OPERATING ENGINEERS NATIONAL HAZMAT PROGRAM

INTERNATIONAL ENVIRONMENTAL TECHNOLOGY & TRAINING CENTER

TRI TOOL, INC.
Split Frame Clamshell
(Equipment Dismantlement)

HUMAN FACTORS ASSESSMENT

JANUARY 1999

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SPLIT FRAME CLAMSHELL
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ACKNOWLEDGMENTS

The human factors assessment of the Tri Tool Inc. Split Frame Clamshell was conducted under support of the U.S. Department of Energy's Federal Energy Technology Center, under cooperative agreement DE-FC21-95MC32260 with the Operating Engineers National HAZMAT Program. The Operating Engineers National HAZMAT Program would like to thank the following people for their participation on the "research action team" and the professional expertise they provided for this assessment:

Barbara McCabe	Operating Engineers National Hazmat Program
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EXECUTIVE SUMMARY

The Tri Tool Split Frame Clamshell technology was tested and is being evaluated by Florida International University (FIU). The equipment dismantlement technology demonstrations are designed to evaluate technologies for decontamination and decommissioning (D&D) work. The human factors assessment conducted in conjunction with FIU's evaluation of efficiency and cost, covers the hazard analysis and safety evaluation for the clamshell. The Tri Tool Split Frame Clamshell is a commercially available technology and has been used for various projects at locations throughout this country.

While the split frame clamshell itself does not inherently involve safety and health hazards associated with D&D work, the activities that are being conducted using the technology do. Safety and health hazards associated with the clamshell are addressed in this report and although not addressed in this summary, the specific hazards involved in D&D activities need to be addressed prior to the start of the project.

The Tri Tool Split Frame Clamshell is a pipe lathe which employs a split rotary bearing design that can be divided into two or more sections (depending on the size of the clamshell). The clamshell requires minimal axial or radial clearances. The sections are placed around the outside of the pipe/tube to be cut and bolted together. The rotating cutting heads then cut either a straight or beveled cut from the outside diameter (O.D.) inward. The clamshell clamps completely around the O.D. of the pipe with clamp pads and jackscrews to provide a stable and secure clamp-up.

Clamshells are designed to cut pipe from ¼-inch to 60-inches in diameter. This is accomplished by having clamshells of varying sizes and incorporating an adjustable O.D. mounting system, as required, to fit the pipe diameter. The clamshell also features an enclosed drive gear and bearing surface and a multi-positionable motor mount. Additional features of the Split Frame Clamshell, which may vary depending on the size of the clamshell, include internal counterbore machining and worm drive tool modules to reduce vibration and extend tool bit life.

The automatic feed star wheels and adjustable slideways provide incremental tool bit feed for controlled cut depth. The star wheels mount on the rotating face of the clamshell and carry the tool bits within the tool holder section. The tool bit is fed into the pipe/tube at a fixed revolution of the head stock with one tripper pin assembly engaged. Multiple trippers increase the total feed of the tool bit per revolution. The star wheels provide 0.0025-inch of radial feed per revolution. The tool bits are carbide cutting bits.

The Split Frame Clamshell can be pneumatically, hydraulically, or electrically powered. Pneumatic power provides the maximum power per unit weight, electric powered are for light duty machining, and hydraulic motors provide the maximum power and speed range capabilities. Dual drives can be fitted for additional power and machining

capabilities. The clamshell used during the testing demonstration was pneumatically powered.

The operator control for the Split Frame Clamshell is located on the shaft of the multi-positionable motor mount. The on-off control is a lever mechanism designed for four-finger operation. It works as a "dead man" switch, shutting down the clamshell if pressure is released off the lever.

During the assessment sampling was conducted for dust and noise and general observational techniques were conducted for ergonomics. General observational techniques for ergonomics showed the potential for ergonomic stressors during setup, operation, maintenance, and decontamination of the clamshell. Awkward postures that are assumed by the operator, because of the way the clamshell has to be placed on the pipe/tube to be cut, is the main ergonomic concern.

Area dust monitoring was conducted during the operation of the split frame clamshell. The area dust samples showed results of <0.072 mg/m^3 and <0.157 mg/m^3. These results are all below the OSHA PEL of 15 mg/m^3 and the ACGIH TLV of 10 mg/m^3. Dust generation does not appear to be a concern during the operation of the split frame clamshell. However, since the time spent in the work area, the distance from the actual cutting operation, and ventilation in the work area may affect an individual worker's exposure level, a monitoring plan will need to be developed to account for the site specific conditions where the split frame clamshell is being used. A complete air sampling plan for a site will need to be developed to include not only dust but other contaminants specific to the D&D project.

Noise monitoring conducted during operation of the split frame clamshell showed a noise dose of 12.52% which would give a time-weighted average (TWA), assuming no further noise exposure for the 8-hour shift, of 75.0 dBA and a noise dose of 34.28% (TWA – 82.3dBA). These area results show potential exposures from below to close to the OSHA "action level" of 85 dBA but are below the PEL of 90 dBA. A projected 8-hour noise dose and resultant TWA showed the following results for the respective area samples: 41.60% (TWA – 83.6 dBA) and 46.66% (TWA – 84.5 dBA). These projected 8-hour noise doses also show the potential exposure range from below to close to the OSHA "action level" but below the PEL.

The OSHA allowable "action level" is a noise dose of 50% or an 8-hour TWA of 85 dBA and the PEL is a 100% dose or an 8-hour TWA of 90 dBA. The levels of exposure recorded during the testing demonstration may require the operators to be included in a hearing conservation program. In addition, engineering controls, administrative controls, and/or personal protective equipment (PPE - hearing protection devices) may be required. Differences in noise exposure will be based on the location of the worker in relation to the cutting operation and the amount of time the worker spends there. The sampling plan should also take into consideration the work environment since the noise

levels may increase or decrease based on the construction of the enclosure where the cutting operation is taking place.

It should be noted that during operation of the clamshell, it became necessary to remove the muffler. This was due to problems associated with the humidity at the test demonstration site. It was noted that noise levels that had ranged from 92 – 94 dBA during operation of the clamshell rose to 99 – 100 dBA. Normal operation of the clamshell should not be done without the muffler in place.

Recommendations for improved worker safety and health during use of the Split Frame Clamshell include: 1. keeping all hoses and lines as orderly as possible in compliance with good housekeeping requirements; 2. ergonomic training to include techniques in lifting, bending, stooping, twisting, etc.; 3. padding the metal operator lever; 4. allowing only sweeping or vacuuming to clean up metal shavings; 5. guarding the area of the rotating star wheels and cutting tip;
6. safety lines on the air hose connections; 7. the operator keeping his/her face away from the rotating/cutting area of the clamshell during operation; and
8. assuring the pipe/tube to be cut can handle the load of the clamshell.

TRI TOOL INC.
Split Frame Clamshell
Human Factors Assessment
(Equipment Dismantlement)

SECTION 1 - SUMMARY

TECHNOLOGY DESCRIPTION

The Tri Tool Split Frame Clamshell technology was tested and is being evaluated by Florida International University (FIU). The equipment dismantlement technology demonstrations are designed to evaluate technologies for decontamination and decommissioning (D&D) work. The human factors assessment conducted in conjunction with FIU's evaluation of efficiency and cost, covers the hazard analysis and safety evaluation for the clamshell. The Tri Tool Split Frame Clamshell is a commercially available technology and has been used for various projects at locations throughout this country.

While the split frame clamshell itself does not inherently involve safety and health hazards associated with D&D work, the activities that are being conducted using the technology do. Safety and health hazards associated with the clamshell are addressed in this report and although not addressed here, the specific hazards involved in D&D activities need to be addressed prior to the start of the project.

D&D activities within the Department of Energy (DOE) require that personnel have access to all areas of structures, some of which are over 40 years old, and many are deteriorated and lack any preventive maintenance over the years. D&D activities and the associated hazards to workers involve not only the contaminants specific to the environment, but general construction safety and health. A safety and health program specific for the project needs to be developed and should include but not be limited to:

- responsibilities for safety and health, including reporting hazards and accidents, obtaining and using personal protective equipment, conducting safety inspections, maintaining a safe and healthful work environment, enforcing safety and health requirements
- procedures for conducting safety and health orientation and periodic training sessions
- procedures for reporting accidents
- procedures for obtaining first aid and emergency treatment

- procedures for reporting work hazards
- procedures for testing and certifying equipment
- job-site sanitation
- the use and purpose of equipment lockout and confined space entry
- the technical requirements (personal protective equipment, hazardous materials, welding and cutting, electrical, material handling, rigging, pressurized systems, scaffolding, etc.)

Workers must be trained in accordance with all applicable OSHA safety and health regulations and only workers trained and certified, as applicable, should be allowed to perform operations and/or operate equipment used during the D&D activities. For example, only workers trained in fall protection in accordance with OSHA 29 CFR 1926.503 are allowed to work from a height; only operators trained on forklifts in accordance with OSHA 29 CFR 1910.178 are allowed to operate a forklift; and functions such as welding and cutting and the operation of heavy equipment should only be done by workers trained and/or certified to perform those duties.

Inspection programs and preventive maintenance programs need to be in place to assure all equipment is in good working condition and removed if it is not. In addition, job pre-planning is essential to assure all work to be performed will be done so in a safe manner.

Hoisting and rigging activities which often account for accidents with injuries and/or fatalities, will be an integral part of all D&D projects. Considerations for hoisting and rigging during a D&D project should include but not be limited to:

- ♦ All hoisting and rigging activities must be conducted in accordance with OSHA 29 CFR 1926 Subpart N Cranes, Derricks, Hoists, Elevators, and Conveyors.

- ♦ Only workers with the appropriate qualifications and training shall be allowed to perform hoisting and rigging functions during the D&D project.

- ♦ All workers, including supervisory personnel, should review and follow established procedures and regulations.

- ♦ When proper procedures, planning, or equipment is not available for the job, work should be stopped.

- ♦ Only manufacturer-approved or properly engineered equipment should be used and it should be used appropriately.

- ♦ Preventive maintenance activities should be scheduled and the process for performance reviewed for adequacy.

- Hoisting and rigging activities, including the use of forklifts, should be properly planned before work begins to ensure proper procedures and equipment are available and the hazards are identified.

- Workers, including supervisory personnel, should familiarize themselves with the equipment, work area hazards, transportation routes, and the layout of the facility before starting the job.

- Before beginning hoisting and rigging activities, including the use of a forklift, assure the center of gravity and weight of the load has been properly calculated.

- Assure workers have training and experience directly applicable to the type of activities to be conducted.

- Inspection of all chain, wire rope, slings, etc. shall be performed to assure it is in good working condition before the hoisting and rigging work is started.

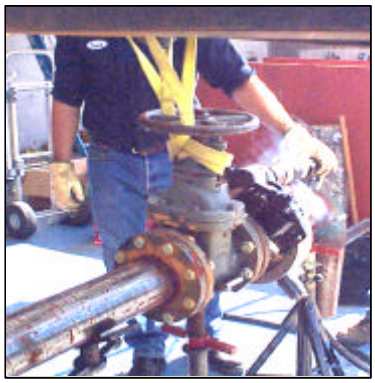

Figure 1. Forklift being used during hoisting & rigging activities

Another frequent cause of accidents with injuries is the use of forklifts. Considerations for the use of forklifts during a D&D project should include but not be limited to:

- All forklift activities must be conducted in accordance with OSHA 29 CFR 1910.178 Powered Industrial Trucks.

- Only trained and authorized operators shall be permitted to operate the forklift.

- Modifications to the forklift should be approved by the forklift manufacturer. If the modifications affect the capacity and safe operation of the forklift, they must be approved in writing by the forklift manufacturer and capacity, operation, and maintenance instruction plates, tags, or decals shall be changed accordingly.

- Modification designs should be approved by a professional engineer. Any welding on modifications should be done by a certified welder and inspected in accordance with ASTM guidelines. All parts used, such as bolts must be rated for the load.
- No one shall be allowed to stand or pass under an elevated portion of the forklift, whether loaded or empty.

- The forklift must not be left unattended with a suspended load. If the operator of the forklift is within 25 ft. and has a view of the forklift, the load engaging means must be fully lowered, controls neutralized, and the brakes set to prevent movement. If the operator is greater than 25 ft. or does not have a view of the forklift, the load engaging means shall be fully lowered, controls neutralized, power shut off, and brakes set.

- The forklift must be rated for the load.

- All hoisting and rigging equipment must be rated for the load.

- It needs to be assured that the forklift is properly equipped with a working backup alarm, beacon light, seat belt, and fire extinguisher.

- A maintenance and inspection program should be in place to assure that any forklift that is not in safe operating condition is removed from service.

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The Split Frame Clamshell can be pneumatically, hydraulically, or electrically powered. The clamshell used during the testing demonstration was pneumatically powered.

KEY RESULTS

The safety and health evaluation during the testing demonstration focused on two types of potential exposure: dust and noise. Visible dust was not seen during operation of the clamshell and the air sampling results showed values below the Occupational Safety and Health Administration (OSHA) permissible exposure limits (PEL), as well as the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV). This will be discussed in greater detail in the Industrial Hygiene Monitoring section of this report. Noise exposure ranged from below to near the "action level". This will also be discussed in greater detail in the Industrial Hygiene section of this

report. Further testing for each of these exposures is recommended because the environment where the technology is being used, the time the worker spends in the area, and the distance the worker is from the operational area may cause exposures to be higher or lower. In addition, since there is potential for noise exposure during cutting operations, noise surveys appear to be required in all operational settings. Other safety and health hazards found were ergonomics, heat stress, pinch points, tripping hazards, struck by hazards, lockout/tagout, and moving machinery.

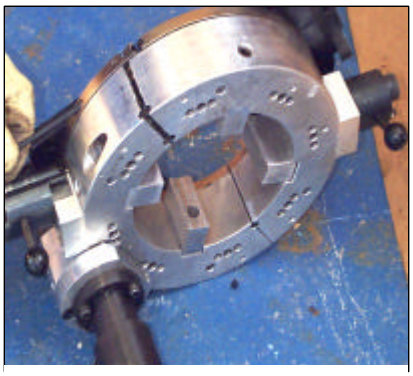

Figure 2. Split Frame Clamshell

SECTION 2 - SYSTEM OPERATION

The Tri Tool Split Frame Clamshell is a pipe lathe which employs a split rotary bearing design that can be divided into two or more sections (depending on the size of the clamshell). The clamshell requires minimal axial or radial clearances. The sections are placed around the outside of the pipe/tube to be cut and bolted together. The rotating cutting heads then cut either a straight or beveled cut from the O.D. inward. The clamshell clamps completely around the O.D. of the pipe with clamp pads and jackscrews to provide a stable and secure clamp-up.

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The operator control for the Split Frame Clamshell is located on the shaft of the multi-positionable motor mount. The on-off control is a lever mechanism designed for four finger operation. It works as a “dead man” switch, shutting down the clamshell if pressure is released off the lever.

SECTION 3 - HEALTH AND SAFETY EVALUATION

GENERAL SAFETY AND HEALTH CONCERNS

Personnel where the clamshell cutting technology is being used need to be concerned with two categories of safety and health issues. Core issues are those that are based on current safety and health regulatory requirements. Best management practices are related to issues that are not based on current safety and health regulations, but are key elements in preventing worker injury and illness on the job.

Safety and health issues of concern with the clamshell cutting technology included:

Core Issues:

- Tripping Hazards - The air lines, while necessary for the operation of the equipment, can become tripping hazards. Stringent housekeeping must be addressed.

- Pinch Points - The potential exists for the operator to have his/her fingers/hand injured during operation if caught in the clamshell during attachment to or removal from the pipe/tube. There is also potential for injury if the fingers/hand are caught/struck by the star wheels as they rotate about the pipe/tube being cut.

- Lockout/Tagout - The user of the technology will need to develop a lockout/tagout program to assure there is not an accidental release of energy during maintenance/repair activities.

- Noise - The operator and workers in the area were subjected to noise levels below and at the OSHA “action level” for noise. The "action level" is 85 dBA for an 8-hour work shift. The potential exists for the operator to be exposed above the OSHA PEL. The level of exposure will be influenced by the amount of time the worker spends in the area where the cutting operation is taking place and the distance the operator is from the operation. Therefore, noise is a potential concern and will be discussed in greater detail in the Industrial Hygiene section of this report.

- Dust - The equipment did not generate any visible dust during operation. Air sampling results showed a level of total dust exposure less than the OSHA PEL and the ACGIH TLV. The PEL is 15 mg/m^3 and the TLV is 10 mg/m^3. Dust does not appear to be a concern during cutting operations with the split frame clamshell but

other contaminants that may be present in the work area need to be considered and a sampling plan developed as appropriate.

- Metal shavings were left on the surface below the pipe/tube being cut by the split frame clamshell. These shavings are sharp and could therefore be a hazard to the worker when cleaning them up. They may also stick to the bottom of the worker's shoes/boots and be carried from the contaminated area to a clean area. One additional concern with the sharp metal shavings is dragging the air hoses across them. This has the potential to cause cuts, scrapes, and/or additional wear on the hoses and could cause them to weaken and rupture.

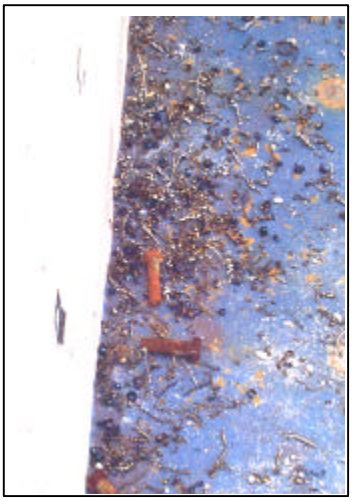


Figure 3. Metal shavings on walking surface after cutting completed.

- Machine Guarding – The rotating star wheels with the cutting tip presents hazards if the operator were to get his/her hand, fingers, etc. in the area of rotation. In addition, any loose pieces of clothing has the potential to get caught in this area and result in injury. This needs to be considered and machine guarding designed for this area.

Best Management Practices:

- Heat Stress - The operator may be subjected to an increase in heat stress due to the need to utilize personal protective equipment (PPE). The user will need to develop a heat stress program for the environment in which the technology is being used, taking into consideration any necessary PPE, ambient temperatures, etc.

- Ergonomics - The user was subjected to some ergonomic stressors that need to be taken into consideration, such as stooping, bending, twisting, kneeling, and lifting.

- Struck by Hazards - The shavings created by the cutting process have the potential to be projected upward and outward during cutting operations. This could become a severe eye injury hazard. The operator may need to utilize a face-shield in addition to safety glasses with side shields or goggles. Long sleeves may also need to be worn. Work practices should include *never* placing the face near the area of operation. If the operator needs to inspect the cut before continuing, the clamshell should be stopped first.

- Communication - Due to the noise generated by the technology, at times, during operation, communication may be difficult. Personnel working in the area should be familiar with and use hand signals when needed.

INDUSTRIAL HYGIENE MONITORING

During this testing demonstration with the split frame clamshell, sampling was conducted for dust and noise. In addition, the wet-bulb globe temperature was monitored to evaluate heat stress. Observational evaluation was conducted for ergonomics.

Figure 4. Clamshell mounted at floor level.

Through general observational techniques the potential for ergonomic problems was evaluated during the testing demonstration. There is potential for upper and lower back, arm, and leg stress and/or injuries due to bending, twisting, and lifting associated with setup, operation, maintenance, and decontamination.

Attaching and removing the clamshell to the pipe/tube to be cut may require the operator to assume awkward positions, in particular when the pipe/tube is in a difficult to reach location, in a congested area, or elevated. This has the potential to place strain on the back, neck, shoulders, arms, knees, and legs. This needs to be taken into consideration and work practices to mitigate this as much as possible need to applied. In addition, training in ergonomics, including using proper lifting techniques needs to be conducted for operators of the split frame clamshell.

Operating the split frame clamshell has the potential to cause the operator to assume positions which place stress on the back, neck, shoulders, arms, knees, and legs. This is partially due to the position in which the clamshell has to be placed on the pipe/tube. The multi-positionable motor mount with the operating lever helps to alleviate a lot of the stress causing positions but there is still the potential for stress to the body areas discussed above.

Figure 5. Deviant wrist position caused by placement of the clamshell.

One situation where awkward operator positioning is most prevalent during operation is when the cut on the pipe/tube must be made at floor level. The clamshell is placed at the bottom of the pipe/tube with the star wheels and cutting tool facing toward the floor. The motor mount with the operating lever is placed on the part of the clamshell facing the ceiling. This will allow the operator to comfortably operate the clamshell without additional stress on the back, neck,

shoulders, arms, etc. However, if the operator needs to observe the cutting operation, he/she must kneel, bend at the waist and turn the neck toward the cutting operation while at the same time, reaching up to the operating lever on the motor mount. The arm will be in a laterally rotated, hyper-extended position and the wrist will be in a deviated position. This has the potential to place a significant amount of stress on the knees, back, neck, shoulder, arm, and wrist. Consideration needs to be given to the placement of the clamshell in relation to operational parameters. In this situation, as well as others that may arise, two person operation may need to be used, one to observe the operation and one to operate the control lever. Note: the person observing the operation should not place his/her face near the area of operation due to the potential for sharp metal shavings to be thrown from the area.

Heat stress parameters were monitored using a Quest QuestTemp°15 Heat Stress Monitor. The wet-bulb globe temperature was used to determine the work/rest regimen in accordance with the ACGIH recommendations. The wet-bulb globe temperature was adjusted for the type of clothing, including PPE that the worker was wearing, in accordance with ACGIH guidelines.

While heat stress will be increased when wearing PPE, the overall heat stress response will vary from worker to worker. Each situation in which the current technology is used will need to be evaluated for the heat stress potential, taking into consideration the wet-bulb globe temperature, PPE in use, physical condition of the worker, and worker acclimatization.

Total dust monitoring was conducted with a sampling train consisting of an MSA Escort Elf air-sampling pump and a pre-weighed cassette with a 5 µg PVC filter. Pre- and post-sampling calibration was accomplished using a BIOS International DryCal DC1 primary calibration system. The sampling was conducted and analyzed in accordance with National Institute of Occupational Safety and Health (NIOSH) Method 0500. Samples were analyzed by a laboratory accredited by the American Industrial Hygiene Association (AIHA).

Area dust sampling was conducted during operation of the split frame clamshell. The actual cutting of pipes/tubes took approximately 2-5 minutes per pipe/tube. Therefore, area dust sampling was conducted throughout the entire process to assess the potential for dust generation and worker exposure during cutting operations. Area samples were taken at a central location in the general work area. A forklift was periodically operated in the area to remove the pipe/tube that was cut.

The area dust samples showed results of <0.072 mg/m^3 and <0.157 mg/m^3. These results are below the OSHA PEL of 15 mg/m^3 and the ACGIH TLV of 10 mg/m^3. (See Appendix B for sampling data).

Dust generation does not appear to be a concern during the operation of the split frame clamshell but since the time spent in the work area, the distance from the actual cutting operation, and ventilation in the work area may affect an individual worker's exposure level, a monitoring plan will need to be developed to account for the site specific conditions where the split frame clamshell is being used. A complete air sampling plan for a site will need to be developed to include not only dust but also other contaminants specific to the D&D project.

Area noise sampling was conducted during operation of the split frame clamshell. Since the actual cutting of pipes/tubes took approximately 2-5 minutes per pipe/tube, area noise sampling was conducted throughout the entire process to assess the potential for worker noise exposure during cutting operations with the split frame clamshell. Area samples were taken at a central location in the general work area. A forklift was periodically operated in the area to remove the pipe/tube that was cut. Area noise sampling was conducted using a Metrosonics db-3100 noise dosimeter. Calibration was conducted pre-and-post monitoring using a Metrosonics CL304 acoustical calibrator.

Monitoring was conducted for 2.4 hours (144 minutes) and 5.9 hours (352 minutes). Noise monitoring showed a noise dose of 12.52% which would give a time-weighted average (TWA), assuming no further noise exposure for the 8-hour shift, of 75.0 dBA and a noise dose of 34.28% (TWA – 82.3dBA). These area results show potential exposures from below to near to the OSHA "action level" of 85 dBA but below the PEL of 90 dBA. A projected 8-hour noise dose and resultant TWA showed the following results for the respective area samples: 41.60% (TWA – 83.6 dBA) and 46.66% (TWA – 84.5 dBA). These projected 8-hour noise doses also show potential exposures ranging from below to near to the OSHA "action level" but below the PEL.

During the monitoring periods, the noise levels were averaged for each one-minute period and then an overall average was calculated. This gave an average exposure level of 83.6 dB and 84.5 dB for the respective area samples. The maximum sound levels observed during monitoring were 106.5 dB and 107.1 dB.

The OSHA allowable "action level" is a noise dose of 50% or an 8-hour TWA of 85 dBA and the PEL for noise is a 100% dose or an 8-hour TWA of 90 dBA. The levels of exposure recorded during the testing demonstration may require the operators to be included in a hearing conservation program. In addition, engineering controls, administrative controls, and/or personal protective equipment (PPE - hearing protection devices) may be required. Differences in noise exposure will be based on the location of the worker in relation to the cutting operation and the amount of time the worker spends in that location. The sampling plan should also take into consideration the work environment since the noise levels may increase or decrease based on the construction of the enclosure where the cutting operation is taking place.

It should be noted that during operation of the clamshell, it became necessary to remove the muffler. This was due to problems associated with the humidity at the test demonstration site. It was noted that noise levels that had ranged from 92 – 94 dBA during operation of the clamshell rose to 99 – 100 dBA. Normal operation of the clamshell should not be done without the muffler in place.

HUMAN FACTORS INTERFACE

Workers using a technology for pipe/tube D&D activities may encounter a variety of contaminants when working in a hazardous waste site environment. This may include contaminants associated with the pipe/tube being dismantled, the material the pipe/tube is constructed of, or contamination inherent in the environment where the pipe/tube is located. Therefore, different levels of PPE, such as level A, B, C, or D or different types as PPE such as Anti-C, for radiation contamination may need to be utilized. These contaminants should be identified by the site characterization prior to the start of the D&D project.

The level of protection being utilized has the potential to cause several human factors interface problems. These may include, but not be limited to, visibility, manual dexterity, tactile sensation, an increase in heat stress, and an overall increase in physical stress.

TECHNOLOGY APPLICABILITY

There was no visible dust during the cutting operation and the air sampling results showed sampling values below the OSHA PEL and the ACGIH TLV. Metal shavings were left on the surface below the pipe/tube being cut by the split frame clamshell. These shavings were sharp and could therefore be a hazard to the worker when cleaning them up. They may also stick to the bottom of the worker's shoes/boots and be carried from the contaminated area to a clean area. One additional concern is dragging the air hoses across the sharp metal shavings. This has the potential to cause cuts, scrapes, and/or additional wear on the hoses and could cause them to weaken and rupture.

The split frame clamshell will need to be disassembled to be decontaminated. This will not necessarily guarantee that decontamination will be complete. If total decontamination is not possible, the equipment and/or parts of the equipment may need to be considered a consumable.

SECTION 4 - JOB SAFETY ANALYSIS

JOB SAFETY ANALYSIS
TRI TOOL INC.
Split Frame Clamshell
(Equipment Dismantlement)

HAZARD	CORRECTIVE ACTION
SETUP AND TEAR DOWN	
* Pinch Points	* Use of hand protection * Use of proper hand tools for the job
* Slips/Trips/Falls	* Awareness of the specific hazards * Organization of materials (housekeeping) * Walking around areas that are congested when possible * Walking around tripping hazards when possible * Marking, isolating, and/or bunching together tripping hazards such as air lines
* Muscular/Back Injury	* Ergonomic training including safe lifting techniques
ATTACHING/REMOVING CLAMSHELL (FROM PIPE/TUBE)	
* Slips/Trips/Falls	* Awareness of site specific hazards (cords, umbilical line, etc.) * Job site organization of materials (housekeeping) * Walk around hazards when possible * Marking, isolating, and/or bunching together tripping hazards such as air lines

HAZARD	CORRECTIVE ACTION
ATTACHING/REMOVING CLAMSHELL (FROM PIPE/TUBE)	
* Struck By/Fall from above (clamshell unintentionally releasing from pipe/tube)	* Assure all workers in the area are aware of where the clamshell is being attached. Do not allow workers to stand under the area where the clamshell has been attached to elevated pipes/tubes * Assure all workers have proper training before attaching and using the clamshell * Assure proper tools are used to tighten screws and that screws are tight before releasing hold on clamshell
* Exposure to Contaminant (when attaching/removing clamshell)	* Use of proper PPE, including respiratory protection
* Pinch Points	* Use of hand protection * Use of proper hand tools for the job * Assure workers are trained in proper method of attaching/removing the clamshell.
* Muscular/Back Injury	* Ergonomics training to include proper lifting techniques * Use two workers to lift, hold and tighten/loosen the screws to attach/remove the clamshell
* Cut/Laceration Hazard	* Assure workers are aware of the cutting tip location and proper positioning without coming into contact with it * Label on clamshell to indicate location of sharp cutting tip * Do not allow workers to rotate cutting tips with hands * Use tool to remove and replace cutting tip instead of using hands
ADJUSTING CUTTING TIP	
* Exposure to Contaminants	* Use of proper PPE, including respiratory protection * Worker training to use good work practices that will enable worker to avoid contact with any contaminated surfaces, i.e. the floor, walls, other structures in the area

HAZARD	CORRECTIVE ACTION
ADJUSTING CUTTING TIP (CONTINUED)	
* Muscular/Back Injury (from stooping, bending, etc.)	* Ergonomics training
* Slips/Trips/Falls	* Awareness of the specific hazards * Organization of materials (housekeeping) * Walking around areas that are congested when possible * Walking around tripping hazards when possible
* Pinch Points	* Use hand protection * Use of hand tools appropriate for the job
* Cut/Laceration Hazards	* Assure workers are aware of the cutting tip location and proper positioning without coming into contact with it * Label on clamshell to indicate location of sharp cutting tip * Do not allow workers to rotate cutting tips with hands * Use tool to remove and replace cutting tip instead of using hands
CUTTING (OPERATION)	
* Muscular/Back Injury (from stooping, bending, awkward arm positions)	* Ergonomics training
* Slips/Trips/Falls	* Awareness of site specific hazards (cords, umbilical line, etc.) * Job site organization of materials (housekeeping) * Walk around hazards when possible * Marking, isolating, and/or bunching together tripping hazards such as air lines
* Pinch Points (from rotating cutting rotating parts)	* Assure worker training in the proper operation of the clamshell * Guarding rotating parts so hand/fingers cannot be placed near the point of operation
* Cut/Laceration Hazard	* Assure worker training in the proper operation of the clamshell * Guarding rotating parts so hand/fingers cannot be placed near the point of operation of the cutting tip
CUTTING (OPERATION)	

HAZARD	CORRECTIVE ACTION
* Eye hazard/struck by (shavings)	* Use face shield with safety glasses with side shields or goggles * Standard Operating Procedures (SOPs) to prohibit placing face near the rotating parts area and cutting tip as it cuts the pipe/tube * Wear long sleeved clothing when operating clamshell * Assure clothing (PPE) is puncture resistant
* Struck by (air hose/high pressure air)	* Safety line to male and female end of fitting
* Noise	* Use engineering controls (do not operate clamshell without muffler) * Use administrative controls * Use proper hearing protection devices, as required
* Pressure Points	* Pad operating level so fingers not in direct contact with metal
* Exposure to Contaminants	* Assure workers are aware of the hazards in the area where they are using the clamshell * Use of proper PPE, including respiratory protection * Worker training to use good work practices that will enable worker to avoid contact with any contaminated surfaces, i.e. the floor, walls, other structures in the area
* Exposure to Oil (used in air lines)	* Assure Hazard Communication training for workers * Use as little oil as required for proper operation * Assure clamshell adjusted to keep oil spray at a minimum
GENERAL MAINTENANCE	
* Exposure to contaminant	* Wear proper PPE, including respiratory protection * Have something to sit or kneel on so do not have additional personnel exposure from sitting or kneeling on contaminated surface

HAZARD	CORRECTIVE ACTION
* Accidental activation of moving parts (pinch points)	* Use proper lockout/tagout techniques
* Pinch Points	* Use of hand protection * Use of hand tools appropriate for the job * Use of appropriate lockout/tagout procedures
* Slips/Trips/Falls	* Awareness of the specific hazards * Organization of materials (housekeeping) * Walking around areas that are congested when possible * Walking around tripping hazards, when possible
* Ergonomics/Bending/Kneeling/ Lifting	* Use proper lifting techniques * Ergonomic training to include proper lifting techniques

SECTION 5 - FAILURE MODE AND EFFECTS ANALYSIS

FAILURE MODE AND EFFECTS ANALYSIS
TRI TOOL INC.
Split Frame Clamshell
(Equipment Dismantlement)

FAILURE MODE	EFFECT
* Air line punctures/ruptures	* Potential for injury to worker from being struck by air line * Potential for injury to worker from high pressure air
* Air line fitting fails	* Potential for injury to worker from being struck by air line * Potential for injury to worker from high pressure air
* Cutting tip breaks/shatters	* Potential for worker to be struck by sharp piece of tip causing injury, of particular concern are eye injuries * Potential for pipe/tube being cut to become off center and break off striking worker, thereby causing injury
* Pipe/tube being cut fails	* Potential for injury to worker from being struck by the pipe/tube and/or clamshell as it falls
* Clamshell attachment mechanism fails	* Potential for injury to worker from being struck by clamshell as it falls

SECTION 6 - TECHNOLOGY SAFETY DATA SHEET

TECHNOLOGY SAFETY DATA SHEET
TRI TOOL INC.
Split Frame Clamshell
(Equipment Dismantlement)

<table>
<tr><th colspan="2">SECTION 1: TECHNOLOGY IDENTITY</th></tr>
<tr><td rowspan="3">Manufacturer’s Name and Address:

Tri Tool Inc.
3806 Security Park Drive
Schenley, PA 15682</td><td>Emergency Contact:
(916) 351-0144
(800) 345-5015</td></tr>
<tr><td>Information Contact:
(916) 351-0144
(800) 345-5015</td></tr>
<tr><td>Date Prepared:</td></tr>
<tr><td>Other Names:
Clamshell
Split Lathe</td><td>Signature of Preparer:

Operating Engineers National Hazmat Program
1293 Airport Road, Beaver, WV 25813, phone 304-253-8674, fax 304-253-7758

Under cooperative agreement DE-FC21-95 MC 32260</td></tr>
</table>

SECTION 2: PROCESS DESCRIPTION

The Tri Tool Split Frame Clamshell is a pipe lathe which employs a split rotary bearing design which can be divided into two or more sections (depending on the size of the clamshell). The clamshell requires minimal axial or radial clearances. The sections are placed around the outside of the pipe/tube to be cut and bolted together. The rotating cutting heads then cut either a straight or beveled cut from the outside diameter (O.D.) inward. The clamshell clamps completely around the O.D. of the pipe with clamp pads and jackscrews to provide a stable and secure clamp-up.

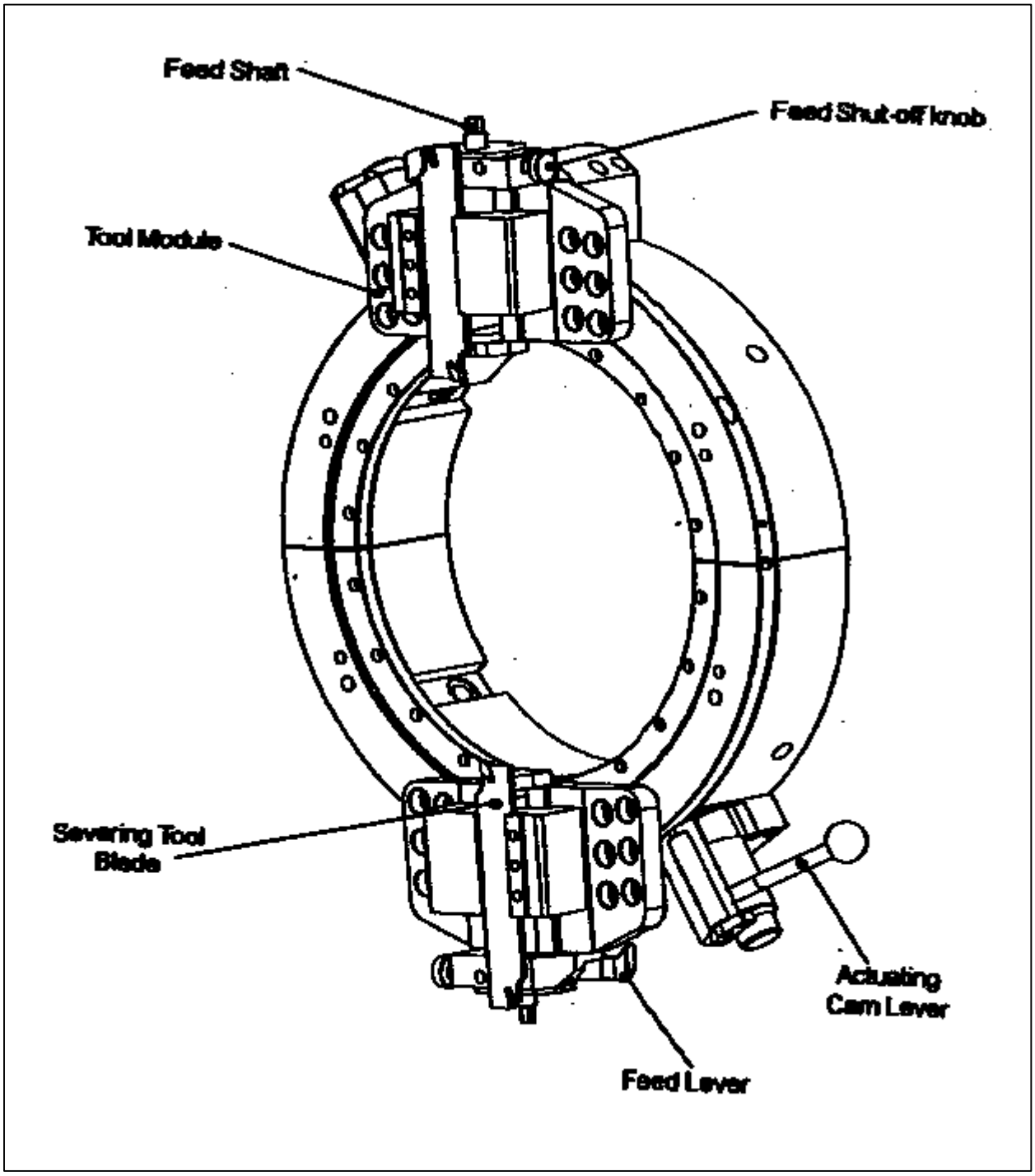
Clamshells are designed to cut pipe from ¼-inch to 60-inches in diameter. This is accomplished by having clamshells of varying sizes and incorporating an adjustable O.D. mounting system, as required, to fit the pipe diameter. The clamshell also features an enclosed drive gear and bearing surface and a multi-positionable motor mount. Additional features of the Split Frame Clamshell may vary depending on the size of the clamshell, including internal counterbore machining and worm drive tool modules to reduce vibration and extend tool bit life.

The automatic feed star wheels and adjustable slideways provide incremental tool bit feed for controlled cut depth. The star wheels mount on the rotating face of the clamshell and carry the tool bits within the tool holder section. The tool bit is fed into the pipe/tube at a fixed revolution of the head stock with one tripper pin assembly engaged. Multiple trippers increase the total feed of the tool bit per revolution. The star wheels provide 0.0025-inch of radial feed per revolution. The tool bits are carbide cutting bits.

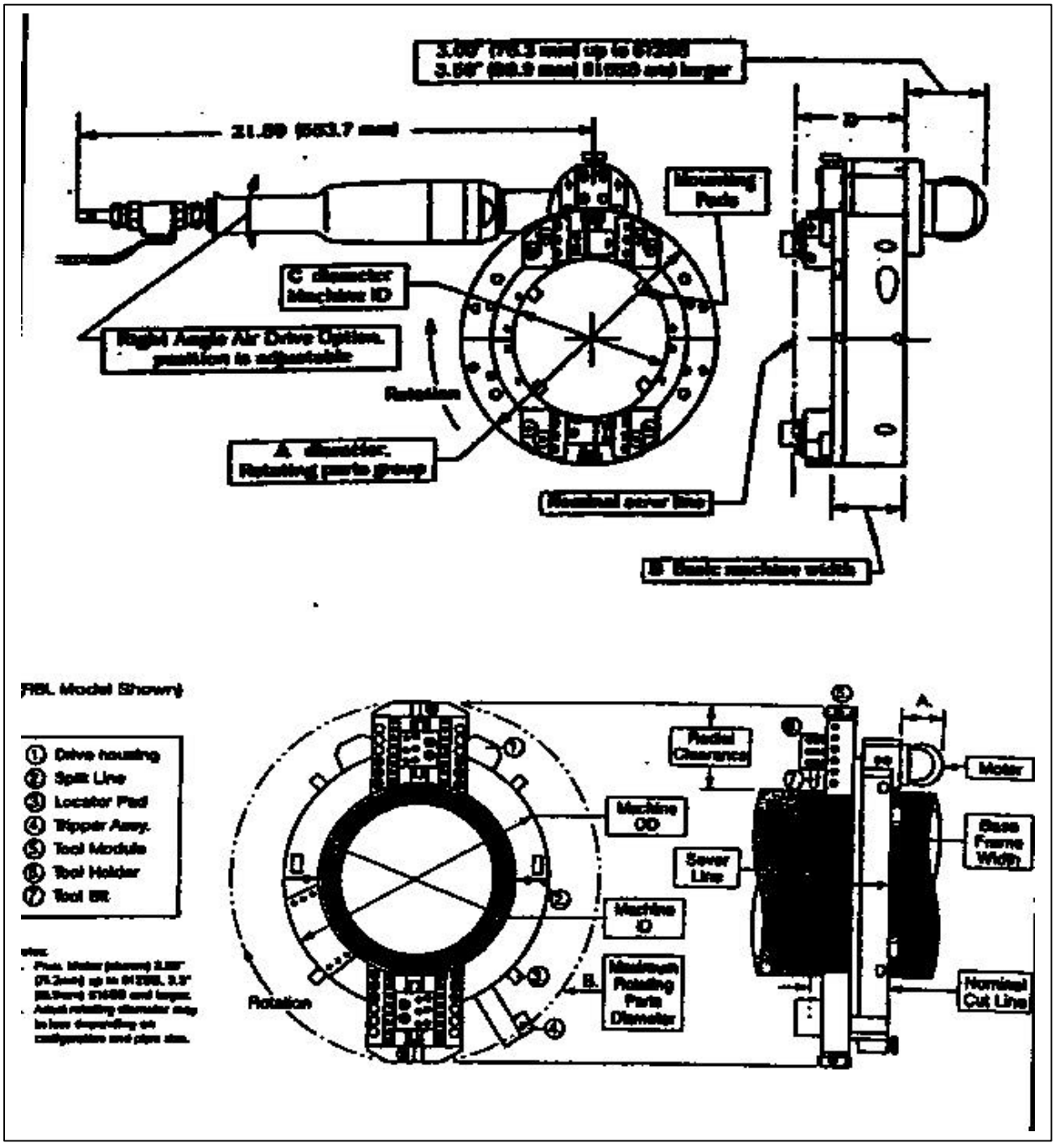
The Split Frame Clamshell can be pneumatically, hydraulically, or electrically powered. Pneumatic power provides the maximum power per unit weight, electric powered are for light duty machining, and hydraulic motors provide the maximum power and speed range capabilities at the machine. Dual drives can be fitted for additional power and machining capabilities.

The operator control for the Split Frame Clamshell is located on the shaft of the multi-positionable motor mount. The on-off control is a lever mechanism designed for four finger operation. It works as a “dead man” switch, shutting down the clamshell if pressure is released off of the lever.

SECTION 3: PROCESS DIAGRAMS



SECTION 3: PROCESS DIAGRAMS



SECTION 4: CONTAMINANTS AND MEDIA
Dust generation does not appear to be a concern with the split frame clamshell. Consideration does need to be given to contamination in the area where the clamshell is being used for D&D activities. An air sampling plan will need to be developed, as appropriate for the site where the clamshell is being used.

SECTION 5: ASSOCIATED SAFETY HAZARDS	
Probability of Occurrence of Hazard: 1 Hazard may be present but not expected over background level 2 Some level of hazard above background level known to be present 3 High hazard potential 4 Potential for imminent danger to life and health	
A. ELECTRICAL (LOCKOUT/TAGOUT)	RISK RATING: N/A
Not part of this technology (unless electrically operated model is used).	
B. FIRE AND EXPLOSION	RISK RATING: 1
Technology does not pose this hazard in and of itself but could not be used in an explosive environment due to the potential for sparking.	
C. CONFINED SPACE ENTRY	RISK RATING: 1
Not part of this technology unless the specific location where the clamshell is being used is a confined space. In this case, confined space procedures would need to be followed.	
D. MECHANICAL HAZARDS	RISK RATING: 4
Attaching and removing the clamshell from the pipe/tube to be cut may pose the following: pinch points and struck by hazards. There is potential for injury from the rotating star wheels. Guarding of the area needs to be considered and proper precautions taken. Loose clothing should not be worn when working around the clamshell.	
E. PRESSURE HAZARDS	RISK RATING: 2
The airlines and high pressure air may present hazards, proper precautions indicated. The airline fittings should have safety lines connecting the male and female half of the fitting.	
F. TRIPPING AND FALLING	RISK RATING: 3
Air lines present potential hazards.	

SECTION 5: ASSOCIATED SAFETY HAZARDS (CONTINUED)	
G. LADDERS AND PLATFORM	RISK RATING: 2
Not part of this technology but may be required for D&D activities. All regulations for working from ladders and platforms, including the OSHA scaffolding standard, must be followed.	
H. MOVING VEHICLE	RISK RATING: 2
Not part of this technology but may be required for D&D activities. All precautions and safety requirements for large pieces of equipment will need to be followed. For example, all moving vehicles should have working back-up alarms, warning lights, etc.	
I. BURIED UTILITIES, DRUMS, AND TANKS	RISK RATING: N/A
Not part of this technology.	
J. PROTRUDING OBJECTS	RISK RATING: N/A
Not part of this technology.	
K. GAS CYLINDERS	RISK RATING: N/A
Not part of this technology.	
L. TRENCHING AND EXCAVATIONS	RISK RATING: N/A
Not part of this technology.	
M. OVERHEAD LIFTS	RISK RATING: 2
Not part of this technology but may be required during D&D activities. All applicable standards and precautions must be followed for the type of equipment used. At a minimum, anyone in the work area should be wearing a hard hat.	
N. OVERHEAD HAZARDS	RISK RATING: 2
May be part of this technology if the pipe/tube being cut is overhead. At a minimum, anyone working in the area should be wearing a hard hat. It needs to be assured that all workers in the area are aware of the clamshell placement and avoid the area when the clamshell is overhead.	

SECTION 6: ASSOCIATED HEALTH HAZARDS	
A. INHALATION HAZARD	RISK RATING: 1
Technology does not appear to produce dust during operation. Other hazards that may be present in the area will be identified from the site characterization.	
B. SKIN ABSORPTION	RISK RATING: 2
This would be dependent on the contaminants at the site and would be identified by the site characterization. The oil used in the air lines may present a skin hazard.	

SECTION 6: ASSOCIATED HEALTH HAZARDS (CONTINUED)	
C. HEAT STRESS	RISK RATING: 1-4
Ambient conditions, work rates, and PPE levels must be considered.	
D. NOISE	RISK RATING: 2
The technology presents a potential noise hazard.	
E. NON-IONIZING RADIATION	RISK RATING: N/A
Not part of this technology.	
F. IONIZING RADIATION	RISK RATING: 1-4
Not part of this technology, but may be associated with the area where D&D activities are taking place.	
G. COLD STRESS	RISK RATING: 1
Technology does not produce a hazard, but ambient conditions need to be considered.	
H. ERGONOMIC HAZARDS	RISK RATING: 3
Poses ergonomic hazards associated with lifting, bending, twisting, stooping and kneeling. These may cause injury/strain to the back, shoulders, arms, knees, hips and/or legs.	
I. OTHER	RISK RATING: 3
Laceration/cutting hazards present from the cutting tip of the clamshell, the sharp shavings from the metal being cut, and the edge of the piece that was cut. Appropriate hand protection should be used.	

SECTION 7: PHASE ANALYSIS
A. CONSTRUCTION/START-UP
The set-up/start-up phase presents several hazards including pinch points, laceration hazards, slips/trips/falls struck by, fall from above hazards, and muscular/back injury.
B. OPERATION
The operational phase presents several hazards including exposure to contaminant, muscular/back injury, pinch points, laceration hazards, slips/trips/falls, pinch points, struck by hazards, fall from above hazards, and exposure to noise.
C. MAINTENANCE
The maintenance phase presents several hazards including pinch points, laceration hazards, slips/trips/falls, muscular/back injury, exposure to contaminants, and accidental activation of moving parts.

SECTION 7: PHASE ANALYSIS (CONTINUED)
D. DECOMMISSIONING
The decommissioning phase presents several hazards, including exposure to the contaminant, pinch points, laceration hazards, slips/trips/falls, and muscular/back injury.

SECTION 8: HEALTH AND SAFETY PLAN REQUIRED ELEMENTS
A. AIR MONITORING
Dust does not appear to be a concern during operation of the clamshell. Monitoring may need to be conducted for contaminants in the area where the D&D activities take place. This will be determined by the site characterization prior to the initiation of the D&D project. Noise monitoring will need to be conducted.
B. WORKER TRAINING
Training that may apply in this case may include but not be limited to: HAZWOPER (Hazardous Waste Operations and Emergency Response), HAZCOM (Hazard Communication), PPE (Personal Protective Equipment) Training, Hearing Conservation, Ergonomics (proper lifting, bending, stooping, kneeling), specific training for equipment operation, CPR/First Aid/Emergency Response/Bloodborne Pathogens, Lockout/Tagout, Hand Signal Communication, and Construction Safety (OSHA 500) and/or General Industry Safety (OSHA 501).
C. EMERGENCY RESPONSE
Emergency response planning for a site needs to assure adequate coverage for hazards described in the TSDS. Having at least one person per shift trained in CPR and first aid is recommended.
D. MEDICAL SURVEILLANCE
Evaluation of personnel's general health with emphasis on the cardiovascular and respiratory system, and back. In addition, medical surveillance as required by OSHA standards must be conducted. Initial and annual audiograms may be required.
E. INFORMATIONAL PROGRAM
Workers must be trained in specific operation of equipment before use.

SECTION 9: COMMENTS AND SPECIAL CONSIDERATIONS
Only personnel who have been adequately trained in the operation of this technology should be permitted to operate and/or work with the equipment.

SECTION 7 - EMERGENCY RESPONSE/PREPAREDNESS

The use of the Tri Tool Split Frame Clamshell would not be applicable in an emergency response situation.

Emergency response/preparedness must be part of every hazardous waste site safety and health plan. In addition to credible site emergencies, site personnel must plan for credible emergencies in connection with the split frame clamshell.

All precautions used when responding to an emergency situation at the site will apply. Before entering an area where the split frame clamshell is being used, the equipment needs to be completely shut down (de-energized).

This technology does not appear to present conditions that could lead to an out-of-the-ordinary emergency. Consideration does, however, need to be given to assuring the pipe/tube being cut can handle the load of the clamshell placed on it.

SECTION 8 - REGULATORY/POLICY ISSUES

The site safety and health personnel where the Tri Tool Split Frame Clamshell is being used need to be concerned with safety and health regulations applicable to the issues discussed above. Regulations that apply may be divided into four categories. Core requirements are those regulations that would apply to any hazardous waste work site, regardless of the type of job. Technology specific requirements are those regulations that apply due to the specific technology being used. Special requirements are standards and policies that are specific to the technology itself and are required by reference in a regulation. Best management practices are not required but are recommended by organizations such as the American National Standards Institute (ANSI), NIOSH, Department of Energy (DOE), National Fire Protection Association (NFPA), etc. These regulations/standards may include but not be limited to the following:

Core Requirements:

- ♦ OSHA 29 CFR 1926.25 Housekeeping
- ♦ OSHA 29 CFR 1910.141 Sanitation (1910.141(a)(3) covers housekeeping)
- ♦ OSHA 29 CFR 1926 Subpart Z Toxic and Hazardous Substances
- ♦ OSHA 29 CFR 1910 Subpart Z Toxic and Hazardous Substances
- ♦ OSHA 29 CFR 1926.59 Hazard Communication

- OSHA 29 CFR 1910.1200 Hazard Communication
- OSHA 29 CFR 1926.65 Hazardous Waste Operations and Emergency Response
- OSHA 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response
- Occupational Safety and Health Act 1970(5)(a)(1) General Duty Clause

Technology Specific Requirements:

- OSHA 29 CFR 1910.147 The Control of Hazardous Energy (Lockout/Tagout)
- OSHA 29 CFR 1910 Subpart O Machinery and Machine Guarding
- OSHA 29 CFR 1910 Subpart P Hand and Portable Powered Tools
- OSHA 29 CFR 1926 Subpart I Tools – Hand and Power
- OSHA 29 CFR 1926.52 Occupational Noise Exposure
- OSHA 29 CFR 1910.95 Occupational Noise Exposure
- OSHA 29 CFR 1926.102 Eye and Face Protection
- OSHA 29 CFR 1910.133 Eye and Face Protection
- OSHA 29 CFR 1926.28 Personal Protective Equipment
- OSHA 29 CFR 1910.132 General Requirements (Personal Protective Equipment)
- OSHA 29 CFR 1926.23 First Aid and Medical Attention
- OSHA 29 CFR 1910.151 Medical Services and First Aid
- OSHA 29 CFR 1910.1000 Toxic and Hazardous Substances

Best Management Practices:

- ACGIH Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices
- NIOSH Revised Lifting Equation, 1994

In addition to the above regulations and policies, it is imperative that all workers have appropriate and adequate training for the task and associated safety and health hazards. Training that would be required may be divided into four categories. Core training is that which is required for anyone entering a hazardous waste site to perform work, regardless of the type of job. Technology specific training is that training which is specific to the technology and required by safety and health standards. Special training is that which is specific to the technology to assure the worker is adequately trained for the task, but is not necessarily required by safety and health standards. Best management practices are trainings that while not mandated by health and safety standards, provide information and knowledge to the worker that will allow the worker to perform his/her job safely. Training to be applied for the Tri Tool Split Frame Clamshell may include but not be limited to:

Core Training Requirements:

- HAZWOPER
- HAZCOM

Technology Specific Training:

- Hearing Conservation
- Personal Protective Equipment
- Lockout/Tagout

Special Training:

- Job specific training for equipment operation

Best Management Practice Training:

- Machine Guarding
- Ergonomics (proper lifting, bending, stooping, kneeling)
- Heat stress (learning to recognize signs and symptoms)
- CPR/First Aid/Emergency Response/Blood-borne Pathogens
- Hand Signal Communication

- Construction Safety (OSHA 500) and or General Industry Safety (OSHA 501)

SECTION 9 - OPERATIONAL CONSIDERATIONS & RECOMMENDATIONS

Recommendations made here for improved worker safety and health take into consideration the operation of the split frame clamshell with a pneumatically powered motor. Specific recommendations include:

- Workers must be aware of the tripping hazards associated with hoses that are necessary to operate the equipment. Keeping these as orderly as possible in compliance with good housekeeping regulations will help avoid injury due to tripping.

- The operators need to have training in ergonomics to assure proper techniques in lifting, bending, stooping, twisting, etc. during equipment setup, operation, maintenance, and decontamination.

  Attaching and removing the clamshell to the pipe/tube to be cut may require the operator to assume awkward positions, in particular when the pipe/tube is in a difficult to reach location, in a congested area, or elevated. This has the potential to place strain on the back, neck, shoulders, arms, knees, and legs. It is recommended that this be taken into consideration prior to the start of the job and work practices to mitigate this be applied. In addition, training in ergonomics, including using proper lifting techniques needs to be conducted for operators of the split frame clamshell.

  Operating the split frame clamshell has the potential to cause the operator to assume positions which place stress on the back, neck, shoulders, arms, knees, and legs. This is partially due to the position in which the clamshell had to be placed on the pipe/tube. The multi-positionable motor mount with the operating lever helps to alleviate a lot of the stress causing positions, but there is still the potential for stress to the body areas discussed above.

  One situation where awkward operator positioning is most prevalent during operation is when the cut on the pipe/tube must be made at floor level. The clamshell is placed at the bottom of the pipe/tube with the star wheels and cutting tool facing toward the floor. The motor mount with the operating lever is placed on the part of the clamshell facing the ceiling. This will allow the operator to comfortably operate the clamshell without additional stress on the back, neck, shoulders, arms, etc. If, however, the operator needs to observe the cutting operation, he/she must kneel, bend at the waist and turn the neck toward the cutting operation. At the same time, he/she must reach up to the operating lever on the motor mount. The arm will be in a laterally rotated, hyper-extended

position and the wrist will be in a deviated position. This has the potential to place a significant amount of stress on the knees, back, neck, shoulder, arm, and wrist. Consideration needs to be given to the placement of the clamshell in relation to operational parameters. In this situation, as well as others that may arise, it is recommended that a two person operation be used, one to observe the operation and one to operate the control lever. Note: the person observing the operation should not place the face near the area of operation due to the potential for sharp metal shavings to be thrown from the area.

- The operating lever is a metal lever designed for multiple finger operation. It is recommended that the lever be padded to avoid pressure points on the operator's fingers/hand.

  The operating lever acts as a “dead-man” switch, meaning that if the operator releases pressure on the lever the clamshell stops. Therefore, the lever should never be held down by anything other than the operator's fingers/hand during cutting operations.

- Noise monitoring showed the potential for operators to be below or at the "action level" of 85 dBA. If this level of exposure had continued for an 8-hour work shift, the potential exists for the operator to be exposed above the OSHA PEL of 90 dBA. Noise needs to be considered a potential hazard when the cutting operation is taking place. The operators may be required to be included in a hearing conservation program. In addition, engineering controls, administrative controls and/or PPE (hearing protection devices) may be required. The level of exposure will be influenced by the amount of time the worker spends in the area where the cutting operation is taking place and the distance the operator is from the operation. Exposure will also be influenced by the construction of the area where the clamshell is being used and the size of the clamshell. A monitoring program will need to be developed to address the site specific conditions where the split frame clamshell is being used. Additionally, the clamshell should never be operated without the muffler in place. Noise levels are increased when the muffler is removed.

- The equipment did not generate any visible dust during operation and air sampling results showed total dust levels below the OSHA PEL of 15 mg/m^3 and the ACGIH TLV of 10 mg/m^3. Dust does not appear to be a concern during cutting operations but it is recommended that a sampling plan be developed, as appropriate, based on any other contaminants in the work area that were identified by the site characterization.

- Metal shavings were left on the surface below the pipe/tube being cut by the split frame clamshell. These shavings are sharp and therefore, present a hazard to the workers when cleaning up the work area. It is recommended that the

shavings be cleaned up by sweeping or vacuuming. Hands or compressed air should never be used to clean up the shavings. Puncture resistant gloves should be utilized, as appropriate.

The metal shavings may be thrown outward from the area where the cut is being made. These have the potential to cause injury, especially eye injury. Safety glasses with side shields or goggles should always be worn during operation of the clamshell. There may be instances where the use of face shields are also warranted. It is also recommended that SOPs disallow the practice of placing the face in the area of the clamshell during operation.

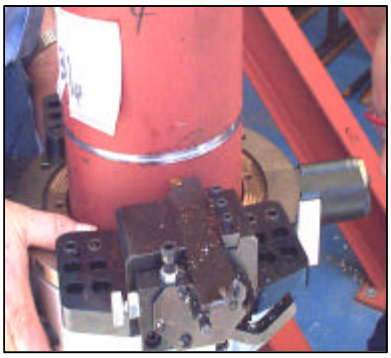


Figure 6. Clamshell showing rotating mechanism with star wheels and cutting tip in place.

The cut pipe/tube pieces may have sharp edges. This presents the potential for laceration/cut injuries from handling these pieces. It is recommended that puncture resistant gloves be worn when handling cut pieces.

♦ The rotating star wheels with the cutting tip have the potential to cause serious injury if the operator were to place his/her fingers in this area during operation. It is recommended that machine guarding be used on this area to prohibit fingers/hands being placed at the point of operation during cutting. Consideration should be given to a clear shield with an interlock to stop operation if raised. Guarding this area would also prohibit the operator from trying to stop the star wheels with his/her hands and removing shavings while the star wheels are rotating. Both of these practices have the potential to cause severe injury.

There is also the potential for worker injury if a piece of loose clothing, jewelry, or long hair were to get caught in the rotating parts during cutting operations. It is recommended that loose clothing and jewelry not be worn when operating the clamshell and that long hair be held back. Special consideration needs to be given to the type of PPE that may be required and any hazards this may present in relation to the rotating parts of the clamshell.

♦ The split frame clamshell was pneumatically powered. The air hoses required to provide high pressure air for operation have the potential to cause injury to the operator if a fitting were to fail. The airlines were connected with quick connect fittings. It is recommended that a safety line between the male and female halves of the fitting be used to keep the hose from becoming a struck by hazard if the fitting failed.

The air hoses or the high pressure air itself has the potential to cause injury to an operator if the air hose were to rupture. It is recommended that all hoses be inspected to assure they are in good condition before use. This is particularly important because of the sharp edges (shavings and cut pipe/tube) the hose may be in contact with throughout the cutting operation.

- The clamshell weights vary, depending on the size of the clamshell, from 11.5 pounds to 1120 pounds. If the pipe/tube or the anchors on the pipe/tube to be cut cannot hold the weight of the clamshell, worker injury could result from collapse of the pipe/tube. It is recommended that before the cutting operation begins, the pipe/tube structure and/or anchors be evaluated to assure they can support the weight of the clamshell.

- As with any lathe-type operation, the system can bind during operation. It is recommended that the clamshell have an automatic shut-off should this occur. Binding can cause the cutting tip to shatter and become a projectile with the potential to cause worker injury.

- As with any pneumatically operated piece of equipment, oil must be used. This presents the potential for the operator to be exposed to the oil either when putting the oil into the air hose or if the oil sprays from the piece of equipment. It must be assured that all workers have had Hazard Communication Training for the hazardous chemicals they are working with and material safety data sheets (MSDS) must be provided.

  If oil gets on the worker's PPE, if required, the PPE could be compromised. This needs to be taken into consideration and it needs to be assured that any PPE being used in the area where cutting operations are taking place be compatible with the oil. This may be of particular concern if Anti-C PPE is being worn.

  If oil gets on the surfaces in the work area, it has the potential to then be a secondary contamination. If the oil gets on the walking surfaces in the work area, it can cause these surfaces to be slippery, thereby having the potential to cause injury to workers from falls. It is recommended that the initial pre-operational checks for the clamshell be conducted before entering the work area to assure the proper adjustments have been made to control the oil spray. Any oil spilled or sprayed should be cleaned up immediately in compliance with good housekeeping standards.

The environment where the D&D activities are taking place has the potential to affect both the dust and noise levels generated. Therefore, the need for an air sampling and noise monitoring program needs to be assessed on a site-by-site job-by-job basis.

APPENDIX A
REFERENCES

DOE Lessons Learned, Identifier 1997-RL-FDH-0001, http://www.hanford.gov/lessons/site11/1197/970001b.htm

DOE Lessons Learned, Identifier 1995-RL-WHC-040, http://www.hanford.gov/lessons/site11/1195/95e040.txt

DOE Lessons Learned, Identifier 1995-RL-WHC-0037, http://www.hanford.gov/lessons/site11/1195/95i037.txt

Keller's Official OSHA Safety Handbook, J.J. Keller & Associates, Nihau, Wisconsin, 1996

National Safety Council, Accident Prevention Manual for Business and Industry, 11th Edition, 1997

Occupational Safety and Health Standards for General Industry, 29 CFR Part 1910, Occupational Safety and Health Administration United States Department of Labor

Occupational Safety and Health Standards for the Construction Industry, 29 CFR Part 1926, Occupational Safety and Health Administration United States Department of Labor

Threshold Limit Values (TLV's) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEI's), American Conference of Governmental Industrial Hygienists, 1995-1996

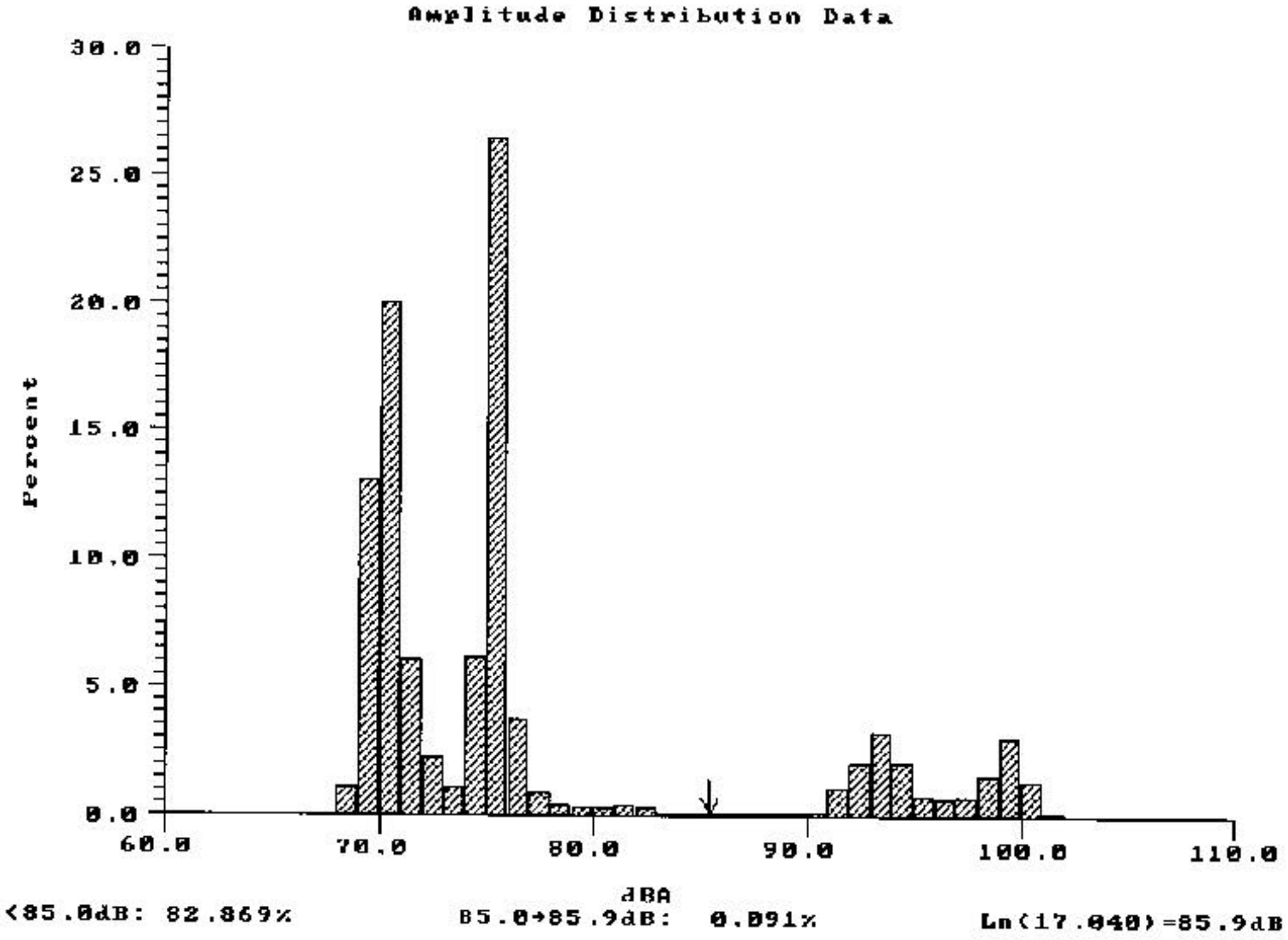
U.S. Department of Health and Human Services, Manual for the Revised NIOSH Lifting Equation, January 1994

APPENDIX B
IH SAMPLING DATA

Pegasus International, Inc. EBE 250VHC Shot Blasting System Total Dust Sampling			
Date	**Sample Number**	**Analyte**	*** Results**
8/18/98	081898-FIU-015	Total dust	< 0.157 mg/m^3
8/18/98	081898-FIU-016	Total dust	< 0.072 mg/m^3
8/18/98	081898-FIU-017	Blank	< 0.05 mg

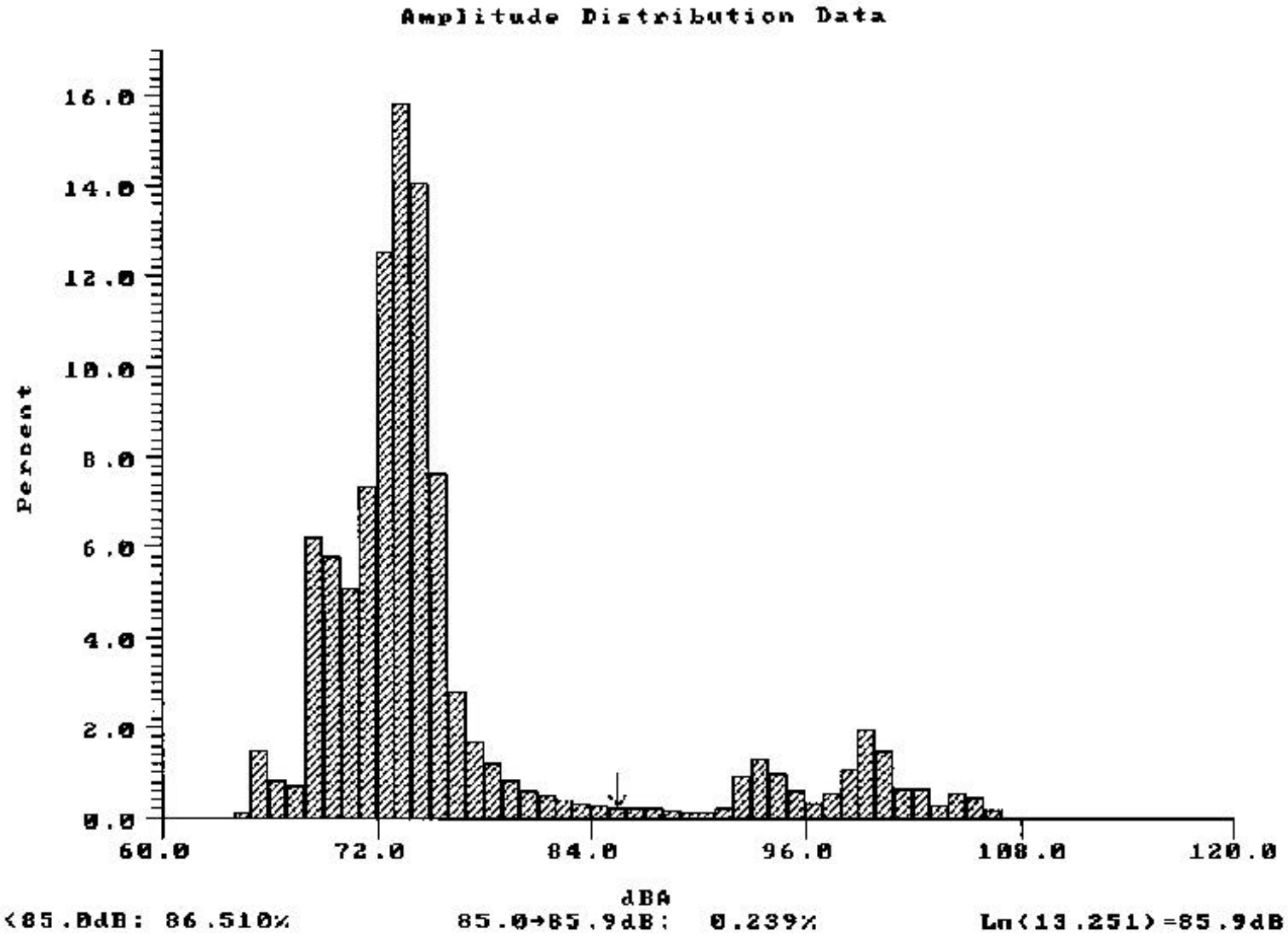
* The OSHA PEL for total dust is 15 mg/m^3 and the ACGIH TLV is 10 mg/m^3. Current sampling was conducted for total dust. The need to sample for respirable dust and silica has to be considered during the coating and concrete removal process.

NOISE SAMPLING



The percentage of time spent at each decibel level can be obtained from the graph. As shown, 82.869% of the time the noise exposure was less than 85 dBA, which means 17.131% of the time, was spent at sound levels above 85 dBA. OSHA requires that a hearing conservation program be initiated if the 8-hour TWA is 85 dBA.

NOISE SAMPLING



The percentage of time spent at each decibel level can be obtained from the graph. As shown, 86.510% of the time the noise exposure was less than 85 dBA, which means 13.490% of the time, was spent at sound levels above 85 dBA. OSHA requires that a hearing conservation program be initiated if the 8-hour TWA is 85 dBA.

APPENDIX C
ACRONYM SHEET

ACGIH	-	American Conference of Governmental Industrial Hygienists
AIHA	-	American Industrial Hygiene Association
ANSI	-	American National Standards Institute
ASTM	-	American Standards for Testing Materials
CFR	-	Code of Federal Regulations
D&D	-	decontamination and decommissioning
DOE	-	Department of Energy
FIU	-	Florida International University
HAZCOM	-	Hazard Communication
HAZWOPER	-	Hazardous Waste Operations
HEPA	-	high efficiency particular air (filter)
MSDS	-	Material Safety Data Sheet
NIOSH	-	National Institute of Occupational Safety and Health
NFPA	-	National Fire Protection Association
O.D.	-	outside diameter
OSHA	-	Occupational Safety and Health Administration
PEL	-	permissible exposure limit
PPE	-	personal protective equipment
PVC	-	polyvinyl chloride
SOP’s	-	standard operating procedures
TLV	-	threshold limit value
TSDS	-	Technology Safety Data Sheet
TWA	-	Time Weighted Average
µg	-	micrograms