# MALAYSIAN STANDARD

MS 2690-4:2022

# Petroleum and natural gas industries — Specific requirements for offshore structures — Part 4: Geotechnical and foundation design considerations (ISO 19901-4:2016, MOD)

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**ICS: 75.180.10**

Descriptors: petroleum and natural gas industries, offshore structures, geotechnical and foundation design

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## Committee representation

The National Standards Committee on Petroleum and Gas (NSC H) under whose authority this Malaysian Standard was developed, comprises representatives from the following organisations:

Department of Occupational Safety and Health Malaysia
Department of Standards Malaysia (Secretariat)
Energy Commission
Federation of Malaysian Manufacturers - Malaysian Industrial Gases Manufacturers Group
Fire and Rescue Department of Malaysia
Malaysia Automotive, Robotics and IoT Institute
Malaysian Gas Association
Malaysian Oil & Gas Engineering Council
Malaysian Palm Oil Board
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The Institution of Engineers, Malaysia
The Malaysian Association of Hydrogen Energy
Universiti Kebangsaan Malaysia
Universiti Teknologi Malaysia
Universiti Teknologi PETRONAS

The Technical Committee on Offshore Structures (NSC H/TC 9) which supervised the adoption of the ISO Standard as Malaysian Standard consists of representatives from the following organisations:

Asian Geos Sdn Bhd
Bureau Veritas (M) Sdn Bhd
Construction Industry Development Board
Department of Occupational Safety and Health Malaysia
Department of Standards Malaysia (Secretariat)
Malaysia Marine and Heavy Engineering Sdn Bhd
Muhibbah Engineering (M) Bhd
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## National foreword

The adoption of the ISO Standard as a Malaysian Standard was recommended by the Technical Committee on Offshore Structures (NSC H/TC 9) under the authority of the National Standards Committee on Petroleum and Gas (NSC H).

This standard is a modified adoption of ISO 19901-4:2016, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 4: Geotechnical and foundation design considerations*, published by the International Organization for Standardization (ISO) with the following modifications:

a) in the source text, “this International Standard” should read “this Malaysian Standard”;

b) the comma which is used as a decimal sign (if any), to read as a point;

c)

| **Clause/Subclause** | **Modifications** |
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| 5.4 c) permanent instrumentation | Add the word “stiffness” such that it reads,<br><br>“there is a need for monitoring the whole foundation with respect to penetration, settlement, stiffness, tilt or other behaviour;” |

**Explanation**: The word “stiffness” is added to signify the important need to apply appropriate soil property that will impact on dynamic response and fatigue characteristic of offshore structures. There is a need to manage ageing asset with foundation integrity issues related to lateral movement of piles. The stiffness properties are related to soil lateral stiffness.

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| 6.1 General | Add as the last paragraph,<br><br>“An integrated geohazard investigation and assessment constitute the determination of the values of geotechnical parameters, assessment of geological hazards and its constraints. Results of an integrated study of the area using geophysical surveys, marine soil investigation and geotechnical engineering should be used to develop a geological model of the area and hazard map, especially for deep water locations and shallow water locations with identified geohazard risks.” |

**Explanation**: The paragraph is added to provide need to manage via an integrated approach investigations and assessments required to place jack-ups at high-risk locations. The understanding of geological model is highlighted as it provides necessary guidance during planning.

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| 6 | Geotechnical data acquisition and identification of hazards | Add as a new subclause “6.5 Multi-layered soils condition”,<br><br>“Multi-layered soil condition can cause foundation damage to mobile jack-up units. This condition exists due to existence of strong over weak clay or sand over weak clay conditions. If circumstance dictate the need to locate mobile jack-up units in location with such condition, risk assessment on placement has to be conducted (see National Annex A).” |

**Explanation**: The new subclause is added as there is a need to manage jack-up punch through or rapid penetration failures due to jack-up rig incidences. Jack-up rig incidences has impact to cost and reputation.

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| 7.1 | General | Add the paragraph as 6th bullet,<br><br>“The stability of structures placed near location with deeper water depth should consider assessment on both geotechnical stability and relevant structural strength checks (refer ISO 19905-1).” |

**Explanation**: The paragraph is added to improve engineering practices for placement of jack-up in water depths deeper than 90 m, considering both geotechnical soils bearing capacity and structural related stability analyses.

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| 7.1 | General | Add as the third paragraph,<br><br>“On-bottom stability analysis of offshore pipelines, jacket and MOPU needs due considerations on immediate or long-term installation effects.” |

**Explanation**: The paragraph is added to raise various concern on overlooking different type of offshore structures due to different loading considerations which could impact on cost and overall time to install. On-bottom stability analysis of offshore pipelines could result in unreasonable pipe embedment and thicker coating requirements. On-bottom stability analysis of jackets and MOPUs could result in jacket and MOPU tilting.

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| 7.3.4.6 | Interaction with other structures | Add as the last paragraph,<br><br>“When mobile jack-up rig units are placed in vicinity of existing offshore structures an integrated geohazard assessment (geotechnical and structural assessment) shall be conducted (see ISO 19905-1, 9.4.8).” |

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**Explanation**: The paragraph is added to provide clarity on jack-up rig placed in vicinity of existing offshore structures. If no assessment is done, potential to identify hazard due to jack-up leg penetration or extraction could have impact on the pile integrity.

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| 8.5 | Soil reaction for piles under lateral actions | Add as a new subclause "8.5.8 Alternative method for lateral soil resistance",<br><br>"For purpose of foundation integrity assessment in very soft to soft clay, an alternative method as proposed by reference OTC-24842-MS can be considered." |

**Explanation**: The new subclause is added as several field test data of laterally loaded piles indicate that the measured pile response under static loading is stiffer than predicted by the API RP 2A method.

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| 8.6.2 | Axial behaviour | Add as the last paragraph,<br><br>"For axial soil reaction, the axial pile interaction in a pile group can be applied by using a z-modifier for the T-z single pile data as per 8.4. The z-modifier is a multiplication factor for all z values in the T-z single pile data. The group effect of end-bearing (Q-z) can be ignored." |

**Explanation**: The paragraph is added to provide guidance on effect of pile group effect.

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| 8.6.3 | Lateral behaviour | Add as the last paragraph,<br><br>"The group effect can be modelled by using a Y-modifier for the P-Y data of single pile as per 8.5. The Y-modifier is a multiplication factor for all y values of the cyclic P-Y data." |

**Explanation**: The paragraph is added to provide guidance on effect of pile group effect.

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| | National Annex A | Inclusion of "Preliminary hazard map for preliminary risk rating for offshore Malaysia soils". |

**Explanation**: The map is included to show the preliminary hazard level for offshore Malaysia soils.

Compliance with a Malaysian Standard does not of itself confer immunity from legal obligations.

NOTE. MOD on the front cover indicates a modified standard i.e. a standard adapted from an International Standard with permitted technical deviations, which are clearly identified and explained. The changes in structure are permitted provided that the altered structure permits easy comparison of the content of the two standards. Modified standards also include the changes permitted under identical correspondence.

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