearest emergency responders based upon potential emergency call locations.

The Michigan ETSC has developed a Suggested Policy Document (initial release date: 8/29/01; updated 1/31/05) that described five policies: Policy A: Routing of Wireless 911 calls, Policy B: Transfer of Emergency Information Between Public Safety Answering Points, Policy C: Procedures for Cellular Telephone Callers Reporting an Incident in Progress, Policy D: Transfer of Wireless 911 Calls Between Public Safety Answering Points, and Policy E: Emergency Medical Services Dispatching (Reference 6).

Although not mandated requirements, Policy E has particular relevance in this incident. Policy E (approved by the ETSC on 2/22/1996) states: "Following a meeting with representatives from the Attorney General's Office, Department of Public Health, State Police, and Emergency Telephone Service Committee, the following guidelines were provided to 911 centers developing their tentative service plans – dealing with EMS ambulance services.

In compliance with the Public Health Code:

- The 911 tentative service plan guidelines should be developed within geographical areas based upon local governance.
- 911 emergency service dispatches (including ambulance calls) are required by statute to send the closest appropriate vehicle to the scene of the emergency. These service calls are not bound by contractual agreements, either public or private, but instead by the concept of what is best for a citizen during an emergency situation. Thus, in consideration of deciding to dispatch an ambulance, faced with choosing based on a contractual basis, the PSAP should always decide in favor of the closest vehicle concept.

It was agreed upon that if a citizen accesses 911 they are accessing a public service. As a public service, ambulance service contracts are not a factor or consideration in deciding whom to dispatch. Instead, the closest appropriately licensed and available responder (to the emergency), regardless of contracts between local units of government and private citizens, should be sent.

To this end, when developing a tentative 911 service plan, the establishment of primary geographic service areas (in lieu of vehicle locators) for EMS providers will provide the most expedient way to make dispatch determinations. If EMS ambulance services question a geographical service area articulated in a tentative service plan on the basis that it fails to adhere to the closest vehicle concept, they should be invited to request their local Medical Control Authority to review their concerns, and if it deems it appropriate, to provide written advice to the 911 board for its consideration in the dispatching of emergency medical services."

The responding EMS did have a private contract with the incident location township to provide EMS service; in this case, they were the closest responding emergency unit. The

difficulty in dispatching the closest ambulance arose because the initial call was directed to a different county from which the caller was in. After being notified by County B, County A recognized the location, and called County C directly to dispatch the nearest EMS units. The firefighters from County C stated that it happens quite frequently that County B calls County A first, then County C is called.

Especially in rural counties, the identification of the nearest emergency responder can be a challenge. Emergency calls are often not directed to a county of incident PSAP, but to another county. To prepare for this challenge, MIFACE recommends that local and county PSAP's meet to identify and establish emergency response coverage areas. Defined areas and the assignment of emergency responders to provide service to that area would provide for more timely dispatching of the closest emergency response unit(s), not only by county of incident PSAPs but also the out-of-county PSAP that a call may be routed to.

Even with Phase II implementation, PSAPs still have a need to know who the closest emergency responders are and what their capabilities are. For example, as in this incident, the incident may require a dive team. Also important is the degree of emergency medical service the emergency responder can provide. In this incident, the ambulance service from County B did not have a technician with as high a level of licensure as did the Emergency responders from County C and thus could not perform some of the response tasks. Emergency Medical Technicians (EMTs) are categorized into three training and licensure levels: Basic, Intermediate (Specialist) and Paramedic (Reference 7). The amount of education and training completed determines the level of licensure. An EMT licensed at the Basic level has training in basic emergency care skills while an EMT licensed as a Paramedic has advanced training including advanced life support treatments such as IV therapy, pharmacology, and cardiac monitoring.

By working together, emergency responders and PSAPs can save valuable time in the case of an emergency by dispatching the closest emergency responders with appropriate capabilities and training.

REFERENCES

MIOSHA standards cited in this report may be found at and downloaded from the MIOSHA, Michigan Department of Labor and Economic Growth (DLEG) website at: www.michigan.gov/mioshastandards. MIOSHA standards are available for a fee by writing to: Michigan Department of Labor and Economic Growth, MIOSHA Standards Section, P.O. Box 30643, Lansing, Michigan 48909-8143 or calling (517) 322-1845.

1. National Emergency Number Association (NENA), NENA Master Glossary of 9-1-1 Terminology, NENA-01-002, March 1998. http://www.nena.org/media/files/MasterGlossary11_29_05.pdf

2. Web MD. A-Z Health Guide from WebMD: Medical Tests - Blood Alcohol. Internet Address: http://www.webmd.com/hw/lab_tests/hw3564.asp

3. Be Responsible About Drinking (B.R.A.D.) Effects At Specific B.A.C. Levels (related to the Blood Alcohol Concentration (BAC)).
   Internet Address: http://www.brad21.org/effects_at_specific_bac.html

4. MIOSHA Construction Safety Standard Part 13, Mobile Equipment. Internet Address: www.michigan.gov/mioshastandards

5. Towing and Recovery Association of America (TRAA), 2121 Eisenhower Avenue, Suite 200, Alexandria, VA 22314. Telephone: 800-728-0136, Local: 703-684-7713, Fax: 703-684-6720. Internet Address: http://www.towserver.net/

6. Michigan State Police, Michigan Emergency Telephone Committee, Suggested Policies. Internet Address:
   http://www.michigan.gov/msp/0,1607,7-123-1579_34040_34203-22589--,00.html

7. Michigan Department of Community Health, Health Policy, Regulations and Professions, Emergency Medical Services and Trauma Section. Internet Address:
   http://www.michigan.gov/mdch/0,1607,7-132-2946_5093_28508---,00.html

 7/27/06
(Revised 8/21/06)

MIFACE
Investigation Report # 05 MI 024
Evaluation

To improve the quality of the MIFACE program and our investigation reports, we would like to ask you a few questions regarding this report.

Please rate the report using a scale of:

Excellent	**Good**	**Fair**	**Poor**
1	2	3	4

What was your general impression of this MIFACE investigation report?

Excellent	**Good**	**Fair**	**Poor**
1	2	3	4

Was the report…	**Excellent**		**Good**	**Fair** **Poor**
Objective?	1	2	3	4
Clearly written?	1	2	3	4
Useful?	1	2	3	4

Were the recommendations …	**Excellent**		**Good**	**Fair** **Poor**
Clearly written?	1	2	3	4
Practical?	1	2	3	4
Useful?	1	2	3	4

How will you use this report? (Check all that apply)

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Thank You!

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