

LARGE MOBILE SHAKERS

NHERI@UTexas



NHERI@UTexas

Safety Plan

Version 2.3

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Form UTNHERI.AA2016: Accident Analysis Worksheet

Form UTNHERI.AI2016: Accident Investigation Report

Form UTNHERI.TM2020: Tailgate Meeting Form

Form UTNHERI.VD2016: Vehicle Inspection Checklist (Daily)

Form UTNHERI.VT2016: Vehicle Inspection Checklist (Pre-Trip)

1. ADMINISTRATIVE

This safety handbook was developed for the training of personnel involved in facility and field work of the Natural Hazards Engineering Research Infrastructure (NHERI) Equipment Facility at the University of Texas at Austin (NHERI@UTexas).

1.1 MANAGEMENT STATEMENT OF SAFETY POLICY

As one of the Equipment Facilities comprising the Natural Hazards Engineering Research Infrastructure (NHERI), NHERI@UTexas offers research capabilities unique among its peers. Our primary research methodology incorporates the use of large-scale mobile seismic sources, or shaker trucks, in the field at research sites across the country. Transportation, operation and maintenance of this industrial equipment in a research setting present numerous challenges.

A typical NHERI@UTexas project is the culmination of intensive preparation over the course of months or sometimes years. Funding, organization, scheduling and myriad logistical issues can define a strictly limited window of opportunity for successful completion of the project. On-site testing can involve long hours in stressful conditions for personnel and equipment. Inclement weather, mechanical failure and a host of other unforeseeable obstacles require strict standards of perseverance and professional conduct to overcome. Project operations are public and often highly visible; as a publicly-funded research organization, we must present a considered, accessible and professional image to the communities we visit.

The many challenging conditions and unique cases presented by NHERI@UTexas research must be managed in a safe and effective manner if we are able to fulfill NHERI research goals. Any incident involving equipment damage, property damage or personnel injury or loss of life can prevent project completion; affect community goodwill; interfere with our ability to conduct research as an organization; and damage the image and reputations of the researchers, personnel and institutions involved. The fundamental operating principle for an organization capable of fulfilling our difficult mission is an uncompromising commitment to safety.

The policies and procedures detailed in this document represent not only applicable federal and local legal requirements for workplace safety, but also the collective experience and understanding of our diligent team of professionals as relating to the maintenance of a safe and effective research environment. Personnel and other participants in NHERI@UTexas operations are expected to maintain familiarity with this material, to abide by its specific policies, and to apply our central doctrine of safety to every field of work-related activity, at all times.

NHERI@UTexas MANAGEMENT TEAM

1.2 TERMINOLOGY

EQUIPMENT FACILITY (EF): The NHERI@UTexas conceptual entity, and the offices and permanent facilities of NHERI@UTexas. These include but may not be limited to offices in the Cockrell School of Engineering building at the University of Texas at Austin main campus, and the Building 46 storage and maintenance facility at the University of Texas J.J. Pickle Research Campus (PRC).

PERSONNEL: Employees, management, principal investigators, and other parties associated with NHERI@UTexas on a permanent basis.

GROUP: General combination term for the NHERI@UTexas site and personnel.

PARTICIPANTS: Anyone participating in a NHERI@UTexas field project or preparations therefor, including NHERI@UTexas personnel; scientists, students and personnel from participating organizations; University of Texas employees; and any other party.

FIELD and/or SITE: NHERI@UTexas research sites. These may be situated on the physical University of Texas campus, or at a remote location off University Property.

1.3 ACCIDENT RECORDKEEPING

All accidents or injuries are to be reported to the Chief Engineer for immediate response and treatment. The Chief Engineer takes the following recordkeeping actions:

1. Immediately informs the Operations Manager via any available means.

Copies of the Accident Report Form are kept on file in Building 46 and in the First Aid kits located in each NHERI@UTexas vehicle, as confirmed during pre-project preparation and periodic safety inspections.

The Group HR Manager must file an Employer's First Report of Injury (DWC-1 form) through the University of Texas system. The form can be found at the following link:

<https://www.utsystem.edu/documents/docs/forms/dwc-1-employers-first-notice-injury-form>

Accident documentation should be kept on file for the duration of the NHERI site's existence to aid in site safety reviews and the identification of accident trends.

2. Completes and submits an Accident Report Form [Form UTNHERI.AR2016] to both the Operations Manager and Group HR Manager via email or fax as soon as possible within 24 hours along with any available related documentation detailing treatment, hospital admission, property damage, etc.

1.4 ACCIDENT INVESTIGATION AND ANALYSIS

In the event any incident occurs relating to NHERI@UTexas operations involving property or equipment damage; or injury, loss of life, or other medical emergency, the Chief engineer and Chief Scientist will conduct an immediate field review of operating conditions and safety procedures and will effect any necessary changes to prevent recurrence of the incident and limit secondary effects, in consultation with the Operations Manager if possible. Details of the review must be documented in an Accident Causal Analysis Worksheet [Form UTNHERI.AA2016] (kept on file in Building 46 and provided in every field project documentation packet) and in written reports. This documentation is to be forwarded to the Operations Manager as soon as possible for review and archiving.

Subsequently, the Operations Manager will perform an accident investigation documented in an Accident Investigation Report Form [UTNHERI.AI2016] to make a final determination of causal factors pertaining to the accident and corrective action to be taken.

The Operations Manager will then conduct a site-wide procedural review for the purpose of updating operating practices and safety policy to reflect knowledge gained in the incident and to limit or eliminate future likelihood of occurrence. The Operations Manager will immediately promulgate these updates to all NHERI@UTexas personnel in the form of email bulletins and a revised safety manual, and undertake safety retraining sessions for each NHERI@UTexas participant at the earliest available opportunity.

The Operations Manager conducts a review of documented accident incidents at the end of each fiscal year to identify historical accident trends and modify safety procedures and personnel training as appropriate.

Documentation from the investigation, review and update procedures is retained on file by the Operations Manager for the duration of the NHERI Equipment Facility's existence.

1.5 EMERGENCY PLAN

The University of Texas Office of Campus Safety has developed extensive emergency preparedness planning for a variety of scenarios, available at the following link:

<https://preparedness.utexas.edu/emergency-plans>

The UT Emergency Operations Plan (EOP) addresses the following topics:

- **Hazard Assessment and Mitigation**
- **Emergency Alert Notification**
- **Building Emergencies**
- **Evacuation, Shelter-In-Place, and Lockdown**
- **Severe Weather Emergencies**
- **Infectious Disease Control**

The EOP represents official NHERI@UTexas policy concerning disaster planning, emergency preparedness and response. All NHERI@UTexas personnel are required to review and familiarize themselves with this material, and to defer to University guidance in an emergency.

1.5.1 ECJ Emergency Evacuation Plan

The Main Campus NHERI@UTexas facilities are located in the Cockrell School of Engineering (ECJ) building, within Evacuation Zone 2. Campus evacuation routes are listed in the Emergency Operations Plan. The ECJ building evacuation plan is not publicly available for security reasons. New employees are given a personal orientation detailing ECJ safety and evacuation procedures. Contact your supervisor for more information.

1.5.2 PRC Building 46 Emergency Evacuation Plan

NHERI@UTexas occupies the south half of PRC Building 46 as an equipment storage area. The main entrance is located on the southeast corner of Building 46. The main entrance (walk through door) is also the Emergency Exit for the south half of Building 46. In case of fire or other type of emergency all personnel in the south half of Building 46 should exit the building through the emergency exit door and meet across Neils Thompson Drive on the east side of the building.

To evacuate by foot or vehicle from the Pickle Research Campus (PRC) at Building 46 during weekday working hours, use the following preferred South route:

1. South on Neils Thompson Drive
2. Exit PRC through the South gate
(NOTE: gate locked during evenings and weekends)
3. To leave the office park area, turn left on Longhorn Blvd. toward Burnet Road.

To evacuate to the North, use the following route (24 hour access):

1. North on Neils Thompson Drive
2. East on Read Granberry Trail (Right turn)
3. North on Road "A" (Left turn)
4. Exit PRC onto Braker Lane.

To evacuate to the East during weekday working hours, use the following route:

1. South on Neils Thompson Drive
2. East on Road "D" (Left turn)
3. North on Harry Ransom Trail (Left turn)
4. East on Read Granberry Trail (Right turn)
5. Exit PRC onto Burnet Road.

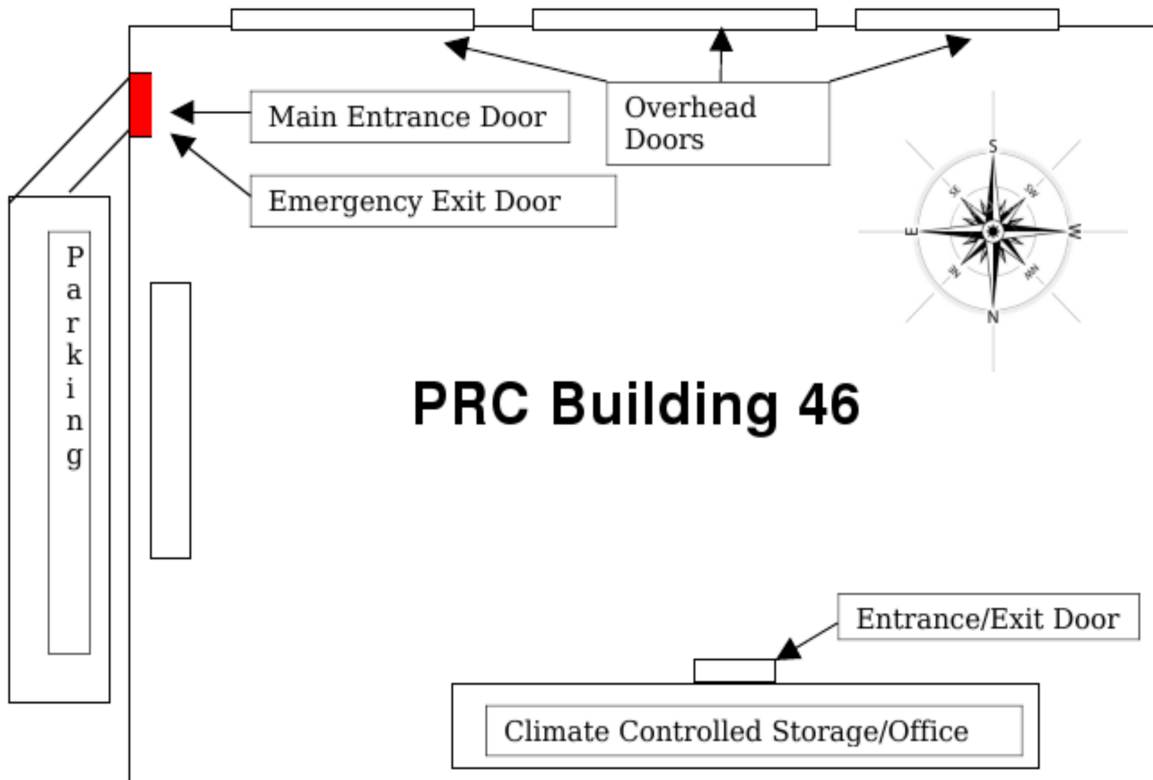


FIGURE 1: BUILDING 46 EMERGENCY EXIT FLOORPLAN

1.6 EMPLOYEE PARTICIPATION

All NHERI@UTexas personnel are required to read this safety manual, and review the safety standards and publications cited herein as a condition of employment. All personnel are involved in safety policy creation via regular employee meetings and the feedback process of daily operations.

1.7 JOB HAZARD ANALYSIS

A hazard is the potential for harm. In practical terms, a hazard often is associated with a condition or activity that, if left uncontrolled, can result in an injury or illness. Identifying hazards and eliminating or controlling them as early as possible will help prevent injuries and illnesses. Job hazard analysis is a technique that focuses on job tasks as a way to identify hazards before they occur. It focuses on the relationship between the worker, the task, the tools, and the work environment. Ideally, after you identify uncontrolled hazards, you will take steps to eliminate or reduce them to an acceptable risk level.

The Occupational Health & Safety Administration (OSHA) publication 3071 addresses job hazard analysis for employees, supervisors and management. A copy of this document can be found at <http://www.osha.gov/Publications/osh3071.pdf>.

The NHERI@UTexas management team has performed a Job Hazard Analysis identifying common field and shop tasks, attendant safety hazards, and appropriate action to mitigate such hazards; the results inform practices and procedures throughout this safety manual. A list of specific hazards is provided below for personnel familiarity. The hazards detailed must be communicated to all persons participating in the following tasks.

Job Task	Task Hazards	Preventative Actions
Moving instrumentation trailer onto test area	<ul style="list-style-type: none">• Trip hazards• Uneven ground• Exhaust fumes from generator	Assess area and choose level area upwind from other equipment if possible to park trailer.
Off-loading equipment at test area	<ul style="list-style-type: none">• Heavy objects• Pinch points• Trip and fall hazards	Use lifting belts and avoid lifting heavy objects. Use dollies when possible. Do not place boxes or objects where someone can trip over them.
Moving shaker truck into position for testing	Contact damage and overhead lines	Survey area first, then minimize backing and have backup and overhead supervision when moving shaker truck.
Noise assessment	Excessive noise in area where other workers may be present	Position shaker truck to direct most noise away from other workers.

Laying out line cables	Trip hazards, damage to cables	Position cables where there is the least amount of foot and vehicle traffic to minimize trip hazards and damage to cables.
Conduct testing	Unauthorized persons entering area where shaker truck is operating	Zone off area where shaker truck is operating with cones or warning tape.
Monitoring equipment while testing	Potential leaks or overheating of equipment causing bodily harm to a person or damage to the environment	Constantly monitor shaker truck and equipment for leaking hoses or excessive heat on or under equipment.
Completion of testing and leaving area	Injury to personnel or damage to equipment or environment	Be aware of trip hazards when picking up and loading equipment and have supervision when moving vehicles; remove all litter

1.8 OSHA ACTION PLAN

As an educational organization, NHERI@UTexas is not subject to OSHA workplace regulations. However, familiarity with OSHA regulations and material is strongly recommended for promotion of workplace safety. In the interests of maximal project efficiency and a safe working environment, NHERI@UTexas facilities are maintained in a state of readiness which is suitable for OSHA inspection.

1.9 REMEDIAL ACTION

When safety issues are raised, the Operations Manager or Chief Engineer perform a root analysis of each issue addressing the following points:

1. Consider potential severity of loss.
2. Evaluate the probability of a loss occurrence.
3. Weight various control alternatives and decide on the best one.
4. Assess the likely degree of control to be achieved.
5. Determine the cost of control.
6. Justify the recommended control if major expenditures are involved.

These points inform appropriate safety policy revisions which are immediately disseminated to all personnel via email or in-person tailgate meetings. Follow-up actions are then scheduled as follows:

1. Issue work orders for immediate correction of the safety issue if this can be done without major expenditure.
2. Monitor the budgeting of resources via purchasing and provisioning feedback.
3. Ensure that remedial action is taken in a timely fashion by adjusting workload prioritization.
4. Monitor activity progress via in-person, phone or email requests for feedback.
5. Check the effectiveness of implemented controls. Are people better protected now than they were before?
6. Give ample credit where credit is due. Safety is a prime concern for all personnel; individual recognition promotes awareness of this principle.

Immediate feedback is expected from actions taken to effect the revised policy, and a follow-up review scheduled within the same work week to gauge policy effectiveness and to formulate and prioritize any further required corrective action.

1.10 SAFETY RULES AND ENFORCEMENT

Specific safety rules and procedures have been developed for each of the three NHERI@UTexas shaker trucks. For this material, personnel should review **Section 2.3: SPECIAL HAZARDS OF NHERI@UTexas EQUIPMENT**.

All NHERI@UTexas personnel monitor each others' actions as relevant to this document and professional standards of safe conduct. Unsafe conditions or behavior **must** be immediately reported to the Chief Engineer or Operations Manager. Any willful violation of NHERI@UTexas safety rules or refusal to follow the directions of NHERI@UTexas management personnel will result in an immediate suspension of the right to work within the facility. Disciplinary action is taken according to University of Texas at Austin standards for safe employee conduct and prescription of punitive measures for violation of said standards.

1.11 SAFETY SELF-AUDITS

NHERI@UTexas is a small organization and operates on a lateral management structure keyed on collaborative work and peer review. The Operations Manager, Chief Engineer and all other personnel are typically in contact on a daily basis. The topic of safety is explicitly maintained in daily operational discussion. Information relating to safety is quickly passed throughout the organization and to Operations Management, and, conversely, safety policy and management judgment calls are quickly disseminated from the top down to all employees.

1.12 SAFETY SELF-INSPECTIONS

Each employee is responsible for conducting a safety inspection of their associated facilities, work and office areas on at least a monthly basis and on a frequent basis at appropriate intervals during project preparation, execution and debriefing. Issues noted during these inspections are corrected with a briefing of the corrective action made to the Operations Manager for integration into global safety policy.

All new employees will be informed by the Chief Engineer on proper safety practices and daily vehicle and equipment usage checklists.

At the start of any field project, the Chief Scientist and/or Chief Engineer will conduct a field safety meeting with all personnel involved in field work. The meeting must cover the following topics:

1. **PPE and Safety Equipment locations**
2. **Evacuation route and post-evacuation meeting location** for use in the event of fire, explosion, fuel or other chemical leak, catastrophic equipment failure, inclement weather conditions, or other emergency
3. **Emergency information** including local Fire, Police, and EMS telephone numbers, and the location of the nearest hospital or first aid station
4. **Hazards present**, including environmental, equipment, and work hazards
5. **Other hazards** or safety topics not covered above, to be noted

After completion of the field safety meeting, personnel shall acknowledge that they were present for the briefing and agree to comply with all safety procedures. A Tailgate Safety Meeting Form [UTNHERI.TM2020] will be signed by all personnel in attendance and a copy maintained by the Chief Scientist and/or Chief Engineer for the duration of project operations.

During field operations the Chief Scientist and/or Chief Engineer will conduct a daily "tailgate meeting" safety briefing with all personnel involved in field work. New safety precautions and recommendations will be addressed at this time; all personnel should provide feedback, recommendations and address any concerns or questions they may have. A Tailgate Safety Meeting Form [UTNHERI.TM2020] will be signed by all personnel in attendance and a copy maintained by the Chief Scientist and/or Chief Engineer for the duration of project operations.

New arrivals to the site must be briefed by the Chief Scientist and/or Chief Engineer on the topics of the project start and daily tailgate meetings, and must sign that day's Tailgate Safety Meeting Form.

Subsequent to any error in judgment, accident, equipment failure, or other unforeseen event recognized as likely to impact the shop or field test schedule, logistics, or site safety, the Chief Scientist and/or Chief Engineer will call an immediate cessation of work and hold a tailgate meeting with all personnel present to determine the corrective action required, and to modify the testing schedule accordingly. A safe and deliberate workflow must always take precedence over schedule concerns.

All personnel are responsible for facility and site safety. If you see something that does not look safe, inform the Chief Scientist and/or Chief Engineer on duty immediately. Never make assumptions regarding safety; other people may not be aware that something is wrong or that they are being unsafe. It is everyone's responsibility to make safety a priority and to ensure that all safety practices are being adhered to.

1.12.1 Vehicle Self-Inspections

Prior to operating any UT vehicle, a daily inspection shall be conducted according to the following criteria:

1. Mileage log with credit card, insurance paperwork and Accident Report Form [UTNHERI.AR2016] present
2. Fuel level sufficient for day's activity
3. Visual inspection of tire condition and pressure
4. Headlight and taillight test
5. Trailer light test (if present)
6. Trailer air line inspection (if present and applicable)
7. Isolation bag visual inspection and pressure check (if applicable)
8. Oil reservoir check (if applicable)

Any problems observed in the vehicle inspection will be entered into the vehicle's logbook. The operator of the vehicle is responsible for communicating the problem to the Chief Engineer or Operations Manager and either taking appropriate corrective action to return the vehicle to a safe operating condition, or halting use of the vehicle until sufficient corrective action has been taken. A checklist for the above criteria is available in form UTNHERI.VD2016.

Prior to the start of any long-distance trip of greater than 50 miles, a pre-trip inspection shall be conducted according to the following criteria. Failure to pass the pre-trip inspection is handled as with the daily vehicle inspection.

1. Mileage log with credit card, insurance paperwork and Accident Report Form [UTNHERI.AR2016] present
2. Fire extinguisher present and charged

3. Jack and spare tire present and in working condition
4. Fuel level sufficient for day's activity
5. Oil level good
6. Coolant level good
7. Power steering fluid level good
8. Belts and hoses in good condition
9. Visual inspection of tire condition, tire pressure test
10. Headlight, taillight, turn indicator and license plate light test
11. Windshield wipers in good condition
12. Horn functional
13. Trailer light test (if present)
14. Trailer air line inspection (if present and applicable)
15. Isolation bag visual inspection and pressure check (if applicable)
16. Hydraulic oil reservoir check (if applicable)

A checklist for the above criteria is available in form UTNHERI.VT2016.

All NHERI@UTexas road vehicles receive preventative maintenance and a safety inspection performed by the University of Texas Parking and Transportation Services Fleet Management Automotive Shop at regularly scheduled three-month intervals.

1.13 SAFETY STAFFING

Safety staffing roles are defined in section **2.2.2: RESPONSIBILITY IN THE FIELD**. The Operations Manager is the ultimate authority on matters of field and facility safety.

2. FIELD AND WORK SAFETY

2.1 GENERAL VEHICLE SAFETY

The University of Texas has in place guidelines for general vehicle safety and driver certification. NHERI@UTexas vehicles, the instrumentation van, T-Rex, Liquidator, Raptor, Rattler, Thumper, Freightliner, and any rental vehicles are covered by these guidelines, consisting of the UT System Policy UTS157 (Automobile Insurance Coverage for Officers and Employees and General Requirements for the Use of Vehicles) and the UT Austin Vehicle Fleet Management Plan. The full documents can be found at the following links:

UTS157: <https://www.utsystem.edu/sites/policy-library/policies/uts-157-automobile-insurance-coverage-officers-and-employees-and-general-requirements-use-of-vehicles>

UT Fleet Management Plan: <https://parking.utexas.edu/fleet/forms>

Under these guidelines, NHERI vehicles must be operated exclusively by UT employees.

2.1.1 Cellphone Use In University Vehicles

NHERI@UTexas and The University of Texas at Austin strongly discourage cellphone use by UT drivers at all times while operating University vehicles or otherwise driving for University business. Additionally, the following federal, state, and city laws govern cellphone use while driving:

- The U.S. Department of Transportation has issued a final rule making it a violation of federal law for commercial truck drivers to talk on a hand-held cellphone while their vehicle is in motion or temporarily stationary. Text messaging is prohibited as well. A commercial truck is defined as a vehicle or combination of vehicles over 26,000 lbs GVWR; this applies to the NHERI big-rig, Raptor, and Rattler. Hands-free mobile phones remain legal.
- The State of Texas prohibits cellphone use, including text messaging, by drivers operating a motor vehicle.
- The City of Austin prohibits the use of all electronic hand-held devices while operating a vehicle.

The above summary should not be considered comprehensive; NHERI@UTexas drivers are expected to maintain familiarity and compliance with current laws and regulations governing cellphone use in UT vehicles.

2.1.2 Passenger Safety

Each occupant of a University or other field project vehicle in motion must have a designated seating position with an available seatbelt.

State regulations prohibit passengers from riding in a towed trailer in the following states:

Alabama, Alaska, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Hawaii, Idaho, Illinois, Kentucky, Louisiana, Maine, Massachusetts, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wyoming.

Project personnel should never ride in a trailer under tow. Sensitive equipment should be secured by fastening or blocking before a vehicle is put in motion.

2.1.3 Parking In University Vehicles

Operators of University vehicles must shift the vehicle into Parking gear (or Parking/Neutral with air brake engaged, if so equipped) while not actively driving; before powering down, exiting, or permitting others to enter or exit the vehicle; or before devoting attention to any task unrelated to driving.

2.2 GENERAL FIELD AND WORK SAFETY

To maintain a safe environment in field conditions, the following elements will be in place:

2.2.1 Safety Preparation Before Field Tests

The Principal Investigator of the user team must perform a survey of the proposed test site to identify all potential hazards of the site and the potential hazards that may be caused by the shaker before field tests, and provide the NHERI@UTexas Project Management Team (PMT) with a description of planned experiments one month before testing commences. The NHERI@UTexas PMT will review the planned experiments to assess hazards that may compromise the safety of NHERI@UTexas personnel and equipment, and may give suggestions accordingly. However, the responsibility for the design of the experiment with regards to safety of the test site and structures in and near by the test site rests on the user, and the Principal Investigator of the user team is responsible for obtaining permits for site access and site liability insurance.

2.2.2 Responsibility In The Field

Each individual participating in the field work is responsible for their own safety and the safety of the people who work around them. Do not do or ask anyone else to do anything that is not safe.

In addition, each field experiment will have two leaders, a Chief Engineer, and a Chief Scientist. The Chief Engineer will be a member of the NHERI@UTexas team, and will be an authority on the operation of all NHERI@UTexas vehicles and equipment. The Chief Scientist is one of the users, who may be the project Principal Investigator of the user team or a person whom is authorized by the project Principal Investigator of the user team to make decisions on site concerning the experiments to be performed.

It is the Chief Scientist's responsibility in the field to ensure the safety of the test site, and response to disaster according to the site specific disaster kit prepared by the Principal Investigator of the user team. The Chief Scientist should participated in the site survey with the Principal Investigator, and be able to identify all potential hazards of the site and those which may be caused by the shaker at any selected shake points. Selected shake

points should avoid and/or be kept a safe distance from structures both above and below ground. The T-Rex, Liquidator, Raptor, and Rattler shakers will normally be used only in open areas. If these shakers are being operated within 100 ft of any structures, the users should perform a pre-vibration survey and monitor the ground near the structures to ensure the vibrations close to the structures are kept below 0.1 in./sec. If vibration-sensitive structures (especially inhabited buildings) are within 50 ft of the shake point, users must consult the owner for permission to shake and are strongly encouraged to perform pre-construction and post-construction photo surveys of these structures. In addition, the ground next the structure should be monitored to be sure that the peak particle velocities do not exceed 0.1 in./sec.

As a frame of reference, the ground motions measured at the Pickle Research Center of UT with T-Rex shaking at 100% driving signal (full vertical force) are shown in Figure 2. In this case, T-Rex was excited at steady-state shaking using a downward, stepped-sine function. As seen in Figure 2, the particle velocities at 100 ft away from T-Rex were well below 0.1 in./sec. at all frequencies. Even at a distance of 30 ft, the peak particle velocities were less than 0.1 in./sec. at frequencies below about 35 Hz.

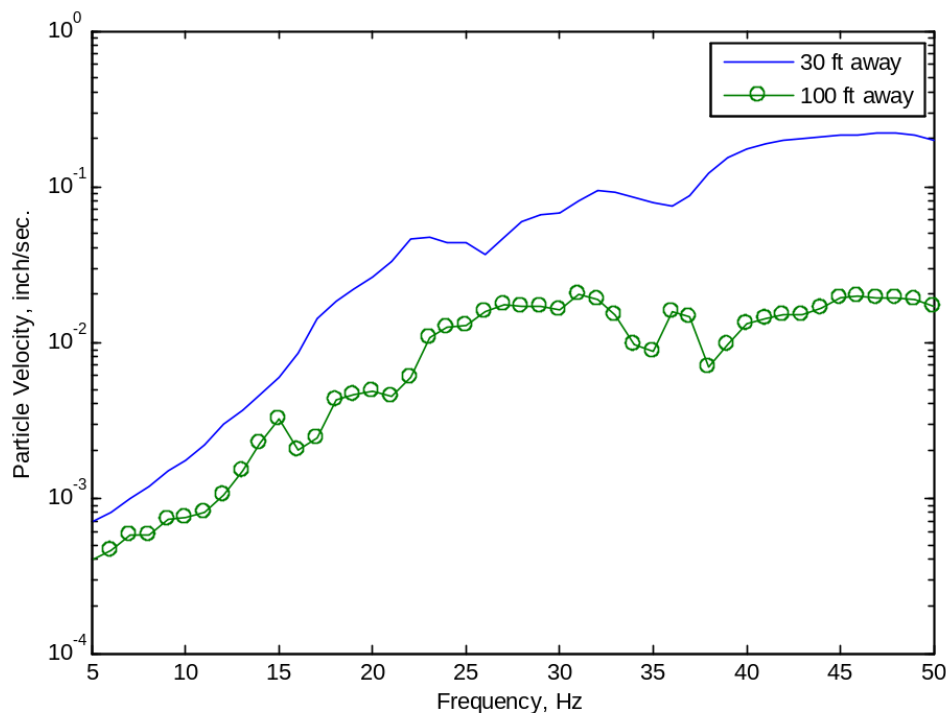


FIGURE 2 – Vertical particle velocity measured at 30 ft and 100 ft away from T-Rex with 100% driving signal; Measurements performed at steady-state vibration (using stepped sine function provided by the Data Physics Analyzer)

The Chief Scientist should also ensure a way of communication (e.g. cellular phone or satellite phone) in the field for emergency contact at all time. The Chief Engineer will maintain an on-site list of emergency contacts for participating NHERI@UTexas personnel.

The Chief Engineer is responsible for the safety of all NHERI@UTexas personnel and equipment, and has final authority concerning operation of any NHERI@UTexas equipment.

2.2.3 General Field Hazards Statement

Every NHERI@UTexas member participated in a field experiment is required to read and acknowledge a statement describing general field hazards, and provide emergency contact information to the Chief Engineer. A sample version of this is in Appendix A. Similar forms are suggested for the non NHERI@UTexas personnel and are to be collected by the Chief Scientist.

2.2.4 Medical Insurance

Every NHERI@UTexas member in a field experiment is required to obtain, at their own expense, suitable medical insurance. Similar requirements are suggested for non-UT personnel.

2.3 SPECIAL HAZARDS OF NHERI@UTexas EQUIPMENT

The hydraulic vibrators of NHERI@UTexas operate with pressures up to 4,000psi, and can output a ground force as high as 60,000 lbs, requiring special consideration for safety. Because the NHERI@UTexas vibrators are similar or identical to those used in the petroleum industry, there is a well established set of safety procedures based upon over 40 years of industry experience. "General Safety Information and Procedures", provided by the manufacturer, Industrial Vehicles International Inc., is shown in Appendix B. All UT personnel who will operate NHERI@UTexas shakers are required to read and follow the procedures shown in Appendix B. It is the responsibility of the Chief Engineer to ensure that all procedures in Appendix B are followed in the field.

The Chief Scientist and all other participants who are not members of the NHERI@UTexas group and will work within a 100 ft radius of operating shaker trucks in a field experiment must attend an on-site safety training session prior to the start of the field experiment. The on-site safety training session will be conducted by the Chief Engineer to address safety issues related to the NHERI@UTexas hydraulic shakers. Topics covered in the on-site safety training session are shown in Appendix C. All trainees are required to read and sign the On-Site Shaker Safety Training statement before field work can be started. The Chief Engineer must keep the copy of the signed statements from all trainees for the duration of project operations, and the Chief Scientist is responsible for ensuring that anyone who works within a 100ft radius of the shaker has been trained.

2.3.1 Safety Rules For Working Around T-Rex

T-Rex is a large Tri-Axial articulated mobile shaker vehicle. Extra caution should be taken when working around T-Rex as there are several features that are unique to T-Rex and need to be pointed out.

- It is very important to be aware that when the engine on T-Rex is at idle speed there is 3,000 PSI of hydraulic pressure in the high side of the hydraulic system. In most cases on other shaker units there is only 250 PSI of hydraulic pressure on low side of the hydraulic system and near zero on the high side when the engine is idling until the engine is brought up to operating speed and the system is pressured up.
- T-Rex has two mass position sensors mounted on the baseplate that control the position of the shearwave actuators. One sensor is mounted on the front of the baseplate for the longitudinal position and the other sensor is mounted on the passenger side to control the transverse position of the actuator. These sensors transmit sound waves out to a flat surface on the actuator to control the position of the actuator in the shearwave mode. Any interference of these sound waves will cause a violent reaction of the actuator potentially causing bodily injury or damage to the unit.
- The hydraulic CPT ram at the rear of T-Rex poses severe pinching and crushing hazards at both the top and bottom of the ram, rod adapter, and rod assembly. Always keep both hands in sight when operating the ram. Keep hands free of the top of the rod adapter when the ram is ascending, and the bottom of the adapter and/or rod assembly when the ram is descending. Do not place hands inside the marked area under the ram cylinder base. The ram cylinder base presents an overhead obstacle; hardhats must be worn when manipulating the CPT assembly.

NEVER attempt to operate T-Rex unless you have proper training by an approved instructor.

ALWAYS use eye and hearing protection within 30 feet of T-Rex. Hearing protection is not required inside of the cab if the windows and doors are completely closed. The highest measured noise levels in the cab are below 70 dB when the windows and doors are closed and the engine is at operating speed.

NEVER work on T-Rex when the engine is running. Turn off electronics, shutdown engine and turn off battery switches before working on T-Rex. Check high and low hydraulic pressure gauges to be sure there is no hydraulic pressure on the system before repairs or adjustments.

ALWAYS use grab handles and steps when climbing into the cab or climbing onto the back of T-Rex around the engine area. **NEVER** jump off of T-Rex. Jumping even short distances can cause severe bodily injury. **USE** the grab handles and steps to get off of or out of the cab of T-Rex.

ALWAYS approach T-Rex from the front of the vehicle to get the operator's attention. See Figure 3 for safe approach area.

NEVER assume the operator is aware of your presence around T-Rex. Exchange some type of hand signals to be sure that the operator acknowledges your presence around T-Rex.

ALWAYS keep away from the driver's side of T-Rex. This is the side that most of the high pressure components are located.

ALWAYS keep away from the articulated area of T-Rex and pinch point areas of the baseplate and lift assembly.

ALWAYS keep away from the exhaust area to prevent burns and be aware that hoses and piping can be hotspots due to the temperature of the oil in the hydraulic system.

NEVER allow dry material such as leaves or brush to accumulate on T-Rex to prevent the possibility of fire on the vehicle.

2.3.2 Safety Rules For Working Around Liquidator

Liquidator is a large low frequency mobile shaker vehicle. Extra caution should be taken when working around Liquidator.

NEVER attempt to operate Liquidator unless you have proper training by an approved instructor.

ALWAYS use eye and hearing protection within 30 feet of Liquidator.

NEVER work on Liquidator when the engine is running. Turn off electronics, shut down engine and turn off battery switches before working on Liquidator. Check high and low hydraulic pressure gauges to be sure there is no hydraulic pressure on the system before repairs or adjustments.

ALWAYS use grab handles and steps when climbing into the cab or climbing onto the back of Liquidator around the engine area. **NEVER jump off of Liquidator.** Jumping even short distances can cause severe bodily injury. **USE** the grab handles and steps to get off of or out of the cab of Liquidator. Be aware of uneven ground or large rocks when getting down from Liquidator.

ALWAYS approach Liquidator from the front of the vehicle to get the operator's attention. See Figure 3 for safe approach area.

NEVER assume the operator is aware of your presence around Liquidator. Exchange some type of hand signals to be sure that the operator acknowledges your presence around Liquidator.

ALWAYS keep away from the driver's side of Liquidator. This is the side that most of the high pressure components are located.

ALWAYS keep away from the articulated area of Liquidator and pinch point areas of the baseplate and lift assembly.

ALWAYS keep away from the exhaust area to prevent burns and be aware that hoses and piping can be hotspots due to the temperature of the oil in the hydraulic system.

NEVER allow dry material such as leaves or brush to accumulate on Liquidator to prevent the possibility of fire on the vehicle.

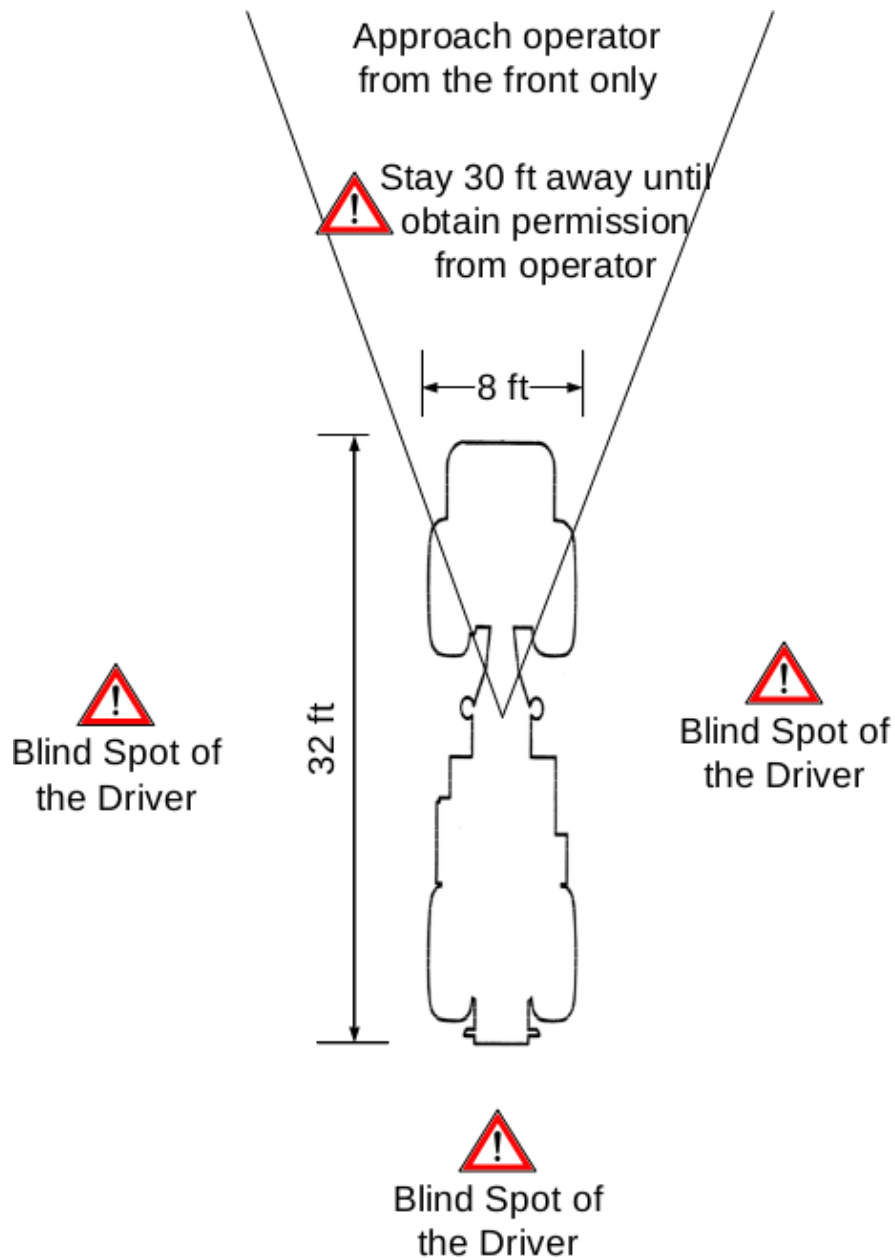


FIGURE 3: T-REX AND LIQUIDATOR SAFE APPROACH AREA

2.3.3 Safety Rules For Working Around Raptor And Rattler

Raptor and Rattler are large low frequency mobile shaker vehicles. Extra caution should be taken when working around these vehicles.

NEVER attempt to operate Raptor or Rattler unless you have proper training by an approved instructor.

ALWAYS use eye and hearing protection within 30 feet of Raptor or Rattler.

NEVER work on Raptor or Rattler when the engine is running. Turn off electronics, shut down the engines and disconnect battery power before performing work. Check high and low hydraulic pressure gauges to be sure there is no hydraulic pressure on the system before repairs or adjustments.

ALWAYS use grab handles and steps when climbing into the cab or climbing onto the back of Raptor or Rattler around the engine area. **NEVER** jump off of the shakers. Jumping even short distances can cause severe bodily injury. **USE** the grab handles and steps to get off of or out of the cab or maintenance deck. Be aware of uneven ground or large rocks when getting down from the shakers.

ALWAYS approach Raptor or Rattler from the front of the vehicle to get the operator's attention. See Figure 3 for safe approach area. (Figure drawn for T-Rex and Liquidator, but also applicable to Raptor and Rattler.)

NEVER assume the operator is aware of your presence around the shaker. Exchange some type of hand signals to be sure that the operator acknowledges your presence before performing work around the shaker.

ALWAYS keep away from the sides of Raptor and Rattler while in operation. In the event of equipment malfunction, hot oil or debris may be thrown from the center area of the truck.

ALWAYS keep away from the pinch point areas of the baseplate and lift assembly.

ALWAYS keep away from the exhaust area to prevent burns and be aware that hoses and piping can be hotspots due to the temperature of the oil in the hydraulic system.

NEVER allow dry material such as leaves or brush to accumulate on Liquidator to prevent the possibility of fire on the vehicle.

2.3.4 Safety Rules For Working Around Thumper

Thumper is small shaker mounted on the back of an International DuraStar 4000 truck. Although Thumper is smaller than our other shakers, extra caution should be taken when working around Thumper because Thumper's operating pressure is 4,000 PSI. **NEVER** allow anyone within 30 feet of the rear of Thumper while it is operating.

NEVER attempt to operate Thumper unless you have proper training by an approved instructor.

ALWAYS use eye and hearing protection within 30 feet of Thumper.

NEVER work on Thumper when the engine is running. Turn off electronics and shut down engine before working on Thumper. Check high and low hydraulic pressure gauges to be sure there is no hydraulic pressure on the system before repairs or adjustments.

ALWAYS use grab handles and steps when climbing into the cab or climbing onto the back of Thumper around the engine area. **NEVER** jump off of Thumper. Jumping even short distances can cause severe bodily injury. **USE** the grab handles and steps to get off of or out of the cab of Thumper. Be aware of uneven ground or large rocks when getting down from Thumper.

ALWAYS approach Thumper from the front of the vehicle to get the operator's attention. **NEVER** assume the operator is aware of your presence around Thumper. Exchange some type of hand signals to be sure that the operator acknowledges your presence around Thumper.

ALWAYS keep away from the back of Thumper. This is the area where most of the high pressure components are located.

ALWAYS keep away from the pinch point areas of the baseplate and lift assembly.

ALWAYS keep away from the exhaust area to prevent burns and be aware that hoses and piping can be hotspots due to the temperature of the oil in the hydraulic system.

NEVER allow dry material such as leaves or brush to accumulate on Thumper to prevent the possibility of fire on the vehicle. If possible try to avoid working in dry grass or brush areas with Thumper because the exhaust is mounted horizontally under the truck.

2.3.5 Safety Rules For T-Rex, Liquidator, Raptor, And Rattler Demonstrations

1. The audience should maintain a safety distance of at least 30 feet from the center of the shaker while the shaker is operating.
2. The audience should stay away from the high pressure (driver's) side of the shaker.
3. The audience should not stand behind the shaker out of the driver's range of vision.
4. The safe area for audience is shown in Figure 4.

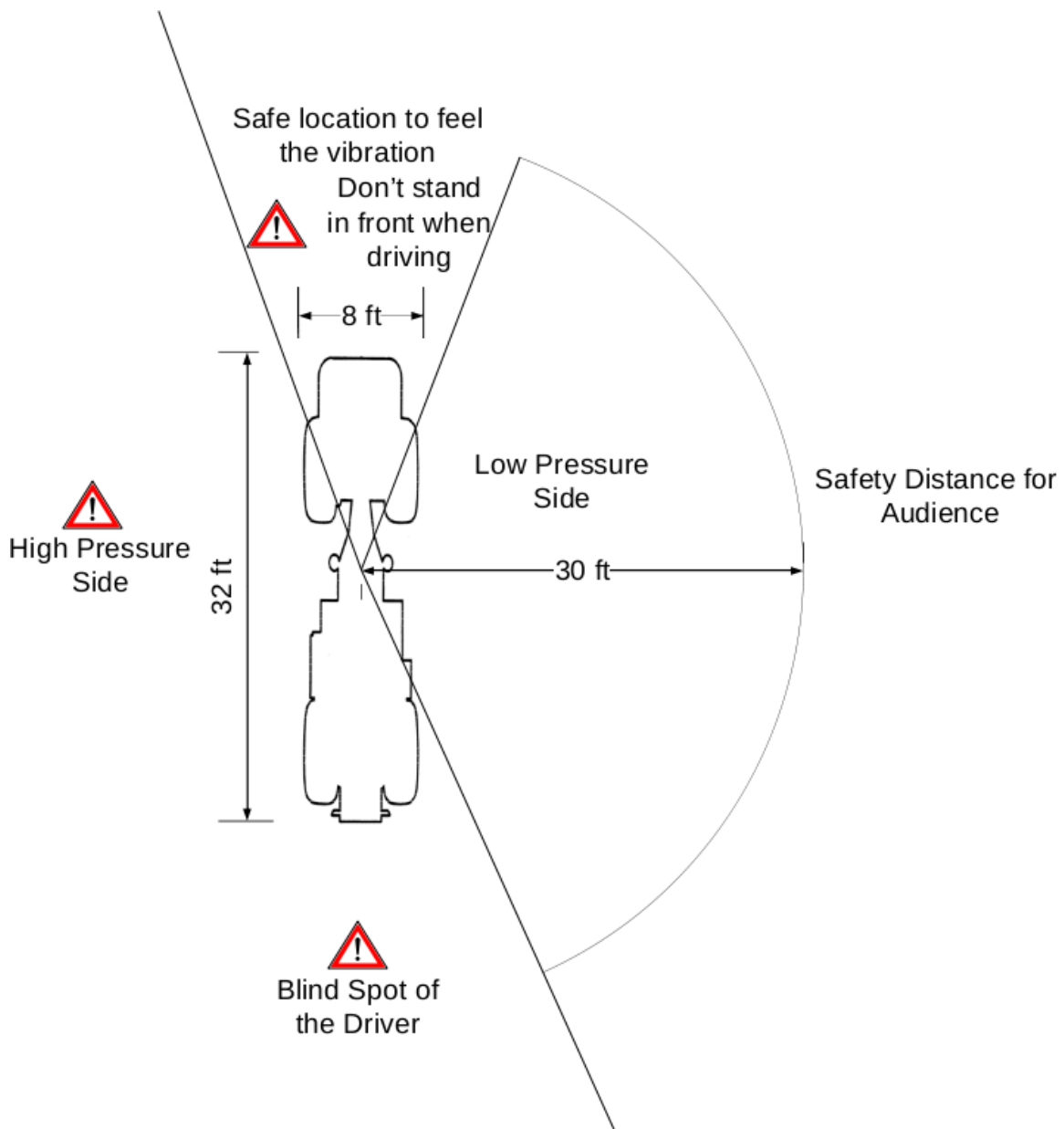


FIGURE 4: T-REX AND LIQUIDATOR AUDIENCE SAFE AREA

3. SPECIFIC SAFETY POLICIES

Service and maintenance of NHERI@UTexas shaker trucks and other vehicles is performed by qualified repair technicians at either the University of Texas Parking and Transportation Services Fleet Management Automotive Shop or third-party commercial vehicle repair depots. The following material represents general NHERI@UTexas safety policy for field work, vehicle transportation and storage.

3.1 BLOOD BORNE PATHOGENS

NHERI@UTexas research and other activities do not normally involve interaction with blood borne pathogens. Unforeseeable personnel injury could potentially result in blood borne pathogen exposure, and these cases should be managed in accordance with the guidelines below.

American Red Cross First Aid training, which includes guidelines for handling spilled blood, is mandatory for all new NHERI@UTexas field employees. First Aid kits which include protective wear are available at prominently marked locations in all NHERI@UTexas facilities and vehicles.

In the event human body fluids require clean up due to an injury, only trained personnel are allowed to clean up spills with approved clean up kits. If no trained personnel are present, secure the area and call the University Environmental Health and Safety department's 24-hour hotline at (512) 471-3511 for instructions.

You are responsible for keeping your immediate work area clean and sanitary. If you become aware of needs beyond general housekeeping, report your concern to your supervisor.

All equipment and working surfaces must be cleaned and decontaminated using sanitizing cleanser after contact with blood or other potentially infectious material.

If you get blood or other potentially infectious materials in your eyes, nose, mouth, or on broken skin:

- Immediately flood the exposed area with water and clean any wound with soap and water or a skin disinfectant if available.
- Report this immediately to your employer.
- Seek immediate medical attention at UT Health Services or the nearest medical care facility.

More information can be found in the UT Austin Bloodborne Pathogens Exposure Control Plan at the following link:

<https://ehs.utexas.edu/documents/ExposureControlPlan.pdf>

3.2 FIRE AND LIFE SAFETY

The University of Texas at Austin Fire Prevention Services offers a variety of resources relating to fire safety and fire emergency management at <http://fireprevention.utexas.edu/safety>. Personnel are directed to familiarize themselves with these resources; they represent official NHERI@UTexas policy as regards to fire safety.

Fire extinguishers are located in prominent marked locations throughout NHERI@UTexas facilities and in the cab or operating compartment of all NHERI@UTexas vehicles. Personnel are trained on proper use as a condition of employment.

3.2.1 Building Fire Safety Procedures

General building fire safety instructions are as follows:

1. **Rescue** yourself first, and then assist others from the fire area if you are able to do so without placing yourself at risk.
2. **Announce** the emergency to everyone in the fire area and inform Fire Prevention Services or other relevant local fire prevention authority.
3. **Contain** the fire and resultant smoke by closing doors and windows leading to the fire area as you leave. This simple action can hold the fire back and keep smoke from entering adjoining areas, allowing time for everyone to escape.

3.2.2 Field Fire Safety Procedures

During all field operations, a safety briefing will be conducted and all personnel will be informed as to where to meet in the event of a fire or natural disaster. Personnel will be informed as to the local emergency numbers to contact for each particular emergency and the location of the nearest medical treatment facility. The Chief Scientist is responsible for collecting and disseminating this information as part of the safety training session referenced in section 2.3, and must verify receipt by all personnel.

In the event of a vehicle or equipment fire, all personnel should evacuate to their designated location and report to the person in charge. Immediately contact local, police, fire and EMS before attempting to extinguish a vehicle fire.

Assess the situation prior to any actions. If a vehicle or piece of equipment is on fire, locate the nearest fire extinguisher and operate according to the extinguisher instructions if it is safe to do so. All NHERI@UTexas personnel are trained in the proper use of fire extinguishers.

If the fire cannot be extinguished, evacuate the area and wait for rescue personnel.

If the fire was successfully extinguished, wait for rescue personnel to check and verify that the fire is out and it is safe to enter the area.

3.3 LOCKOUT/TAGOUT

The purpose of Lockout/Tagout policy is to prevent injuries to employees from the unexpected energizing, start-up, or release of stored energy from machines, equipment, or processes when such employees are engaged in activities where they are at risk from these hazardous sources.

Large mobile equipment platforms such as the NHERI@UTexas shaker trucks can pose significant risk of personnel injury or loss of life when powered up or moved in an improper manner. The following procedures have been developed to prevent inadvertent starting or other activation of NHERI@UTexas equipment in accordance with OSHA 29 CFR 1910.147.

3.3.1 Access Control

The NHERI@UTexas mobile shaker trucks and other vehicles are secured from inadvertent or unauthorized access or ignition with keyed locks. Certain vehicles include self-powered generator or pump equipment which is also secured via ignition key and/or locking access panel. Keysets for each vehicle and its associated equipment are secured in one of three locations:

- 1) A locking key cabinet in the UT Geotechnical Engineering Senior Administrative Associate's office. Access to both the cabinet and the office is controlled by the Associate.
- 2) A locking key cabinet in the locking tool cage in Bldg. 46. Access to both the cabinet and the cage is strictly limited to NHERI@UTexas personnel.
- 3) A mileage logbook binder which accompanies each vehicle into the field. The binder and keyset is secured by the NHERI@UTexas employee responsible for that vehicle.

3.3.2 General Lockout/Tagout

Tagout tags are available on prominent display in the Bldg. 46 office and placed in an accessible location in every vehicle. When such maintenance is required on NHERI@UTexas equipment as would cause danger to personnel or property when the equipment is energized or moved, as determined by the person undertaking said maintenance, the shop supervisor, or NHERI@UTexas personnel, a tagout tag must be filled out by the person undertaking the maintenance and affixed to either:

- A) In the case of a mobile shaker or other vehicle, a visible location on the vehicle's steering wheel.

- B) In the case of a generator, hydraulic pump or other self-powered equipment without a steering mechanism, on the throttle or other primary control for that equipment.
- C) In the case of an electrical device, the power switch, plug, safety interlock or other prominent feature required to energize the device.
- D) In the case of a hydraulic, mechanical or gas pressure system activated by valve or other manual control, the control interface for that system.

This tag must contain at a minimum: the name of the person performing the maintenance, the date the tag was attached, and a note summarizing the maintenance being performed.

3.3.3 Specific Lockout Procedure For T-Rex And Liquidator

NOTIFY AFFECTED EMPLOYEES

Verbally notify all affected employees that the machine or equipment will be shut down and locked/tagged out for servicing or maintenance.

SHUTDOWN THE MACHINE/EQUIPMENT

1. Put machine in neutral, lever located in cab right side of driver seat on floor
NOTE: IF ON HILLY OR SLOPING TERRAIN: power down in gear, and with baseplate down if possible
2. Set parking brake, yellow brake valve located on dash panel, right side
3. Pressure down machine, control valve left side of dash panel
4. Return engine to idle with throttle control located right side of driver seat of floor
5. Return ignition key to the off position, located on right side of dash
6. Switch battery isolation switches to the off position, located right side rear of vehicle

ISOLATE THE MACHINE/EQUIPMENT FROM ALL ENERGY SOURCES

- Ignition key located in cab, right side of dash
- Battery isolation switches located right rear of equipment

APPLY LOCKOUT/TAGOUT DEVICES

A tag must be placed on the steering wheel of the vehicle and a tag must be placed at the battery isolation switches; keys must be tagged and locked in cabinet

DISSIPATE OR RESTRAIN ALL STORED OR RESIDUAL ENERGY

- **ELECTRICAL**

Electrical energy is stored in the batteries at the rear of the machine and isolated by turning the isolation switches to the off position.

- **HYDRAULIC**

Even after the machine is pressured down and the high and low pressure gauges on the dash read zero, there may still be hydraulic energy stored in the system. Cycle the lift switch to release any remaining hydraulic pressure.

Before operating on the hydraulic brake system, pump the brakes to release any stored pressure. Ensure wheels are chocked and that the machine is externally immobilized on level ground.

- **AIR PRESSURE**

Drain air tanks if servicing air system, once dash gauge reads zero and no air can be hear coming from drain valve located on air tank, stored energy has been depleted.

- **ACCUMULATOR (COMPRESSED NITROGEN)**

Dissipate stored accumulator pressure prior to servicing: open release valve on accumulator; once local accumulator gauge reads zero and no sound can be heard coming from release valve, all stored energy has been depleted.

VERIFY/TEST THAT THE MACHINE/EQUIPMENT HAS BEEN ISOLATED

1. Turn the ignition key to the on position. If the machine does not start, then the electrical system has been isolated.
2. Attempt to release the parking brake. If the brake valve pops back out, there is no air in the system.
3. The machine will not operate if there is no hydraulic pressure/accumulator pressure.

PERFORM THE NECESSARY SERVICE, MAINTENANCE AND/OR REPAIR WORK

Following normal safety procedures and with all needed Personal Protective Equipment e.g. safety glasses, chemical resistant gloves, coveralls, steel-toe safety shoes.

REMOVAL/RESTORE FROM LOCKOUT/TAGOUT

1. Clear all nonessential tools/personnel and verify that all machine/equipment components are operationally intact.
2. Verify that the controls are in neutral.
3. Remove lock-out/tag-out devices.
4. Replace all safety guards.
5. Notify affected employees that machine/equipment is ready for use.
6. Re-energize machine/equipment.

3.3.4 Specific Lockout Procedure For Thumper

NOTIFY AFFECTED EMPLOYEES

Verbally notify all affected employees that the machine or equipment will be shut down and locked/tagged out for servicing or maintenance.

SHUTDOWN THE MACHINE/EQUIPMENT

1. Put vehicle in neutral, handle located in cab right side of driver seat on console
2. Pull to set air parking brake, handle located above shifter handle on console
3. Pressure down shaker using shaker remote control box
4. Return rear engine to idle using shaker remote control box
5. Turn off rear engine and remove key from ignition switch
6. Turn off front engine and remove key from ignition switch

ISOLATE THE MACHINE/EQUIPMENT FROM ALL ENERGY SOURCES

To isolate machine, turn circuit breaker levers to off position. The shaker engine breaker is located outside on the driver's side, behind the rear steps. The vehicle engine breaker is located on the passenger's side, behind the front steps.

APPLY LOCKOUT/TAGOUT DEVICES

Place a tag on the steering wheel; tag keys and lock in cabinet.

DISSIPATE OR RESTRAIN ALL STORED OR RESIDUAL ENERGY

There is no release of stored energy from batteries.

VERIFY/TEST THAT THE MACHINE/EQUIPMENT HAS BEEN ISOLATED

Attempt to start rear engine. If starter does not engage, the engine has been isolated

PERFORM THE NECESSARY SERVICE, MAINTENANCE AND/OR REPAIR WORK

Following normal safety procedures and with all needed Personal Protective Equipment e.g. safety glasses, chemical resistant gloves, coveralls, steel-toe safety shoes.

REMOVAL/RESTORE FROM LOCKOUT/TAGOUT

1. Clear all nonessential tools/personnel and verify that all machine/equipment components are operationally intact.
2. Verify that the controls are in neutral.
3. Remove lock-out/tag-out devices.
4. Replace all safety guards.
5. Notify affected employees that machine/equipment is ready for use.
6. Re-energize machine/equipment.

3.4 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment, or PPE, is designed to protect employees from serious workplace injuries or illnesses resulting from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. Besides face shields, safety glasses, hard hats, and safety shoes, PPE includes a variety of devices and garments such as goggles, coveralls, gloves, vests, earplugs, and respirators.

Hearing Protection

Exposure to high noise levels can cause irreversible hearing loss or impairment as well as physical and psychological stress. Wearing earplugs or earmuffs can help prevent damage to hearing. Earplugs made from foam, waxed cotton, or fiberglass wool are self-forming and usually fit well. Clean earplugs regularly, and replace those you cannot clean.

Skin Protection

Workers exposed to harmful substances through skin absorption, severe cuts or lacerations, severe abrasions, chemical burns, thermal burns, and harmful temperature extremes will benefit from hand protection. In some cases workers must shield most or all of their bodies against hazards in the workplace, such as exposure to heat and radiation as well as hot metals, scalding liquids, body fluids, hazardous materials or waste, and other hazards. In addition to fire-retardant wool and fire-retardant cotton, materials used in whole-body PPE include rubber, leather, synthetics, and plastic.

Respiratory Protection

When engineering controls are not feasible, workers must use appropriate respirators to protect against adverse health effects caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors. Respirators generally cover the nose and mouth or the entire face or head and help prevent illness and injury. A proper fit is essential, however, for respirators to be effective. All employees required to wear respirators must first undergo medical evaluation.

Eye Protection

Besides spectacles and goggles, PPE such as special helmets or shields, spectacles with side shields, and face shields can protect employees from the hazards of flying fragments.

Foot Protection

In addition to foot guards and safety shoes, leggings (e.g. leather, aluminized rayon, or other appropriate material) can help prevent injuries by protecting employees from hazards such as falling or rolling objects, sharp objects, wet and slippery surfaces, molten metals, hot surfaces, and electrical hazards.

Head Protection

Hard hats can protect your employees from head impact, penetration injuries, and electrical injuries such as those caused by falling or flying objects, fixed objects, or contact with electrical conductors. Also, OSHA regulations require employers to ensure that workers cover and protect long hair to prevent it from getting caught in machine parts such as belts and chains.

PPE Requirements for Shop and Field Use

All personnel involved in field operations involving shaker trucks are required to wear long pants such as jeans or coveralls and closed toe shoes.

Whenever working within 30 feet of shaker equipment, you must wear long pants, such as coveralls or jeans, steel-toe shoes, safety glasses, and hearing protection.

Proper PPE such as hard hats, safety glasses and hearing protection is available from the Chief Engineer.

When performing refueling operations of equipment, you must wear face shield, goggles or other protection suitable to prevent eye contact with fuel.

We work with a variety of hand and power tools. All personnel will be introduced to site specific tools by the Chief Engineer upon hiring. Selection of Proper PPE will be in accordance with manufacturers instructions, contained in the safety pamphlets supplied with the equipment. Specific tool safety requirements will be available for review from the Chief Engineer and kept on file at Building 46.

Each person will be responsible for checking their PPE and verifying that each piece is in safe working condition. Any PPE showing signs of wear, having tears, breaks or cracks will be disposed of immediately to prevent use by any other personnel.

Personnel who are unsure of what PPE should be used during specific operations, should always consult with the PI and/or the Chief Engineer on duty prior to starting your task.

3.5 COMPRESSED GASSES

Compressed gas storage in NHERI@UTexas facilities is limited to non-flammable compressed nitrogen, used for recharging accumulator devices on T-Rex and Liquidator. Compressed gases are to be used only by the shop supervisor and personnel trained and approved by the shop supervisor. Cylinders are to be refilled only by a commercial gas service provider. Cylinders must be inspected upon each use and on a weekly basis when in storage for leaks or damage. Leaking or damaged cylinders must immediately be removed from service and returned to the provider. Gas cylinders must be strapped to an appropriate carrier at all times. When the cylinders are not in use, the carrier must be strapped to a stable, robust vertical support; any regulators, hoses or other apparatus external to the cylinders must be removed; and a manufacturer-approved protective cap must be installed over the valve or outlet of each cylinder. Compressed gas usage and storage must conform to OSHA 29 CFR 1910.101.

3.6 FLAMMABLES HANDLING AND STORAGE

3.6.1 Shop Flammables

Shop flammables are limited to cleaning solvents, aerosol paint, and other general-purpose chemicals. These are stored in clearly identified closed cabinets manufactured for that purpose, in accordance with OSHA 29 1910.106, and used according to manufacturer's instructions. MSDS for all products are maintained in a visible, clearly marked receptacle in the Chief Engineer's office in Building 46.

3.6.2 Field Flammables

Field flammables are limited to liquid diesel and gasoline fuel for powering the vehicles and generators used in NHERI@UTexas projects. Fuel handling and storage must follow the following guidelines:

- Only designated persons shall conduct fueling operations.
- In case of spillage, filler caps shall be replaced and spillage disposed of before engines are started.
- Equipment engine(s) shall be stopped during refueling operations. Generator cooling and refueling intervals shall be coordinated with field project participants to minimize interruption; if continuous power is needed, multiple generators and/or battery backup should be provisioned.
- Smoking and open flames shall be prohibited in areas used for fueling, fuel storage or enclosed storage of equipment containing fuel.
- Equipment shall be refueled only at designated locations.
- Liquid fuels not handled by pump shall be handled and transported only in portable containers or equivalent means designed for that purpose. Portable containers shall be UL-approved metal or plastic, have tight closures with screw or spring covers and shall be equipped with spouts or other means to allow pouring without spilling. Leaking containers shall not be used.
- When filling portable fuel containers, remove from vehicle or truck bed and place on flat, level ground to prevent buildup of static electricity.
- Flammable liquids may be dispensed in the open from a tank or from other vehicles equipped for delivering fuel to another vehicle only if:
 1. Dispensing hoses do not exceed 50 feet (15.24 m) in length; and
 2. Any powered dispensing nozzles used are of the automatic-closing type.

- Liquid fuel dispensing devices shall be provided with an easily accessible and clearly identified shut-off device, such as a switch or circuit breaker, to shut off the power in an emergency.

Personnel shall inform the Chief Scientist and/or Chief Engineer prior to starting any refueling operations. Personnel not involved in the refueling operation shall remain clear of the refueling until refueling is complete as instructed by the Chief Scientist and/or Chief Engineer.

Fuel containers will only be carried in open bed of vehicle or vented storage compartment; protected from direct sunlight; and secured to prevent spillage during transport.

3.7 LIFTING, MANUAL

NHERI@UTexas official policy prohibits manual lifting of weight over 50 pounds. Personnel are provided with OSHA-certified back support belts for weights less than 50 pounds as deemed necessary.

NHERI@UTexas field operations do not routinely require lifting weights of more than 50 pounds. If weight over 50 pounds must be moved or lifted, personnel must proceed according to one of the following courses of action:

- Disassemble or unpack the object into component pieces weighing less than 50 pounds.
- Enlist the aid of sufficient additional personnel to lift the weight such that no single person is lifting more than 50 pounds. All personnel involved should wear provided OSHA-approved back-support belts to prevent torsional back stress. Combined weight load should not exceed 150 pounds.
- Use provided hand trucks to move the weight under supervision of the Chief Engineer and in accordance with manufacturer's directions on file at Building 46. Do not to exceed the weight rating of the trucks as clearly marked.

3.8 LIFTING, MECHANICAL

NHERI@UTexas mechanical lifting devices are limited to hand-operated shop cranes, hydraulic jacks and winches. Personnel are required to use these devices in accordance with the manufacturer's instructions, available on file in the Chief Engineer's office. The rated lifting capacity of each device is not to be exceeded. OSHA-approved steel or composite protective toed footwear must be worn when lifting weights over 50 pounds by mechanical means. OSHA-approved hardhats are provided and must be worn when items are lifted over waist height.

3.9 MACHINE GUARDING

Machine guards are in place to prevent injury to personnel while equipment is operating. During shaker truck demonstrations, clear plastic panels are to be placed next to each truck on the spectator side in case of an accidental release of hydraulic fluid.

During engine operation, fan blade guards are to be in place and secure and engine compartment doors are to remain closed, except during engine inspection. These guards are in place to prevent accidental injury to spectators and personnel during engine/machine operation. Do not remove, modify or operate equipment without guards in place without discussing and getting approval from the Chief Engineer on duty. During routine morning inspection of equipment, prior to operation, verify all guards are in place and secure.

Always inform the Chief Scientist and/or Chief Engineer prior to performing any maintenance, removing guards or safety devices, and performing lockout/tagout procedures.

For specific machine guarding procedures, refer to section **3.1: LOCKOUT/TAGOUT**.

3.10 NOISE EXPOSURE

Noise hazard evaluations incorporating sound meter surveys of the NHERI@UTexas T-Rex and Thumper shaker trucks indicate sound levels approaching 95 decibels within a 10-foot radius while in operation, exceeding OSHA's safe human hearing threshold of 90 decibels over an 8-hour period. NHERI@UTexas personnel are required to use OSHA-approved earplugs or protective earpieces with a Noise Reduction Rating of at least 25 dB when working within a 30-foot radius of the shakers. Protective earpieces meeting the 25 dB NRR requirement are supplied for all NHERI@UTexas field personnel, and 25 dB disposable earplugs are available in sufficient quantity for use by all participants over the duration of the project.

Personnel are cautioned not to rely on their sense of hearing while hearing protection is in use:

- Maintain visual awareness of your surroundings and the location of other personnel and vehicles at all times.
- Supplement verbal communication with eye contact, hand signals and other visual cues; confer in a sound-protected environment such as the shaker cab or instrumentation trailer.
- Spatial awareness relies in part on acoustic cues which can be masked by hearing protection. Hardhats are provided and should be worn around the shakers at all times while in operation to prevent head injury from unexpected contact. Always maintain visual awareness of the shaker relative to your person.

3.10.1 Audiometric Testing

Audiometric testing, evaluation and diagnosis are available through the University of Texas at Austin Speech and Hearing Center.

Any change in an employee's hearing threshold will be investigated by the Operations Manager as a possible workplace safety incident with appropriate action taken to identify and correct the hearing safety hazard and modify safety policy as appropriate.

3.11 *POWER TOOLS, FIXED*

Fixed power tools are limited to drill press, bench grinder and other standard small shop tools. Fixed power tools are used only by the shop supervisor and personnel trained and approved by the shop supervisor.

Fixed power tools must be used in accordance with manufacturer's directions. Manuals for every piece of powered shop equipment are maintained in a visible, clearly marked location in the Chief Engineer's office in Building 46, and personnel must read this material and familiarize themselves with the safe and proper operation of each tool before use.

Prior to operation, any fixed power tool must be inspected for safe and functional operation. Tools found deficient must be withdrawn from service via power removal and applicable lockout/tagout procedure or other warning notice, and the deficiency brought to the attention of the Operations Manager or Chief Engineer.

Appropriate clothing must be worn during use, including sturdy, closed-toed shoes; jeans or other sturdy long pants; and no loose-fitting clothing, jewelry or hair. OSHA-approved eye and ear protection is provided in accessible locations and must be worn while machines are in operation. Protective gloves are provided and recommended.

3.12 *POWER TOOLS, PORTABLE*

Portable power tools are to be used in accordance with manufacturer's directions and under the supervision of the Operations Manager or Chief Engineer. Prior to operation, the tool must be inspected for safe and functional operation and withdrawn from service if found deficient. OSHA-approved eye protection must be worn during operation and ear protection is recommended. Clothing must be maintained in an appropriate state for the hazards of the tool and the task at hand.

3.13 TEMPERATURE STRESS

Field projects include shade, air-conditioned work areas and sufficient water as provided for in the project proposal. All participants are informed of temperature stress dangers and appropriate precautions at the start of the project. All NHERI@UTexas personnel working in the field are trained by the Red Cross to recognize and treat heat stress.

The following guidelines are provided for recognition, treatment and prevention of temperature stress:

HEAT STRESS

When the body is unable to cool itself by sweating, several heat-induced illnesses such as heat stress or heat exhaustion and the more severe heat stroke can occur, and can result in death.

Factors Leading to Heat Stress

- High temperature and humidity
- Direct sun or heat
- Limited air movement
- Physical exertion
- Poor physical condition
- Some medicines
- Inadequate tolerance for hot workplaces

Symptoms of Heat Exhaustion

- Headaches, dizziness, lightheadedness or fainting.
- Weakness and moist skin.
- Mood changes such as irritability or confusion.
- Upset stomach or vomiting.

Symptoms of Heat Stroke

- Dry, hot skin with no sweating.
- Mental confusion or losing consciousness.
- Seizures or convulsions.

Preventing Heat Stress

- Know signs/symptoms of heat-related illnesses; monitor yourself and coworkers.
- Block out direct sun or other heat sources.
- Use cooling fans/air-conditioning; rest regularly.
- Drink lots of water; about 1 cup every 15 minutes.

- Wear lightweight, light colored, loose-fitting clothes.
- Avoid alcohol, caffeinated drinks, or heavy meals.

What to Do for Heat-Related Illness

- Call 911 (or local emergency number) at once.

While waiting for help to arrive:

- Move the worker to a cool, shaded area.
- Loosen or remove heavy clothing.
- Provide cool drinking water.
- Fan and mist the person with water.

3.14 WELDING

Welding, gas cutting or brazing operations are not performed in Bldg. 46 or other Group facilities. NHERI@UTexas does not maintain equipment for these purposes. Work using these techniques is to be performed by the UT Welding Shop or other outside agencies according to said agencies' safety policies and as required by OSHA 29 CFR 1910.251.

Should welding, gas cutting or brazing operations unavoidably need to occur inside Group facilities or be performed by Group personnel, they shall be subject to OSHA 29 CFR 1910.251 and the following policy:

Hazards

There are several hazards to consider when performing welding, brazing, or gas cutting operations. These hazards include fires, explosions, electrocution, burns, welder's flash, oxygen depletion, and toxic fumes. Each Supervisor/Manager will be responsible to ensure their personnel are aware of these hazards and have taken adequate steps to prevent such an occurrence.

Personal Protective Equipment

It is the responsibility of the Supervisor/Manager to ensure each employee utilizes the appropriate equipment required to safely perform welding, gas cutting, or brazing operations. This includes personal protective equipment listed below:

1. Respirators should be used when ventilation is less than adequate.
2. Flame retardant clothing should be worn to prevent clothing from catching on fire.
3. High top boots should be worn to prevent burns to the legs and feet.
4. Gloves are recommended to prevent hand burns.

5. All personnel are required to use an approved welder's shield or goggles. All shields must be ANSI (American National Standard Institute) approved and the proper shade for the type of operation being performed.

Training

Supervisors/Managers are required to ensure personnel who weld, gas cut, or braze have received proper training. They are also responsible to ensure personnel are trained in the following areas:

- Fire extinguisher use.
- Respirator training, if they are required to use a respirator.
- How to respond to an emergency (emergency numbers and alarm locations).
- Confined space training, which includes all requirements of the Confined Space Policy, if personnel are required to work in confined spaces.
- Personal protective equipment and the type of shield required for their specific operation.

Permits

A welding permit is required for each welding project and should be renewed each day. Copies of permits shall be obtained and filed by the Department Supervisor/Manager. Outside contractors are required to obtain permits from Facilities Services before the beginning of each project. The contractor is required to complete each permit and fulfill each requirement before work begins.

3.15 ENVIRONMENTAL

All field project participants are briefed on common environmental hazards relating to the specific field site as determined by the Chief Scientist at the beginning of the project. NHERI@UTexas personnel maintain familiarity with weather, wildlife, traffic and other hazards and monitor one other for appropriate protection. Raincoats, safety vests and other protective gear sufficient for all personnel are maintained in every NHERI@UTexas vehicle.

NHERI@UTexas vehicles do not present unusual environmental hazards. The hydraulic oil used in the shaker trucks is a biodegradable vegetable oil-based synthetic and is safe for human contact. MSDS for this oil is available on file at Building 46. For procedures addressing noise level and fuel handling, see section 3.10 (Noise Exposure) and 3.6 (Flammables Handling and Storage).

3.15.1 Snake And Insect Hazards

NHERI@UTexas projects often take place in remote or overgrown areas with a strong potential for venomous and stinging wildlife such as snakes, scorpions, and insects. Be

cautious in areas which are overgrown or covered with debris such as logs, plywood or sheet metal, as these are favored habitats for snakes and scorpions. Bodies of water such as creeks or ponds can harbor poisonous snakes and should be avoided. Stinging insects which pose a low individual danger can attack en masse if their habitat is threatened, causing considerable pain and injury. Always maintain awareness of your environment, staying alert for visual or audible clues to these hazards.

3.16 LANGUAGE BARRIER

All NHERI@UTexas personnel are fluent in English. Foreign-language student field workers must be able to acknowledge and demonstrate understanding of safety policies and training directly or through the assistance of a bi-lingual intermediary to participate in NHERI@UTexas field projects.

3.17 INFECTIOUS DISEASE

In the event of an infectious disease outbreak, personnel should follow control guidelines established by the Center for Disease Control and Prevention (CDC) and the University of Texas at Austin (UT Austin). Staff and students may be required to work from home and avoid social contact per University guidance or a city-wide Shelter in Place order. All personnel must follow the guidelines enumerated in such an order.

Students and staff conducting field project work during the onset of a disease pandemic should adhere to CDC and UT Austin guidelines for limiting disease exposure. If a shelter in place order is given, either at the project location or in Austin, all work must be shut down regardless of completion status in a safe manner as soon as possible. Students and staff must return home or other safe location(s) to shelter in place. Work may be resumed when the order has been lifted, and approval to resume work has been received from University administration.

The CDC offers guidance and educational materials on pandemic preparedness and preventative measures at the following link:

<https://www.cdc.gov/nonpharmaceutical-interventions/index.html>

3.17.1 Project Planning

When planning any field research project, the Chief Scientist and Chief Engineer should make plans for safe lodging and/or return home of project personnel, as well as for equipment storage and/or return to Austin, in the event of a disease pandemic declaration or order on the state or federal level.

Project vehicles should be provisioned with a supply of the following PPE and consumables in good condition, sufficient to provide all Austin participants with daily protection for a return trip by road or air:

- **Face masks meeting CDC guidelines**
- **Nitrile gloves (size: Large and Medium)**
- **Hand sanitizer meeting CDC guidelines**
- **Sanitizing hand wipes**
- **Disinfectant spray cleaner**

Appendix A

Acknowledgement of General Field Hazards and Policies

NHERI@UTexas Safety Handbook

Appendix A: Acknowledgement of General Field Hazards and Policies

Because scientists and students on NHERI@UTexas experiments are exposed to a variety of situations and experiences that are different from those found in the classroom, office, or lab, special rules of conduct are necessary. Traveling and field work involve hazards and risks, so each person must exercise care to avoid personal injury to others. Examples of dangers specific to field work are the use of heavy equipment, high pressure hydraulic systems, geologic picks, poisonous snakes, tick bites, and toxic plants, falling or slippery rocks encountered when hiking on steep slopes or crossing streams. Other dangers, as well as damage to property, may be created by carelessness. A NHERI@UTexas experiment may involve access to certain private properties and use of private facilities. Continued access to these properties will depend upon proper consideration for these resources by everyone involved. Researchers or students who abuse NHERI@UTexas or other property during a field experiment, or who jeopardize the health and safety of other people, will be required to leave immediately. The Safety Officer (Chief Engineer) has the authority to make this decision. NHERI@UTexas has the following rules and recommendations which apply to field activities.

1. Release, Waiver and Indemnity Agreement. A release is to be signed by all participants. Minors (under the age of 18) must have a parental form signed.
2. Medical Care. A medical form must be filled out by all participants. Any participant who has medical problems (e.g. asthma, diabetes, metabolic disorders, allergies, trick knees) should so inform the Chief Engineer. If you require special medications, it is your responsibility to insure that they are available when needed. Field activities are sometimes in very remote areas and immediate medical assistance is not possible.
3. Every participant must have medical insurance, and provide information on the carrier to the Chief Engineer.
4. Clothing and protective cover. Wear suitable clothes, and bring a hat. Long pants, and boots are essential in some areas. Open-toed shoes (sandals, thongs, bare feet) are not acceptable during a field experiment. Field dangers such as sunstroke, insect bites, and encounters with cacti or thorny shrubs can be prevented by proper clothing. Insect repellent and sunscreen are often required. Consider significant possibilities of rain or cold weather.
5. General field hazards. Insects, poisonous snakes, and toxic plants may be found on any field experiment. Wearing suitable clothing and boots helps reduce these hazards. Remember to check yourself for ticks, which can transmit diseases such as Rocky Mountain spotted fever, Lyme disease, etc. Ticks should be removed immediately; be sure to remove the body with head intact. Do not use a match to kill the tick first. Watch for, don't play with, and avoid snakes. If you are allergic to such things as bee stings, you must bring appropriate medication. Participants are expected to stay out of the water if they cannot swim; stay out of thunderstorms, particularly at high elevations, and out of flash flood-prone areas in any rain. Use common sense in climbing in areas with cliffs.

6. Head and eye protection. Use eye protection when using, or are around a geologic pick, hammer, cone penetrometer, or other tools and equipment. Hard hats should be used in mines, quarries, steep road cuts, or other areas where rock falls or blows to the head could occur; some sites may require these protective devices. Safety goggles and hard hats will be available as part of the equipment contained in the instrumentation van.
7. Firearms. Possession of firearms or facsimiles at any time during any field experiment is forbidden.
8. Drugs, tobacco, alcohol, and driving restrictions. Alcoholic beverages may not be consumed at any time while traveling in the vehicles nor during any activity in which the vehicles are operating in a stationary mode. Drivers may not consume alcoholic beverages prior to driving. Only UT employees are permitted to drive or operate the vehicles. Smoking is not permitted in any UT vehicle. Use or possession of illegal drugs at any time is also forbidden.

TO: Chief Engineer, NHERI@UTexas

I have read the "Acknowledgement of General Field Hazards and Policies ". I understand the requirements and conditions stated therein, and agree to abide by these regulations and University regulations. I agree to hold harmless and indemnify The University of Texas at Austin or the faculty/staff of the University for illnesses contracted or for injuries sustained or caused by me while participating in the field experiment.

In case of accident, injury, or illness, I hereby authorize you to arrange for emergency medical care and to notify the person named below.

IN CASE OF AN EMERGENCY, NOTIFY:

Name: _____

Address: _____

Phone(s) (____) _____

Signature and Date _____

Printed Name _____

Home Address and Institution _____

MEDICAL FORM

List any special medication that you are allergic to, or other special medical problems which the Chief Engineer should be aware of:

Provide the name of your medical insurance carrier, group number, identification number, and telephone numbers of the carrier and your primary care physician (if applicable).

Provide the name of your dentist, and dental insurance information (if applicable):

SIGNATURE

NAME PRINTED

DATE

Appendix B

***General Safety Information and Procedures for
Working with Hydraulic Shaker***

(Provided by Industrial Vehicles International, Inc.)

SAFETY

GENERAL SAFETY INFORMATION AND PROCEDURES

INTRODUCTION

IVI has prepared the following Information for the benefit of everyone whose responsibility is to service, maintain and operate any IVI equipment. It is important that these people read both these recommendations and other manuals before they begin to operate this equipment.

MAINTENANCE WITHOUT ACCIDENT

Every employer has a safety program. Know what it is. Consult your supervisor for specific instructions on a job, and the safety equipment required. For instance, you may need: hard hat, safety shoes, safety goggles, heavy gloves, reflector vests, ear protectors, or respirators.

Always avoid loose clothing or any accessory - floppy cuffs, dangling neckties and scarves, or rings and wristwatches - that can catch in moving parts and put you out of work.

Be alert ! Plan ahead - Work safely - Avoid accidental damage and injury. If a careless moment does cause an accident or fire, react quickly with the tools and skills at hand. Know how to use a first aid kit and a fire extinguisher, and where to get aid and assistance. In an emergency, split second action is the key to safety.

Specific safety procedures should always be observed, whether servicing or making repairs on this equipment. Remember these - it can prevent an injury ... or save your life !

AVOID FIRE HAZARDS

Don't smoke while refueling, Don't smoke while handling highly flammable material. Don't smoke near the vehicle battery.

The engine should be shut off when refueling.

Don't use open pans of gasoline or diesel fuel for cleaning parts. Good commercial, nonflammable solvents are preferred.

Battery gas is highly flammable! Provide adequate ventilation when charging batteries.

Don't check battery charge by placing metal objects across the posts.

Don't allow sparks or open flame near batteries.

A flame is not a flashlight. Never check fuel, battery electrolyte or coolant levels with an open flame. Never use an open flame to check for leaks anywhere on the equipment. Never use an open flame as a lamp anywhere on or around the equipment.

Always know where fire extinguishers are kept!

MAINTENANCE CONDITIONS

Always block the wheels and set the parking brake before working on the equipment.

Do not perform any work on this equipment unless authorized to do so. Then be sure you understand the services required. Follow recommended procedures.

Never service the equipment while it is being operated. This is automatic equipment and may start at any time without warning. Always lock out the controls before servicing. Know where the emergency shutdown switches are located.

Never allow anyone to walk under equipment that is raised and not properly blocked.

Avoid working directly under raised and blocked equipment.

Use hoisting equipment for lifting heavy parts. Take care! Watch out for other people in the vicinity.

Use extreme caution in removing drain plugs, grease fittings, or hydraulic pressure caps.

Wear safety glasses when drilling, grinding, or hammering metal.

Make sure the maintenance area is adequately ventilated.

Keep maintenance area clean and dry. Oily and wet floors are slippery; greasy rags are a fire hazard; wet spots are dangerous when working with electrical equipment.

SERVICING PRECAUTIONS

Don't forget that the hydraulic system may be pressurized, even though it has been turned off.

When checking hydraulic pressure, be sure to use the correct gauge for the pressure in that particular system.

Some equipment is equipped with an accumulator. Recharge accumulators using only dry nitrogen. Discharge the accumulator before disassembly.

Keep all components free of dirt and oil. This attention will minimize fire hazards and facilitate spotting of loose or defective parts.

ADJUSTING PRECAUTIONS

Keep brake control units properly adjusted at all times. Before making adjustments, stop engine.

Before removing any housing covers, stop engine.

Don't attempt to check belt tension while the engine is running.

Don't adjust the fuel system while the machine is in motion.

Always wear gloves when handling cable.

Take all objects from your pockets which could fall into the opened housings. Don't let adjusting wrenches fall into opened housings.

Never let your bare hands come in contact with sharp edges. Wear gloves!

KNOW EQUIPMENT IS READY!

Check guards, canopies, safety bars and all protective devices installed on the equipment. Everything should be in place and secure:

Emergency shutdown switches

Guards

Canopies

Shields

Protective Devices

Fire Extinguisher

Fire Suppression Systems, Etc.

Carefully inspect equipment for visual defects - leaks in the fuel, lubrication, and hydraulic systems. Do not search for pressurized fluid leaks with your hands. Use cardboard or wood to search for the leaks.

Check levels of fuel, coolant, hydraulic fluid, and lubricating oil. If fuel must be added, do not smoke!

Check and secure all caps and filler plugs for fuel, oils, radiator, etc.

Be sure to clean any oil, grease or mud accumulation from floor of operator's compartment, stepping points, and grab rails to minimize the danger of slipping.

In freezing weather beware of snow or ice deposits on stepping points, grab rails, and floor.

Remove loose bolts, tools, or other objects from the floor of the operator's compartment.

SUMMARY

Although it is impractical to try to cover every possible maintenance situation, the safety precautions recommended here should serve to develop and promote safe maintenance procedures.

The information contained in this manual is not intended to replace safety codes, insurance requirements, federal, state, and local laws, or rules and regulations. In particular, your service area or job site activities may be subject to state safety rules and/or federal regulation under the Occupational Safety and Health Act (OSHA). Familiarize yourself with all regulations applicable to your situation in order to avoid possible safety violations.

This equipment cannot be modified in any way without written permission from IVI.

Appendix C

On-Site Shaker Safety Training Statement

NHERI@UTexas Safety Handbook

Appendix C: On-Site Shaker Safety Training Statement

E.1 INTRODUCTION

This statement is prepared for the on-site safety training for non-NHERI@UTexas personnel who will work within 100 ft radius of the NHERI@UTexas hydraulic shakers. The hydraulic vibrators of NHERI@UTexas operate with pressures up to 4,000psi, and can output a ground force as high as 60,000 lbs. Additional training is required for people who work around the shaker. On-site shaker safety training will generally take 20 minutes. The following topics will be covered in the training.

E.2 UNDERSTANDING MECHANISM AND POTENTIAL HAZARDOUS OF HYDRAULIC SHAKERS

Hydraulic shakers are driven by pressurized hydraulic oil. Pressurized hydraulic oil is alternatively directed into different side of the actuator by a servo-valve and causes the reaction mass to oscillate up and down (or side to side). The pressurized hydraulic oil of the T-Rex and Liquidator is at a pressure of 3,000 psi, and the pressurized hydraulic oil of the Thumper is at a pressure of 4,000 psi. The high pressure accumulator is located close to the shaker on the driver side of the vehicle. It is important to stay in the passenger side (low pressure side) of the vehicle when the vibrator is in operation.

Components of the vehicle are under high hydraulic pressure and strong vibration for a very long period of time. Although it is rare, but from time to time, component can fail and blow away from the shaker. The distance that a flying failed-component can reach can be as far as 100 ft. Also, in a hot summer day, the hydraulic fluid can reach a temperature as high as 170°F (~77 °C). If a component failed, people around the vehicle can be injured by both the flying component and the spilling hydraulic fluid. It is important to stay alert at all time while working around the vehicle. The second potential hazardous is losing balance during vibration. It is important to stay at least 10 ft away from the shaker during vibration.

In this training section, Chief Engineer should identify the follow components to the trainee.

- a. Shaker reaction mass
- b. Shaker base plate
- c. High pressure accumulator
- d. Vehicle engine
- e. Drivers blind spots

For your safety:

- a. Make sure the driver can see you.
- b. Stay in the passenger side (low pressure side) of the vehicle when the vibrator is in operation.
- c. Do not stand within a 30 ft radius of the shaker while the engine has been turned on.

- d. Do not expose any body part in the path of the shaker reaction mass, shaker base plate, or the vehicle.
- e. Be alert while working around the vehicle.

E.3 CLOTHING

- You must wear long pants, safety shoes, safety goggles, and ear protection while working around (within 30 ft radius) the shaker. Open-toed shoes (sandals, thongs, and bare feet) are never acceptable around the shaker.
- Always avoid loose clothing or any accessory - flopping cuffs, dangling neckties and scarves - that can catch in moving parts and put you out of work.

Both Chief Engineer and Chief Scientist have the authority and the responsibility to ask anyone who does not dress appropriately to leave the test site immediately.

E.4. AVOID FIRE HAZARDS

- Always know where fire extinguishers are kept!
- No smoking around the vehicle.
- The engine should be shut off when refueling.
- Don't use open pans of gasoline or diesel fuel for cleaning parts.
- Provide adequate ventilation when charging batteries.
- Don't check battery charge by placing metal objects across the posts.
- Don't allow sparks or open flame near batteries.
- A flame is not a flashlight. Never check fuel, battery electrolyte or coolant levels with an open flame. Never use an open flame to check for leaks anywhere on the equipment. Never use an open flame as a lamp anywhere on or around the equipment.

E.5. SUMMARY

Be alert! Plan ahead - Work safely - Avoid accidental damage and injury. If a careless moment does cause an accident or fire, react quickly with the tools and skills at hand. Know how to use a first aid kit and a fire extinguisher, and where to get aid and assistance. In an emergency, split second action is the key to safety. Specific safety procedures should always be observed, whether servicing or making repairs on this equipment. Remember these - it can prevent an injury ... or save your life!

TO: Chief Engineer, NHERI@UTexas

I have attended the on-site shaker safety training, and read the "NHERI@UTexas On-Site Shaker Safety Training Statement". I understand the mechanism and potential hazardous of hydraulic shakers, clothing requirement, and fire prevention procedures stated therein, and agree to abide by these regulations and University regulations. I agree to hold harmless and indemnify the University of Texas at Austin or the faculty/staff of the University for illnesses contracted or for injuries sustained or caused by me while participating in the field experiment.

In case of accident, injury, or illness, I hereby authorize you to arrange for emergency medical care and to notify the person named below.

IN CASE OF AN EMERGENCY, NOTIFY:

Name: _____

Address: _____

Phone(s) (____) _____

Signature and Date _____

Printed Name _____

Home Address and Institution _____

NHERI@UTexas Accident Report Form

Upon completion this form must be emailed or faxed as soon as possible within 24 hours to the NHERI@UTexas Operations Manager and HR Manager along with any available related documentation detailing treatment, hospital admission, property damage, etc.

*Operations Manager: Dr. Farn-Yuh Menq email: fymenq@utexas.edu phone: (512) 232-2049 fax: (512) 471-6548
HR Manager: Alicia Zapata email: alicia@mail.utexas.edu phone: (512) 232-3682 fax: (512) 471-6548*

Status (check one): ☐ Employee ☐ Collaborator ☐ Student worker ☐ Visitor
☐ Other, please explain: _____

Name of Injured Party: _____

Injured Party Phone: () _____ - _____ Affiliation: _____

Date of Injury: ____/____/____ Time: _____

Location of incident: _____

Give full details of how injury/accident occurred:

What part of body was injured?

Did injured party receive first aid? Yes ☐ No ☐
If yes, administered by who:

Were there any witnesses to the accident? Yes ☐ No ☐
If yes, please provide names, addresses, and phone number:

Did injured party see a Doctor or go to a Hospital for treatment? Yes ☐ No ☐
If yes, list provider's name, address, and phone number:

If seen by Doctor or Hospital, what type treatment was received?

(See reverse side)

EMPLOYEE/STUDENT WORKER ONLY

Has injured employee lost time from work? Yes ___ No ___

If yes, when did lost time begin? _____

Has employee returned to work? Yes ___ No ___

If yes, when did employee return? _____

Name and phone number of supervisor: _____

When did supervisor first learn of this injury? _____

Date: ___/___/___ Supervisor's signature: _____

Supervisor's email: _____

TO THE INJURED PARTY: READ THE FOLLOWING STATEMENT CAREFULLY:

I hereby certify that all the above statements are true. I hereby authorize all doctors presently involved or who may become involved in consultation and/or treatment of me for the above-named accident injury to release all information regarding said accident/injury to the University of Texas at Austin. Further, I hereby authorize any party receiving medical information regarding the above accident/injury to release such information to the University of Texas at Austin.

Date

Injured Party's Signature

If filled out by other than the injured party, please sign and date:

Name (please print): _____ Position: _____

Date ___/___/___ Signature: _____

NHERI@UTEXAS ACCIDENT CAUSAL ANALYSIS WORKSHEET

VICTIM'S NAME _____ DATE OF INCIDENT _____
LOCATION/DEPT. _____

Loss	Contact with Energy or Substance	Substandard Act or Condition	Basic Causes	Remedial Actions to be Taken

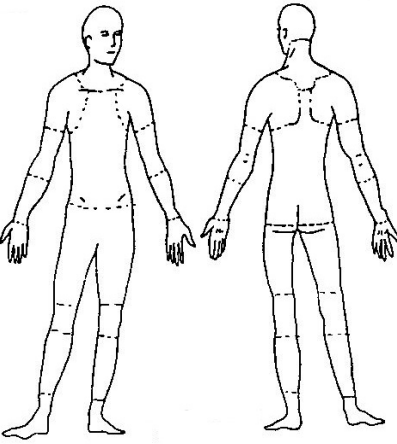
PREPARED BY _____

NHERI@UTexas Accident Investigation Report

Instructions: Complete this form as soon as possible after an incident that results in serious injury or illness.
(Optional: Use to investigate a minor injury or near miss that *could have resulted in a serious injury or illness.*)

This is a report of a: <input type="checkbox"/> Death <input type="checkbox"/> Lost Time <input type="checkbox"/> Dr. Visit Only <input type="checkbox"/> First Aid Only <input type="checkbox"/> Near Miss	
Date of incident:	This report is made by: <input type="checkbox"/> Employee <input type="checkbox"/> Supervisor <input type="checkbox"/> Team <input type="checkbox"/> Other_____

Step 1: Injured employee (complete this part for each injured employee)

Name:	Sex: <input type="checkbox"/> Male <input type="checkbox"/> Female	Age:
Department:	Job title at time of incident:	
Part of body affected: (shade all that apply) 	Nature of injury: (most serious one) <input type="checkbox"/> Abrasion, scrapes <input type="checkbox"/> Amputation <input type="checkbox"/> Broken bone <input type="checkbox"/> Bruise <input type="checkbox"/> Burn (heat) <input type="checkbox"/> Burn (chemical) <input type="checkbox"/> Concussion (to the head) <input type="checkbox"/> Crushing Injury <input type="checkbox"/> Cut, laceration, puncture <input type="checkbox"/> Hernia <input type="checkbox"/> Illness <input type="checkbox"/> Sprain, strain <input type="checkbox"/> Damage to a body system: <input type="checkbox"/> Other _____	This employee works: <input type="checkbox"/> Regular full time <input type="checkbox"/> Regular part time <input type="checkbox"/> Seasonal <input type="checkbox"/> Temporary <hr/> Months with this employer <hr/> Months doing this job: <hr/>

Step 2: Describe the incident

Exact location of the incident:	Exact time:
What part of employee's workday? <input type="checkbox"/> Entering or leaving work <input type="checkbox"/> Doing normal work activities <input type="checkbox"/> During meal period <input type="checkbox"/> During break <input type="checkbox"/> Working overtime <input type="checkbox"/> Other_____	
Names of witnesses (if any):	

Number of attachments:	Written witness statements:	Photographs:	Maps / drawings:
What personal protective equipment was being used (if any)?			
Describe, step-by-step the events that led up to the injury. Include names of any machines, parts, objects, tools, materials and other important details.			
Description continued on attached sheets: <input type="checkbox"/>			

Step 3: Why did the incident happen?	
<p>Unsafe workplace conditions: (Check all that apply)</p> <p><input type="checkbox"/> Inadequate guard</p> <p><input type="checkbox"/> Unguarded hazard</p> <p><input type="checkbox"/> Safety device is defective</p> <p><input type="checkbox"/> Tool or equipment defective</p> <p><input type="checkbox"/> Workstation layout is hazardous</p> <p><input type="checkbox"/> Unsafe lighting</p> <p><input type="checkbox"/> Unsafe ventilation</p> <p><input type="checkbox"/> Lack of needed personal protective equipment</p> <p><input type="checkbox"/> Lack of appropriate equipment / tools</p> <p><input type="checkbox"/> Unsafe clothing</p> <p><input type="checkbox"/> No training or insufficient training</p> <p><input type="checkbox"/> Other: _____</p>	<p>Unsafe acts by people: (Check all that apply)</p> <p><input type="checkbox"/> Operating without permission</p> <p><input type="checkbox"/> Operating at unsafe speed</p> <p><input type="checkbox"/> Servicing equipment that has power to it</p> <p><input type="checkbox"/> Making a safety device inoperative</p> <p><input type="checkbox"/> Using defective equipment</p> <p><input type="checkbox"/> Using equipment in an unapproved way</p> <p><input type="checkbox"/> Unsafe lifting</p> <p><input type="checkbox"/> Taking an unsafe position or posture</p> <p><input type="checkbox"/> Distraction, teasing, horseplay</p> <p><input type="checkbox"/> Failure to wear personal protective equipment</p> <p><input type="checkbox"/> Failure to use the available equipment / tools</p> <p><input type="checkbox"/> Other: _____</p>
Why did the unsafe conditions exist?	
Why did the unsafe acts occur?	
<p>Is there a reward (such as “the job can be done more quickly”, or “the product is less likely to be damaged”) that may have encouraged the unsafe conditions or acts? <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>If yes, describe:</p>	
<p>Were the unsafe acts or conditions reported prior to the incident? <input type="checkbox"/> Yes <input type="checkbox"/> No</p>	

Have there been similar incidents or near misses prior to this one?

☐ Yes ☐ No

Step 4: How can future incidents be prevented?

What changes do you suggest to prevent this incident/near miss from happening again?

- ☐ Stop this activity ☐ Guard the hazard ☐ Train the employee(s) ☐ Train the supervisor(s)
- ☐ Redesign task steps ☐ Redesign work station ☐ Write a new policy/rule ☐ Enforce existing policy
- ☐ Routinely inspect for the hazard ☐ Personal Protective Equipment ☐ Other: _____

What should be (or has been) done to carry out the suggestion(s) checked above?

Description continued on attached sheets: ☐

Step 5: Who completed and reviewed this form? (Please Print)

Written by:

Title:

Department:

Date:

Names of investigation team members:

Reviewed by:

Title:

Date:

NHERI@UTexas Tailgate Safety Meeting Form

This form should be used to register attendance and topics for a safety meeting involving all personnel, to be conducted at the beginning of each day of field project operations. () Indicates topics for first project meeting or new arrivals.*

Location of work: _____

Description of work: _____

Project Supervisor: _____ Date: _____

PPE and Safety Equipment Locations*: _____

Evacuation Route and Meeting Location*: _____

Emergency Information*: _____

(Local Fire, Police, EMS numbers, nearest hospital or first aid station for this location)

Hazards Present *(Control measures)*:

- ☐ Sun Exposure *(Wear protective clothing and/or sunscreen, seek shade)*
- ☐ Heat Exhaustion *(Drink water, take frequent breaks)*
- ☐ Wildlife Hazard ☐ Snakes ☐ Insects ☐ Other _____
(Avoid contact, use insect repellant, do not disturb)
- ☐ Tripping Hazard ☐ SEVERE ☐ Cables ☐ Rough Terrain ☐ Other _____
(Maintain awareness, avoid obstacles, use designated pathways)
- ☐ Shaker Hazard *(PPE, User training, 30ft distance from operating shaker)*
- ☐ Public Interaction *(Crowd control, 30ft distance from operating shaker)*
- ☐ Off-Limits Areas *(Observe barriers and signs)*

Other Hazards

Control Measures

Personnel in attendance (please print and sign name):

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____
- 6) _____
- 7) _____
- 8) _____
- 9) _____
- 10) _____

NHERI@UTexas Daily Vehicle Inspection Checklist

Prior to operating any University of Texas vehicle, a daily safety inspection shall be conducted according to the following criteria.

Vehicle Description: _____

Name of Operator: _____ Date: _____

- ☐ Mileage log with credit card, insurance paperwork and Accident Report Form [UTNHERI.AR2016] present
- ☐ Fuel level sufficient for day's activity
- ☐ Visual inspection of tire condition and pressure
- ☐ Headlight and taillight test
- ☐ Trailer light test (if present)
- ☐ Trailer air line inspection (if present and applicable)
- ☐ Isolation bag visual inspection and pressure check (if applicable)
- ☐ Oil reservoir check (if applicable)

Any problems observed in the vehicle inspection will be entered into the vehicle's logbook. The operator of the vehicle is responsible for communicating the problem to the Chief Engineer or Operations Manager and either taking appropriate corrective action to return the vehicle to a safe operating condition, or halting use of the vehicle until sufficient corrective action has been taken.

Notes:

NHERI@UTexas Pre-Trip Vehicle Inspection Checklist

Prior to the start of any long-distance trip of greater than 50 miles, a pre-trip inspection shall be conducted according to the following criteria.

Vehicle Description: _____

Destination: _____ Project: _____

Name of Operator: _____ Date: _____

[] Mileage log with credit card, insurance paperwork and Accident Report Form [UTNHERI.AR2016] present

[] Fire extinguisher present and charged

[] Jack and spare tire present and in working condition

[] Fuel level sufficient for day's activity

[] Oil level good

[] Coolant level good

[] Power steering fluid level good

[] Belts and hoses in good condition

[] Visual inspection of tire condition, tire pressure test

[] Headlight, taillight, turn indicator and license plate light test

[] Windshield wipers in good condition

[] Horn functional

[] Trailer light test (if present)

[] Trailer air line inspection (if present and applicable)

[] Isolation bag visual inspection and pressure check (if applicable)

[] Oil reservoir check (if applicable)

Any problems observed in the vehicle inspection must be entered into the vehicle's logbook. The operator of the vehicle is responsible for communicating the problem to the Chief Engineer or Operations Manager and either taking appropriate corrective action to return the vehicle to a safe operating condition, or halting use of the vehicle until sufficient corrective action has been taken.

Notes: