

# MONOPILE GRIPPER ARMS (MGA)

Fixing the position of the monopiles during lowering to the seabed for stability and safety



## Application

- + Construction of Offshore Wind Farms (OWFs) – Monopile Foundations Installation

The Gripper Arms provide the horizontal restraint required to resist environmental forces acting on the large foundation piles during installation, providing a necessary support for efficient installation and to reduce safety hazards.

## BENEFITS

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- Provide the horizontal restraint required to maintain accuracy and seep up pile installation
- Arms require minimal deck space. They are mechanically stowed “latched” at main deck level.
- Inherently safe with fail safe hydraulics and redundancy
- Single console on deck located on the deck for efficiency

## HIRE OPTIONS

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Houlder has one unit available for hire.

## RELEVANT CODES, STANDARDS & LEGISLATION

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The Monopile Gripper Arm system complies with the requirements of:

- DNV-OS-C101-Design of Steel Structures, General, LRFD Method, April 2011

All operations shall be engineered in accordance with the most recent versions of, or similar to:

- Design according to the regulations stated in the European Machinery Directive Regulations and derived standards (e.g. EN ISO 14122)
- Noble Denton Guidelines 0030 – Guidelines for the Marine Transportations
- DNV Rules for Planning and Execution of Marine Operations (DNV-OS-J101)
- DNV-GL Guidelines (DNVGL-ST-N001)
- Applicable Danish Law
- International Maritime Organization Standards & Guidelines
- SOLAS & MARPOL

# TECHNICAL DETAILS

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## DESIGN PARAMETERS

The main design parameters are presented below:

### Main Design Parameters

Monopile max diameter	7.5m
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## OPERATING CONDITIONS

The main operating conditions are listed below:

### Main Operating Conditions

Significant wave height	2m
Max current	3knots

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Conditions vary with pile diameter. Smaller piles may have higher limits.

## SYSTEM SPECIFICATION

In recognition of the system requirements and in response to general requirements, the main design specifications are listed below:

- To be fitted on the deck of a nominated construction vessel in a location with sufficient space to maximise the capacity of the main crane
- Shall provide lateral stability and restrain to monopiles
- Maximum permissible load during the installation of piles is approximately 150t side load
- Shall be designed to withstand all forces imposed during the positioning of monopiles taking into account all necessary DAF factors and the potential loads imposed by pile oscillations during installation
- The system shall provide adequate lateral adjustability to ensure the pile is installed within a vertical tolerance of  $\pm 0.25^\circ$
- Tolerance for positioning radially in plan from consented location to be  $\pm 1.5m$
- To be designed such that it is safe as is reasonably practicable and does not present a significant risk to health or environment
- Can be integrated with Houlder Upending Frame
- Gripper Arm allows hammer sleeve to pass during piling by opening of jaws
- Equipment to include safe and easy access structures particularly on the arms
- Maintenance friendly

## SYSTEM COMPONENTS

The following list gives an indication of the main items and components that make up the gripper system.

### System Components

Jaw assembly (x2)

Inner arm assembly (x2)

Outer arm assembly (x2)

Hinge assembly (x2)

Outer cylinder (x2)

Inner cylinder (x2)

Lifting cylinder (x2)

Lifting link assembly (x2)

Lifting frame assembly (x2)

Deck frame assembly (x2)

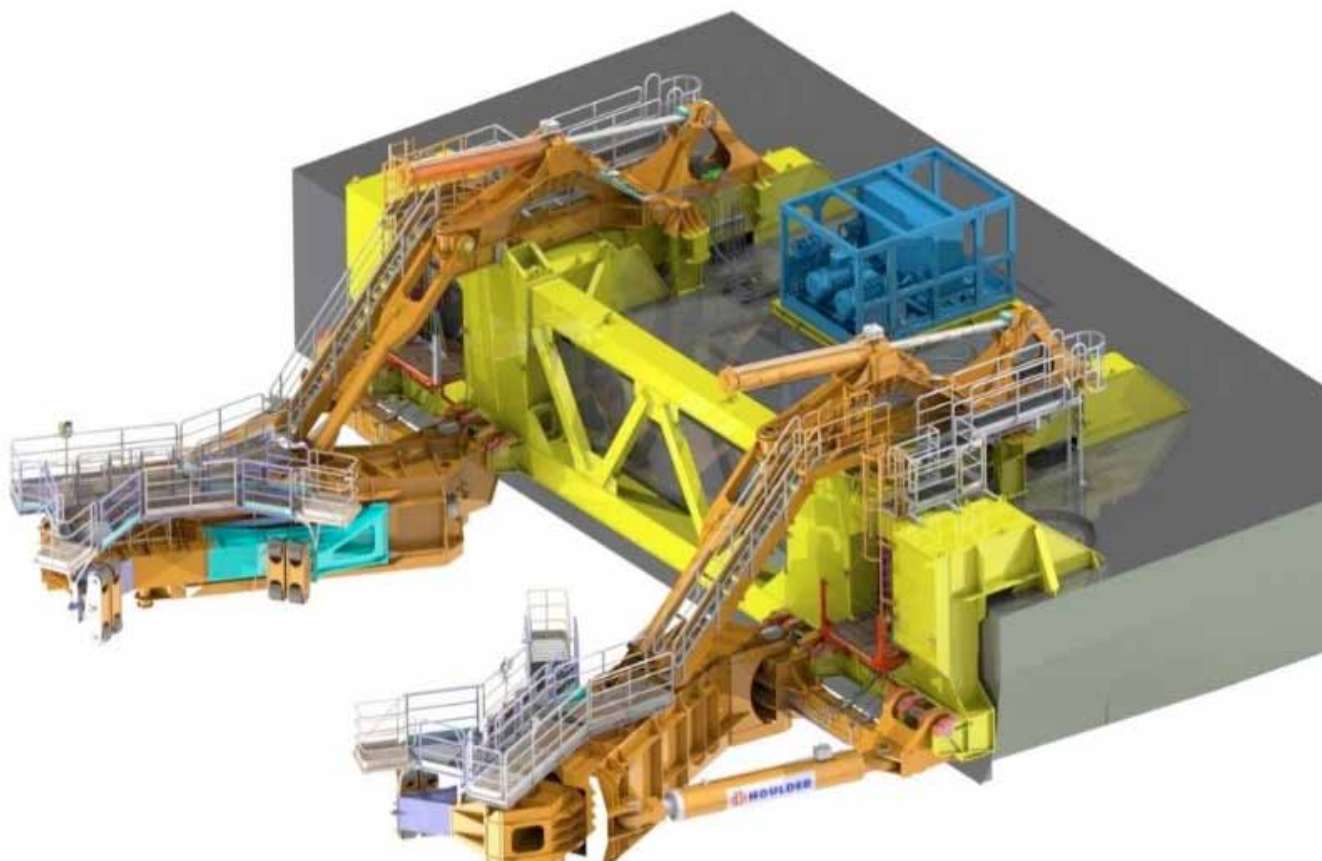
Grillage

Hydraulic Power Unit (HPU)

## HPU

The equipment is powered by a twin 110kw Hydraulic power that is electrically driven, open frame and deck mounted. The HPU is supplied with a 2000ltr stainless steel tank. The optimal position for the HPU is between the two deck frames as shown in Figure 3 however it will require repositioning for this specific project due to the location of the Upending Hinge. The equipment requires the following power supply which is expected to be derived from vessel power and distribution system:

- 415/440v 3ph
- 50/60HZ
- 200A



## OPERATING PROCEDURE & FUNCTION

The following operations are typically undertaken during monopile installation:

- The windfarm construction vessel (loaded with piles) is positioned over reference target at pre-defined orientation. (Orientation can depend on cable routes, current and weather data etc.) Vessel is jacked to working height
- The gripper arms are lowered to the horizontal position, one arm at a time. Both arms will be at their maximum opening with both outer cylinders fully retracted
- The gripper arms are extended at their mid-stroke position and are kept opened
- The pile is upended from horizontal to vertical using installation vessel crane and deck tools
- Crane moves the pile to the pre-calculated crane radius (actual centre of gripper radius). This radius varies according to pile diameter
- Crane slews until centre of pile meets the centre line of gripper arms
- The pile is lowered through the open pile gripper. Pile is kept out of the water
- The pile orientation is verified and pile may be rotated as required
- The pile gripper arms are closed around the pile to restrain and guide it laterally. A small gap is maintained between the gripper jaws and the pile
- The pile is lowered through the open pile gripper until the self-weight penetrates the seabed
- Pile inclination is verified (by human intervention) and adjusted by the gripper arms if necessary to bring the pile to the 'true vertical' position
- The main crane is unlatched from the pile (via pile upending and lifting tool)
- The main crane installs the driving hammer on to the pile top
- Pile inclination is frequently verified (by human intervention) before and between the hammering operations (hammer blows). The inclination of the pile is adjusted by the gripper arms if necessary to maintain its vertical position
- The pile is driven to the predetermined depth where the pile can hold itself vertically without the assistance of the gripper. The gripper arms are then fully opened to allow clearance for the pile hammer
- The pile is driven to the target depth
- The gripper is retracted and raised prior to the "Transition Piece" installation

## TRAINING

Training can be provided to personnel nominated by the client. Training shall comprise of on-site, hands on supervisor operator and maintainer training. This will be specific to the equipment supplied under this agreement and instruction in the procedures and routines contained in the equipment's operations and maintenance manual. The client shall only nominate personnel that it considers to be competent and experienced generally within their respective roles, in offshore lifting and installation works.

## OFFSHORE SUPPORT

Houlder can make available one offshore technician familiar with the system operation and troubleshooting to sail with the nominated installation vessel on the first cycle. Alternatively Houlder can provide offshore operations for the full offshore period to operate the gripper.

## MAINTENANCE

Houlder can carry out maintenance work on the items of equipment in accordance to the O&M manual. Client may carry out such work using personnel trained to do so.



# VARIATIONS

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## HOULDER MGA-01

Houlder provided the first Monopile Gripper Arm system to MPI Offshore in 2013 which is installed upon their wind turbine installation vessel the MPI Discovery. The equipment has aided installation works for various windfarm projects including the London Array, Humber Gateway, Amrumbank West & Rampion offshore windfarms. The system is currently configured to handle piles with a maximum diameter of 6.5m

The system has aided the monopile installation works of the Rampion Offshore Windfarm and was demobilised from Swire Blue Ocean's Pacific Orca during November 2016.

The equipment differs from the original design due to the incorporation of a modular grillage which enables the system to be connected to the vessel deck with no attachment to the transom. This allows the equipment to be mobilised and demobilised from vessel to vessel.

## HOULDER MGA-02

Houlder recently supplied a system to Rampion Offshore Wind Ltd (a subsidiary company of E.ON Climate & Renewables) as part of a hire agreement.

## 7.5M JAW

The existing gripper's jaw configuration can be modified to suit a maximum pile diameter of 7.5m.





Houlder is an independent, innovative offshore engineering company. We build on 30 years' offshore expertise and work closely with clients to design solutions for their technical challenges. We provide complete EPCI services with special equipment, consultancy, project management and engineering solutions for the offshore wind and wider energy sector.

## CONTACT US

### HOULDER LIMITED

22 Witney Way  
Boldon Business Park  
Tyne & Wear  
NE35 9PE  
UK

**T:** +44 (0)191 536 2777

[enquiries@houderltd.com](mailto:enquiries@houderltd.com)

[www.houderltd.com](http://www.houderltd.com)