Activity Hazard Analysis (AHA) — Pile Driving Operations

Overall RAC: **M** · SAMPLE formatted to EM 385-1-1 (15 March 2024) and ENG Form 6206 (SEP 2024) conventions. Adapt every step, hazard and control to actual site conditions; requires competent-person preparation, SSHO review and Government acceptance before the definable feature of work begins (EM 385-1-1 2024, para 2-6). Contracts solicited before 15 March 2024 remain governed by the 2014 edition — verify which edition your contract cites.

JOB STEPS	HAZARDS	CONTROLS	RESIDUAL RAC
Mobilization, utility locates, and pre-work planning	Contact with above- or below-grade utilities by the rig, leads, or driven pile	• Develop the site-specific pile driving safety plan before any driving or extraction begins, identifying the location of all above- and below-grade utilities (16-7.e(1)). • Obtain and review a geotechnical report identifying subsurface and surface conditions at each pile location before finalizing rig travel paths and pile layout (16-7.e(5)). • Designate specific areas for equipment operations and material storage clear of marked utility corridors and overhead lines (16-7.e(2)).	L
	Unauthorized personnel entering the pile driving work zone	• Implement the controlled work area plan from the 16-7.e safety plan — physical barricades and signage that prevent access by anyone not directly involved in the operation (16-7.e(7)). • Notify the KO or COR within 24 hours of any LHE entering the site so government spot checks can occur before operations start (16-5.c). • Brief the controlled-area boundaries at the preparatory meeting and have every involved employee review and sign the AHA before starting work (para 2-6.d(2)).	L
Assembly of crane, leads, and hammer	Struck-by or crushing injury during assembly/disassembly of pile driving equipment	• Follow the written assembly and disassembly sequence required in the site-specific pile driving safety plan (16-7.e(3)). • Assemble pile driving leads using only the approved fasteners and torque values required by the manufacturer, with leads of adequate size, length, and strength for the hammer, pile, and driving position (16-8.ff(10)(a)). • Comply with all manufacturer's instructions and procedures; where none exist, use QP-developed operational procedures and RPE-sealed capacity procedures (16-8.a, 16-8.ff(2)).	M
	Structural failure of a modified excavator or forklift pile-driving attachment	• Have a Registered Professional Engineer design any LHE pile driving attachment used for other than its intended purpose, such as an excavator or forklift modified for pile driving (16-8.ff(3)). • Have an RPE seal and sign the procedures related to the capacity of the equipment before use (16-8.ff(2)(b)). • Permit only operators trained and authorized on the specific pile driving attachment to run it, with the manufacturer's load rating charts for approved attachments kept onsite (16-8.ff(4), 16-8.ee(2)(d)).	L
	Rig tipover or instability during setup	• Provide guys, outriggers, thrust outs, counter-balances, or rail clamps as necessary to maintain stability of the pile-driver rig (16-8.ff(9)). • Verify ground bearing capacity against the geotechnical report and prepare mats or pads at each setup location before positioning the rig (16-7.e(5)).	M
Rigging and hoisting piles into the leads	Dropped pile from rigging failure or accidental disengagement	• Have a Qualified Rigger inspect all rigging and rigging hardware before use each shift and as necessary during use, per manufacturer's instructions and ASME B30 (15-5.a). • Perform all pile hoisting and driving using a closed shackle or other positive attachment that prevents accidental disengagement of the rigging (16-8.ff(15)(b)). • Keep all employees clear of piling being hoisted into the leads (16-8.ff(15)(a)).	M
	Struck-by from a swinging or rotating pile during hoisting	• Use taglines to control unguided piles and free-hanging (flying) hammers (16-8.ff(15)(c)). • Use a qualified signal person to direct the operator whenever the load or landing area is not in the operator's full view (29 CFR 1926 Subpart CC). • Restrict the hoisting path to the controlled work area established under 16-7.e(7).	L

JOB STEPS	HAZARDS	CONTROLS	RESIDUAL RAC
Driving piles (impact or vibratory hammer)	Hammer disengages from the leads and falls or rises uncontrolled	• Equip the pile driver with positive and negative restraint devices to prevent accidental hammer disengagement from the leads (16-8.ff(1)). • Verify stop blocks are installed in the leads to prevent the hammer from being raised against the head block (16-8.ff(10)(d)). • Install guards across the top of the head block to prevent the wire rope from jumping out of the sheaves (16-8.ff(12)). • Place a blocking device capable of supporting the hammer's weight in the leads under the hammer whenever employees must work under it, except momentary lean-through to guide a pile (16-8.ff(10)(f)).	M
	Ground crew struck by the hammer, pile, or debris ejected during driving	• Keep all personnel except the equipment operator out from under the kicker/spotter and at least 12 feet (or greater if the manufacturer specifies) from the hammer or pile while it is being driven (16-8.ff(6)). • Prohibit employees from being on the leads or ladders while a pile is being driven (16-8.ff(10)(b)). • Provide the crane/track hoe/forklift operator station with falling object protection (16-8.ff(7)). • Keep lead landings clear — store nothing on them (16-8.ff(10)(c)).	M
	Whipping of pressurized steam, air, or hydraulic lines on hose or joint failure	• Securely attach all pneumatic or steam hose connections to hammers, pile ejectors, and jet pipes with at least 1/4-inch alloy steel chain with a 3,250 lb WLL (or wire of equal strength) to prevent whipping if a joint breaks (16-8.ff(13)). • Provide two shutoff valves in hydraulic/pneumatic/steam line controls, one a quick-acting lever type within easy reach of the hammer operator (16-8.ff(14)). • Perform daily documented inspections covering fuel lines, pressurized hoses, clamps, welds, and hardware before each shift of driving (16-7.e(6)).	L
	High-intensity impact noise exposure to operator and ground crew	• Require hearing protection for all personnel inside the controlled work area, with dual protection (plugs plus muffs) near operating impact hammers per the project hearing conservation program. • Position non-essential personnel outside the 12-foot exclusion distance and rotate ground crew to limit exposure duration (16-8.ff(6)).	L
Cutting off driven pile tops	Cut-off crew struck by an adjacent pile or hammer while driving continues	• Suspend pile-driving operations during cut-off work unless the cutting operation is located at least twice the length of the longest pile cut-off away from the driver (16-8.ff(17)). • Keep cut-off work inside the controlled work area with only directly involved personnel present (16-7.e(7)).	L
	Falling or rolling cut-off section striking workers	• Rig each cut-off section with a positive attachment before completing the cut so the section is lowered under control rather than dropped (16-8.ff(15)(b)). • Stage cut-off sections in the designated material storage area, blocked against rolling (16-7.e(2)).	L
Pile extraction (when required)	Crane overload or tipover while pulling piling	• Use a pile extractor if piling cannot be pulled without exceeding the load rating of the equipment (16-8.ff(18)(a)). • Equip the crane with an LMI device when pulling piling, unless the load can be determined, is within the crane's load rating chart, and the boom is not raised more than 60 degrees above horizontal; vibratory pulling devices are excepted (16-8.ff(18)(b)). • Never pull piling by tipping the crane, momentarily releasing the load brake, and catching the load before the crane settles (16-8.ff(18)(c)). • Use a hook with a positive locking safety device when rigging for pile pulling (16-8.ff(18)(d)).	M

JOB STEPS	HAZARDS	CONTROLS	RESIDUAL RAC
Barge-mounted / waterborne pile driving (if applicable)	Barge listing, taking on water, or crane breaking loose from its flotation	• Have a Competent Person inspect the means used to secure the crane to the barge each shift for wear, corrosion, loose or missing fasteners, defective welds, water leaks, and insufficient tension (16-5.i(1)). • Have a CP perform the monthly flotation inspection: taking on water, deck load securement, water-tight compartments and hatches, and firefighting and lifesaving equipment in place and functional (16-5.i(2)). • Remove the vessel or flotation device from service immediately if a QP determines an identified deficiency constitutes a hazard (16-5.i(3)). • Comply with Chapter 19, Floating Plant and Marine Activities, for all work from floating plant (Ch 19).	M
	Fall into water / drowning	• Provide fall protection per Chapter 21 for workers on fixed leads exposed to falls of 6 feet or greater, or any fall over water, machinery, or dangerous operations — guardrails or personal fall protection with certified anchorages (16-8.ff(10)(i)). • Provide US Coast Guard-approved PFDs and rescue equipment for personnel working over or adjacent to water per Chapter 19 (Ch 19).	M
Demobilization, disassembly, and cleanup	Uncontrolled hammer movement while relocating or breaking down the rig	• Lower the hammer to the bottom of the leads whenever the pile driver is being moved (16-8.ff(15)(d)). • Follow the disassembly sequence documented in the site-specific pile driving safety plan (16-7.e(3)). • Maintain the controlled work area until leads, hammer, and counterweights are down and secured for transport (16-7.e(7)).	L

Equipment To Be Used

• Crane, excavator, or purpose-built pile driving rig (LHE per Ch 16) with load rating charts onsite

• Pile driving leads (fixed or swinging) with stop blocks, head block guards, and hammer blocking device (16-8.ff(10))

• Impact or vibratory hammer with positive and negative restraint devices (16-8.ff(1)) and cushion blocks

• RPE-designed pile driving attachment, if using a modified excavator or forklift (16-8.ff(3))

• Rigging hardware: slings, closed shackles or positive-locking attachments, taglines (Ch 15; 16-8.ff(15))

• Pile extractor and LMI-equipped crane for extraction work (16-8.ff(18))

• Safety chains (min 1/4-in alloy steel, 3,250 lb WLL) on all pneumatic/steam hose connections (16-8.ff(13))

• Guys, outriggers, thrust outs, counterbalances, or rail clamps for rig stability (16-8.ff(9))

• Barge/floating plant with lifesaving and firefighting equipment, if waterborne (Ch 19; 16-5.i)

• PPE: hard hat, safety glasses, hearing protection (dual near impact hammers), hi-vis, safety-toe boots; PFDs over water

Training Requirements

• Crane operator certification (written and operational testing) plus employer qualification and written designation before operating any LHE (16-3.a, 16-3.c)

• Class I crane operator training: minimum 24-hour initial and minimum 8-hour refresher at least every 5 years, per ASME B30 syllabus (16-3.d); Class II operators: minimum 2-hour initial and minimum 1-hour refresher every 5 years (16-3.e)

• Operators of pile driving attachments trained and authorized on the specific attachment (16-8.ff(4))

• Qualified Rigger training and demonstrated proficiency: load calculations, rigging principles, equipment limitations, hazards, and inspection procedures (15-3.b)

• Signal person qualification per 29 CFR 1926 Subpart CC (1926.1428)

• All involved employees review and sign the AHA before starting work, and after any update (para 2-6.d(2))

Inspection Requirements

• Pile driving leads: inspected at least weekly with documented findings; equipment removed from service immediately on any safety deficiency (16-5.j, 16-8.ff(10)(g))

• Daily documented inspections of the hammer, cushion blocks, rigging, fuel lines, pressurized hoses, clamps, welds, hardware, and all other pile driving equipment (16-7.e(6))

• LHE shift, monthly, and annual inspections per Ch 16, ASME standards, and manufacturer's instructions (16-5.a, 16-5.e)

• Rigging and rigging hardware inspected by a Qualified Rigger before use each shift and as necessary during use (15-5.a)

• Barge/flotation securement inspected each shift and full vessel inspection monthly by a CP, when operating from floating plant (16-5.i)

• All LHE test and inspection records maintained onsite and available on request (16-5.b); KO/COR notified within 24 hours of LHE arriving onsite (16-5.c)

Competent / Qualified Person Requirements

• Competent Person(s) who prepare the AHA (para 2-6.d(1)), designated in writing by name on the form

• Certified, qualified crane/LHE operator designated in writing by the employer, with certifications documented in the AHA (16-3.a, 16-6.a)

• Lift Director — competent and qualified on lift operations, able to develop, review, and approve lift plans (16-3.b)

• Qualified Rigger for all rigging work and shift rigging inspections (15-3, 15-5.a)

• Competent Person for pile driving lead and LHE inspections, and for barge/flotation inspections on waterborne work (16-5.j, 16-5.i)

• Registered Professional Engineer for design of modified pile driving attachments and equipment capacity procedures (16-8.ff(2)(b), 16-8.ff(3))

References

• EM 385-1-1 (2024) Ch 16 — Load Handling Equipment

• EM 385-1-1 (2024) 16-8.ff — Pile Driving Operations

• EM 385-1-1 (2024) 16-7.e — Pile Driving — Site-Specific Safety Plan (Minimum Plan Requirements)

• EM 385-1-1 (2024) 16-5.j — Pile Drivers — Weekly Documented Pile Driving Lead Inspections

• EM 385-1-1 (2024) 16-6 — Activity Hazard Analysis (AHA) Requirements for LHE

• EM 385-1-1 (2024) 16-3 — Personnel Required Qualification/Training (LHE Operators)

• EM 385-1-1 (2024) Ch 15 — Rigging

• EM 385-1-1 (2024) Ch 19 — Floating Plant and Marine Activities (waterborne pile driving)

• EM 385-1-1 (2024) para 2-6 — Activity Hazard Analysis (AHA) Requirements

• 29 CFR 1926.603 — Pile driving equipment (Subpart O)

• 29 CFR 1926 Subpart CC (1926.1400–1926.1442) — Cranes and Derricks in Construction