Appendix 4: The hierarchy of protection under PUWER and SMSR

In selecting safeguarding measures for drilling and piling rigs, dutyholders should apply the following hierarchy of protection, with the use of guards being highest in the hierarchy.

Fixed guards - are practicable for machines or applications where sections do not need to be routinely added or removed or the process is completely automated and enclosed. Fixed guards need to be secured so that a tool is needed to remove them, e.g. bolted to the mast or frame.

Moveable interlocked guards - are practicable to prevent access to the dangerous rotating part where access to the drill string is routinely needed during the work process. Opening the guard should activate the interlock so that dangerous rotation stops.

Where some rotation is needed this is known as restricted operating mode (ROM) – e.g. to make or break drill rod threaded connections - and the following measures are required:

- Rotational speed should be limited on re-start with the guard open to a speed as low as practicable and no more than 30rpm;
- With the guard open, a jog control should give no more than ½ rotation per control operation;
- Feed speed should be restricted to 15m/min or 10cm per activation (20m/min on horizontal directional drilling rigs);
- An indicator should be automatically activated to warn the operator that the rig is operating in the restricted operating mode;
- All controls should be 'hold to run' during ROM and on releasing the rotation control, motion should stop within less than ½ a revolution;
- Full rotational speed should only be available on restart with the guard shut;
- Rotating/moving parts within reach distance (i.e. up to 2.5m above the ground/operators position) should be restricted speed/motion during ROM.

Interlocked guards are practicable for vertical, horizontal and inclined drilling operations.

Guards should not be removed to enable working close to structures - rather the borehole/pile location should be redesigned or the guard should be redesigned to make the rig more versatile. Under exceptional circumstances only, barriers may be used to prevent access to the rotating drill/auger. Note that BS EN 16228 Part 1 (Clause 5.23.2.2.5) does allow full speed operation with auger and drill string guards removed in confined areas. This must be in a 'Special Protective Mode' (SPM) - which specifies that controls are hold to run; a warning signal is activated; and additional pressure sensitive devices

are fitted. Pressure sensitive devices include: pressure mats; pressure bars; and trip wires. The Construction Sector view is that where practicable, pile locations should be designed and plant selected to allow use of guards. Where SPM is used the user should provide justification and control measures within their risk assessment.

See Appendix 3 section on mini piling rigs as these machines are often selected for use in confined areas. Appendix 6 is also relevant to mini rigs as many owners were known to fit trip-wires instead of guards when HSE first asked the industry to improve control of entanglement issues.

Trip-wires - do not prevent access to the rotating part but may mitigate injury. Separate guidance can be found at Appendix 6.

Pressure sensitive mats - are another option favoured by some European suppliers but rarely seen in the UK. These are designed to be placed by the rig crew in the danger areas around the rotating drill/auger and shut off rotation etc if they are stepped on.

Advanced protective devices - are available but are not in widespread use. They are defined in the Machinery Directive (2006/42/EC) in that they must stop moving parts of machine before a person can touch them and moving parts can only be operated in ROM while they are within the operator's reach. Protective devices are still a developing technology with radar, light, infrared, ultrasonic, proximity/RIFD being investigated. (Note that systems which depend on the person carrying a transponder do not provide collective protection). Current UK research suggests that some proximity devices can be effective at preventing someone reaching into or entering the protected zone, whilst coping with small pieces of spoil and water spray. Inspectors may find drilling rigs fitted with proximity devices undergoing field trials in the UK and Construction Sector Safety Unit would like to receive any observations. Once the technology is proven in practice these systems may move up the hierarchy.