Prepared by OWIC Environment & Consents workstream

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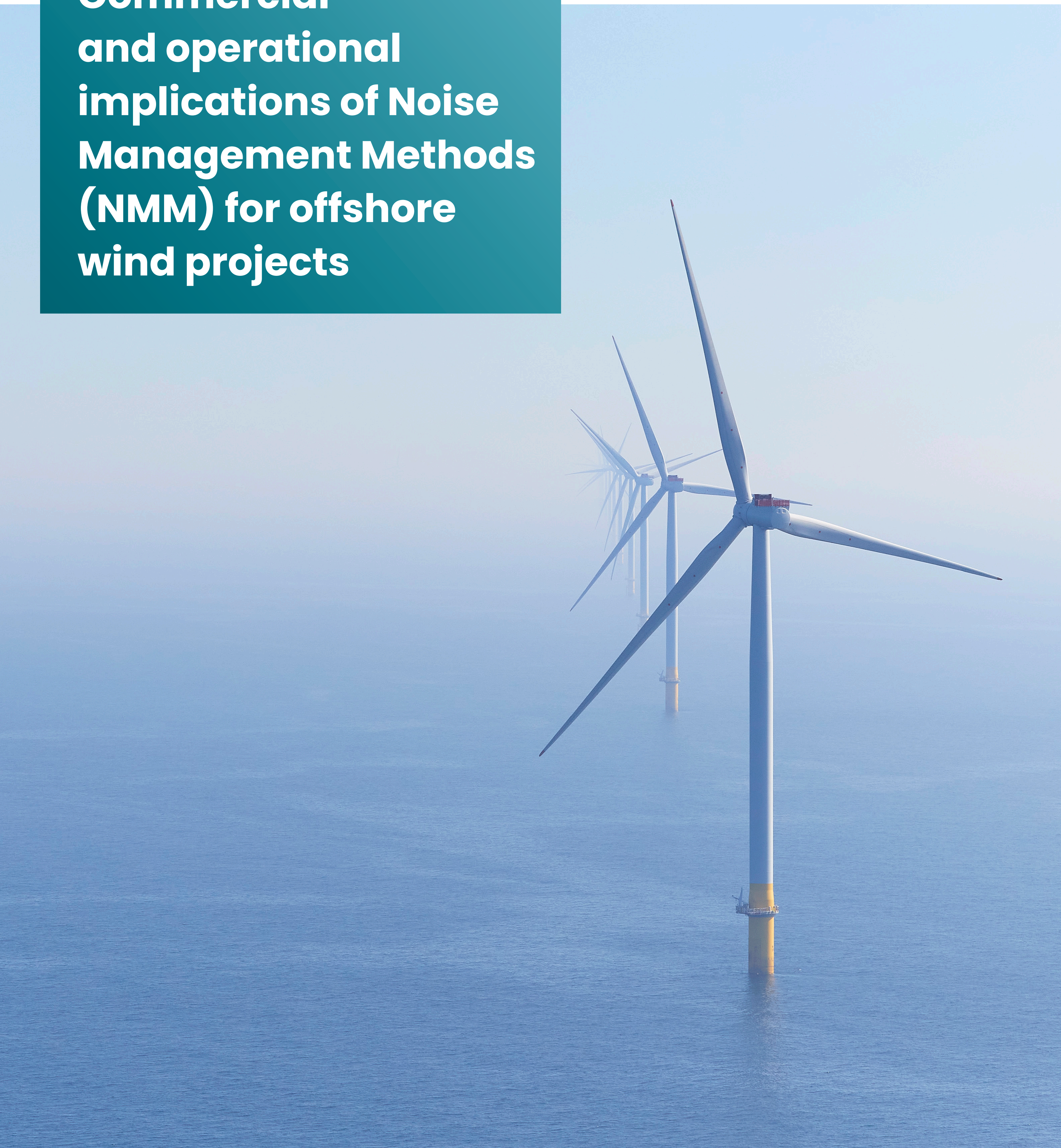
Offshore Wind Industry Council

Evidence Note: Commercial and operational implications of Noise Management Methods (NMM) for offshore wind projects



Evidence Note: Commercial and operational implications of Noise Management Methods (NMM) for offshore wind projects

1. Summary

This note provides a summary of the commercial and operational implications that are considered by offshore wind projects when assessing the feasibility of deploying different Noise Management Methods (NMM). This is a broad term which captures both Noise Abatement Systems (NAS) that are technologies which attenuate the underwater noise that is produced (e.g. bubble curtains) and Noise Mitigation Systems (NMS) that are designed to reduce the production of noise at source (e.g. Hammer attachments). Feedback from offshore wind project developers has been collated by the Offshore Wind Industry Council's Environment and Consents (OWIC E&C) team for the purpose of informing the development of policy on marine noise and supporting well informed consent and licence decisions.

This note is limited to the commercial implications of different NMM, however developers have also shared information on NMM efficacy and wider environmental issues which is being used to support our understanding of the potential broader ecological implications of different NMM.

The collated feedback serves to demonstrate, through information provided by live projects in development, construction and operation phases, the wider project implications resulting from the new requirement to deploy NMM for projects from 2025 onwards. It also provides evidence to inform the feasibility of any future decibel limit currently under consideration. Key points include:

- Overall incurred direct costs for NMM are high, ranging from **£2.9 million to £122 million for a single system for one project**. These costs include, where developers have been able to provide the relevant information, estimated mobilisation, equipment modification and contractual costs. The highest costs are quoted for enhanced and/or double bubble curtains.

- The additional cost of delays incurred by NAS can be significant for projects. Evidence gathered from developers indicates this could be up to **£18 million per project.** NMM use can increase the risk of contractual standby charges being incurred, as projects will have increased sensitivity to weather or mechanical downtime. These charges are between **£250,000 and £750,000 per day.**

- A project's construction programme is intricately linked to the project's major construction contracts, external financing and Contract(s) for Difference (CfD). Therefore, for projects which have already secured a CfD (under a different marine noise policy approach), the high cost of NMM alongside the risk of delays to the construction programme may present such high risks as to cast doubt on the Final Investment Decision (FID) ahead of proceeding with developments and thereby **risks the viability of the project.**

- For projects yet to win a CfD, these costs will be priced into increased strike price bids. This can reduce the chances of a project winning in an allocation round and may inflate the clearing price which would be worse value for the consumer.

- The deployment of NAS introduces a significant risk of delays to the overall piling programme due to operational limitations of equipment or additional time required for deployment. Extended piling programmes are likely to slow down the overall delivery of OW projects and cumulatively put the **delivery of Government Clean Power 2030 targets at risk.**

- In addition to the overall slowing down of OW delivery, up to 2 hours can be added per pile installation, extending, on average, pile installation time from 6 to 8 hours. This means there is less opportunity for developers to maximise time limited weather opportunities. Therefore, a developer will have less flexibility to coordinate with other scheduled activities to ensure the 20% Southern North Sea Special Area of Conservation (SAC) noise threshold is not exceeded and instead may need to delay further. This may result in **valuable threshold headroom not being utilised efficiently.** It also reduces the number of piles being installed per day with a higher risk that programmes will be pushed into the next summer season.

- As well as delays to programme, the introduction of NAS as a requirement of consents and licences will mean additional time and cost on developers and regulators during the consents process and more critically at the point of condition discharge and may serve to **slow down decision making**. Projects constructed in 2025 experienced significant delays for approvals (in part due to SNCB resource availability) and there are concerns that the consideration of NAS and NMS will further exacerbate this.

- NAS and NMS deployment introduces **significant new Health, Safety and Environment (HSE) risks** and increases the accident risk profile of projects due to new systems and operations being introduced, including increasing construction carbon emissions by **approximately 8%.**

When considering the feasibility of NAS or NMS for a project, there are a complex range of issues that need to be considered including finance, programme, site conditions, logistics, vessel suitability, HSE and wider supply chain constraints. These factors will vary considerably at any given point in time and are **highly project specific**. What is achievable for one project may not be achievable for another. Due to high costs incurred, final project decisions on the use of NAS or NMS will have required detailed consideration and scrutiny of all feasible options, and developer concerns regarding project viability should be considered seriously.

2. Glossary

Term	**Definition**
CfD	Contract for Difference
FID	Financial Investment Decision
HSE	Health, Safety and Environment
Industry	The offshore wind sector
NAS	Noise Abatement System
OW	Offshore wind
OWIC E&C	The Offshore Wind Industry Council's Environment & Consents team
OWIC	Offshore Wind Industry Council
PSV	Project Support Vessels
ROV	Remotely Operated Vehicle
UXO	Unexploded Ordnance

3. Introduction

At the Defra-led marine noise policy workshop on 24th January 2025, offshore wind (OW) developers raised a number of commercial and operational concerns regarding the use of Noise Management Methods (NMM). This is a broad term which captures both Noise Abatement Systems (NAS) that are technologies which attenuate the underwater noise that is produced (e.g. bubble curtains) and Noise Mitigation Systems (NMS) that are designed to reduce the production of noise at source (e.g. Hammer attachments). It was agreed that a better understanding of some of the wider consequences of the updated Government position on the use of NAS and NMS would be of benefit to inform the future development of marine noise policy. The OWIC Environment and Consents workstream took an action to collate this evidence.

The information presented in this evidence note has been provided by OWIC developers and is based on their direct project experience and engagement with both NAS and NMS suppliers and installation contractors across a range of OW projects in the UK and overseas. This note summarises the commercial and operational implications of NAS and NMS deployment which developers consider when assessing the feasibility and suitability of NAS and NMS options for projects. This includes financial and programme risks, supply chain challenges, new Health, Safety and Environment (HSE) risks and operational considerations.

Due to the commercially sensitive and confidential nature of the information supplied to OWIC for this note, all information provided by developers has been anonymised and aggregated. Where costs or times have been referenced, these are gathered from first hand developer experience. NAS technology suppliers have not been identified within this note, and where technology specific issues are discussed, these are grouped by NAS type (hammer modifications, resonators/screens/nets and bubble curtains).

4. Project cost increases and financial risk

OWIC E&C requested information from OW developers regarding how much extra cost is added to projects from incorporation of NAS. Information provided indicates that NAS adds significant direct cost to projects, with a range between **£2.9 million to £122 million for a single NAS per project,** as set out in Figure 1.

This large per project cost range is to be expected given the diverse range of NAS and NMS options being explored by developers currently. Even within NAS and NMS types however, costs can vary significantly. The higher cost values in excess of £100 million are for double and/or enhanced bubble curtains. Projects currently in the consents process are being strongly advised by the SNCB, Natural England, to commit to this type of NAS so it is likely that that these costs will become typical. The large cost range is also due to the range of GW size projects that provided information to OWIC. Longer installation duration will incur higher costs, and some NAS (e.g. resonators/screens/nets) are 'consumable' and require regular replacement during the construction programme.

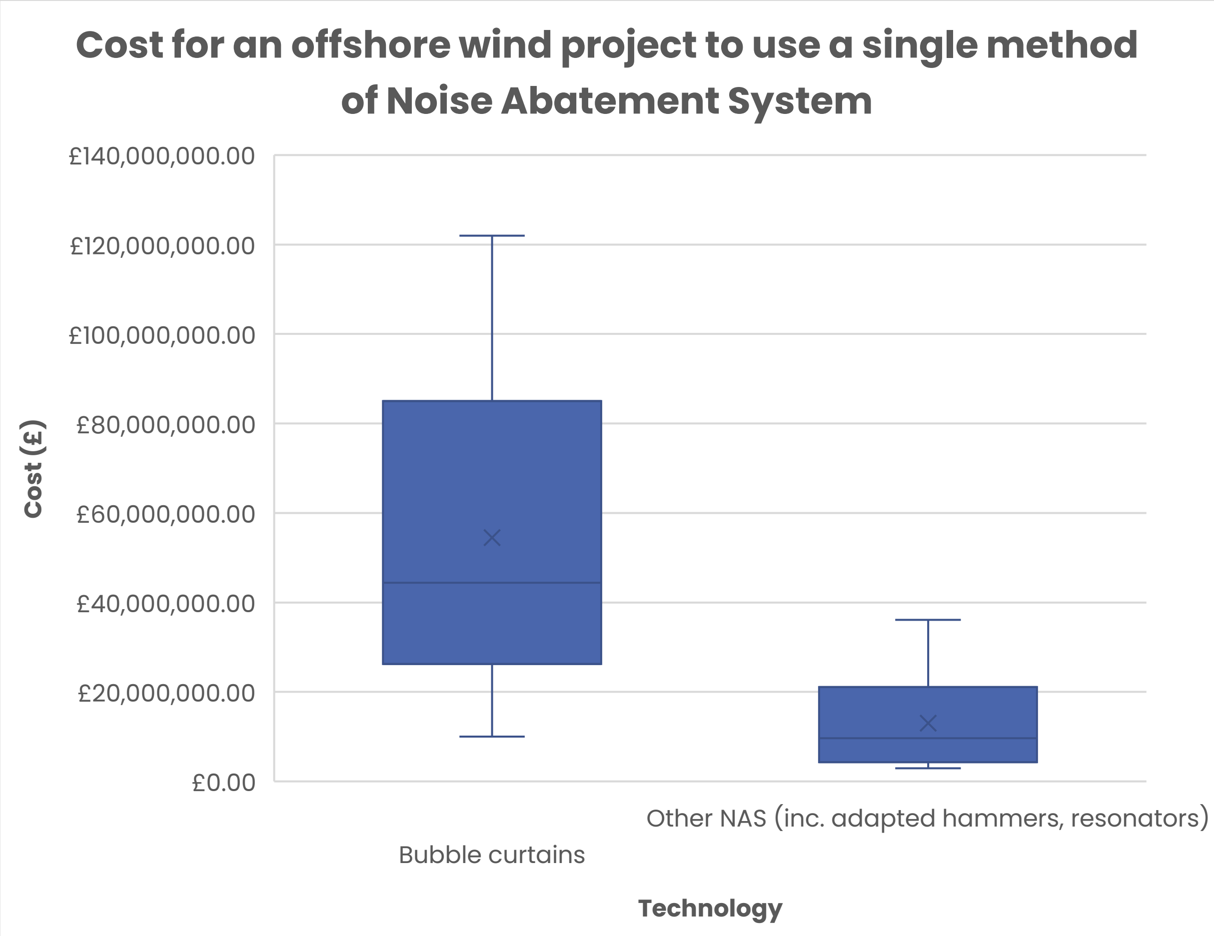


Figure 1: Cost of using a single method of NAS/NMS per offshore wind project. These costs include, where developers have been able to provide, estimated mobilisation, equipment modification and contractual delay costs. Some costs presented will therefore be an underestimate where this contextual information has not been possible to share. The 'X' shows the mean cost.

It should be noted that these estimates include both confirmed and projected costings and that there can be significant cost fluctuations between projects and planned construction timings.

There may also be situations, for example due to NAS/NMS efficacy or a future noise limit, that projects may need to deploy more than one type of NAS or NMS. As different NAS/NMS technologies are in general supplied separately by different companies these costs will be additive.

In addition to the cost of NAS/NMS supply and additional vessels, where necessary, there are often additional project specific costs which may be incurred. For example:

- Increased onshore mobilisation costs for hammer add-on technologies or resonators to be set up. This includes additional time required and specialist technicians.
- Any vessel or equipment modifications that may need to accommodate NAS/NMS systems safely. E.g. specialist grippers, hydraulic winches and steelworks design, fabrication and design. These costs alone can be significant where complex or bespoke solutions are required– up to **£6.5 million**. This is particularly challenging for projects planning construction ahead of 2030 which already have vessels and foundation types agreed where specific/bespoke design changes may be required to ensure NAS/NMS can work with these.
- Once laid, it is recommended that bubble curtain hoses are checked by a Remotely Operated Vehicle (ROV) to ensure they are in the correct position and working effectively, often incurring additional costs.

Some NAS technologies are designed very specifically to absorb certain frequencies which are determined by pile size. This means that where projects are installing piles of significantly different sizes, e.g. pin piles and monopiles, different configurations may be required and therefore additional costs may be incurred.

Deployment of NAS/NMS also opens up significant increased risk of financial claim from the installation contractor in the event that installation programme is delayed due to the NAS. To an extent, downtime costs from weather and/or mechanical failure can be managed contractually. How this is agreed can vary depending on the contract type, but regardless of the approach, it can significantly increase the overall contract cost. In addition, where vessel downtime/standby days exceed contractual agreements, additional costs in the range of **£250,000 to £750,000 per day** could be incurred, meaning that overall contingency budgets for projects will also need to increase to allow for this additional risk. Some projects have estimated that **cost of overall delays from NAS could be up to £18 million** due largely to vessel down time. Evidence gathered from developers suggests that the large variability in standby charges is influenced by the NAS technology type and will be a major consideration when assessing NAS feasibility.

In summary, additional costs incurred on projects extend far beyond the procurement of NAS technology and additional vessels due to the way complex construction programmes and installation contracts are managed.

For projects which have already secured a CfD (under a different marine noise policy approach), the high cost of NAS alongside delays to the foundation installation programme may present such high risks to projects as to cast doubt on the Final Investment Decision (FID) ahead of proceeding with development. The higher costs presented are significant in the context of overall construction cost, and therefore risk the viability of the project.

For projects yet to win a CfD, these costs will be priced into increased strike price bids. This can reduce the chances of a project winning in an allocation round and may inflate the clearing price which would be worse value for the consumer.

5. Extended piling programmes and additional delays

The deployment of NAS/NMS introduces a significant risk of additional delays to the piling installation programme due to operational limitations of equipment, breakdown or additional time required for deployment. **Time delays can range from days to months** depending on the type of NAS/NMS, and how far in advance NAS/NMS are incorporated into a project. As already noted, this has significant project cost implications. Extended piling programmes are likely to also slow down the overall delivery of OW projects and cumulatively put the delivery of Government Clean Power 2030 targets at risk. OWIC E&C have presented analysis of the Clean Power pipeline to Defra and DESNZ highlighting the importance of streamlining and accelerating construction to meet Clean Power 2030.

In addition to the overall slowing down of OW delivery, daily extensions to pile installation periods means there is less opportunity for developers to maximise time limited weather opportunities. This means a developer has less flexibility to coordinate with other scheduled activities to ensure the 20% SAC noise threshold is not exceeded and instead may lead to delay further. This may result in valuable threshold headroom not being utilised efficiently to facilitate activities.

All NAS/NMS are potential additional failure points in a very tough offshore environment for the operation, maintenance and performance of equipment. In addition, due to their use being relatively new to the UK OW sector, UK projects may not have a robust understanding of how some systems will perform offshore in different environmental and weather conditions. This uncertainty increases the overall risk profile of these technologies for developers. To ensure Health, Safety and Environmental (HSE) requirements are met, mobilisation, operations and demobilisation may also take longer when the additional complexity of NAS/NMS and simultaneous operations is integrated into a project. Please see later HSE section for more detail.

Evidence gathered from developers indicates that delays are inherent for all NAS/NMS. Risk of delay varies by NAS/NMS type, with the most regular delays being associated with the use of bubble curtains. The list below summarises the nature of delays experienced by projects.

5.1 Bubble Curtains (NAS)

Without this NAS a single monopile can be installed, on average, (depending on the installation method) within a 6-hour window. Contractor experience indicates that, on average, using bubble curtains can extend this to 8 hours. When combined with a standard piling interval of 6 hours, this extension means the number of piles that can be installed per day is reduced resulting in an extension to overall programme with subsequent knock-on impacts.

- The deployment and retrieval of bubble curtain technology before and after piling can take up to 12 hours. Some projects can reduce this programme risk through utilising multiple bubble curtain systems in a leapfrogging system, whereby whilst one system is in use, the other is being deployed at the next pile. Although reducing some programme risks, this incurs significant extra carbon and monetary cost as it requires two bubble curtain systems and two vessels/crews and compounds other HSE risks highlighted below.
- The deployment of bubble curtains is constrained by surface tidal currents which vary through the daily tidal cycle, thereby limiting activity and decreasing piling window opportunities further.
- The performance of bubble curtains is limited by site specific conditions including water depth (effectiveness not proven beyond 40m), depth averaged currents (effectiveness is not proven beyond 0.75m/s) and wave height (1.7-2m). Typical metocean conditions will need to be considered as part of NAS optioneering. Deep water, high average current speeds and/or wave heights at sites may make use of bubble curtain unsuitable or significantly increase the risk of piling delays.
- When using a bubble curtain, it is recommended that a remotely operated vehicle (ROV) to be deployed to confirm that the hoses are laid and functioning correctly. This further increases reliance on additional mechanical equipment, which in turn could be subject to technical problems and deployment constraints. ROVs

require specialist technician to operate which not only increases crew costs but also presents logistical challenges as increases berth requirements (by 2-4 people) which are at a premium on offshore vessels.

The most time-consuming aspect of using bubble curtains is their ongoing maintenance. Once retrieved, hose holes need regular redrilling and plugging.

Even with maintenance, bubble curtains have a short life span and therefore, depending on how many piles need to be installed, more than one bubble curtain system maybe need to be purchased and reloaded which again adds cost and time to projects.

5.2 Hammer attachments (NMS)

- Adding the hammer attachment makes the piling operation more complicated, with additional maintenance for the hammer attachment and potential for breakdowns. Should the unit require any maintenance or repair, the vessel would need to return to port as this work is undertaken onshore, leading to construction delays.
- Hammer attachments or add-ons cannot be used where there is risk of pile refusal, which includes situations where there is a risk of reaching a hard layer. If there was a case of refusal, it would not be possible to remove the attachment offshore and operations would need to be abandoned and the vessel returned to port to remove the hammer attachment.
- Contracts for piling hammers have a long lead in time, sometimes years, and as such any attachments or add-ons needs to be planned in well in advance.

5.3 Resonators (NAS)

- Resonators are a relatively new technology which have not been rigorously tested in UK waters with higher current speeds. There is a risk that resonators may deform or flex in the current and be pushed against the pile. If this occurred, it would necessitate piling to cease and result in construction delays.
- Resonators present an increased risk of mechanical failures and delays from constant tension in winches.
- Many resonator systems are new technologies and therefore less well understood by operators. They therefore come with a higher risk of delays from repair and maintenance. Some projects have experienced delays to piling due to technology failure.
- Contractors have reported system recovery delays when using resonators, especially during high current or wind periods.

Some resonators are designed very specifically to absorb a certain frequency of noise in a way which means they are fully integrated into the piling installation process. The frequency emitted during piling is related largely to monopile size and therefore where a project may have different sized piles being installed, different resonators for each size may be required. This would necessitate a return to port and lengthy delays due to demobilisation and mobilisation of resonators.

5.4 Delays to consent and licencing decisions

As well as delays to programme, the introduction of NAS/NMS as a requirement of main consents and additional licences is already resulting in additional time and cost required from developers and regulators during the consenting process. More critically, differences in opinion between developers, the regulator and relevant SNCBs on what is required as part of pre-construction discharge of consent conditions has led, in part, to projects constructing in 2025 not having received licences until two weeks before construction is planned to commence.

To ensure developers have fully discharged NAS/NMS requirements, they will likely need to explore all NAS/NMS options and present the project's approach and rationale to NAS/NMS to decision makers. Projects are already experiencing significant delays for approvals and there are concerns that the consideration of NAS/NMS will further exacerbate this. It is hoped that this evidence note will provide a greater understanding across regulators and advisors of the complexity of this issue and support a swifter decision-making process.

6. Vessel availability

Currently offshore wind construction vessel availability is very limited, and the market is intense due to the high demand for large installation vessels worldwide. These vessels are now booked years in advance across many projects (not just OW) globally. As a result, developers have less choice about when and which vessels might be able to install foundations to meet their construction programmes. Contracts with foundation installation vessels are signed with an indicative start and end date by which the vessel needs to depart for another contract, therefore any delays which push a project beyond this agreed end date can have significant commercial implications.

Lead in times to secure vessel availability is, as with costs, variable depending on current supply and demand, the scale of any overarching contract, and what type of vessels are required.

From evidence gathered, piling installation vessels have a minimum lead in time of 2 years, but some projects, due to market competition, need to secure a vessel up to 4 years ahead of works. Installation vessels and contracts are usually secured well in advance of final decisions on which NAS technology is appropriate. Once a vessel is secured, the installation methodology and vessel footprint will dictate what NAS options are viable.

Adaptive or late-stage application of NAS/NMS can result in costly change orders to existing vessel contracts, and any NAS/NMS use should ideally be planned far in advance. Experience in the US, where the use of NAS/NMS has been a requirement for some time, indicates developers commonly require the installation contractor to secure appropriate NAS/NMS for their vessel. This minimises the risk of not achieving compliance, reduces risk of additional financial claims and gives delivery confidence to the programme. This however requires vessel tenders 5+ years in advance of construction and flexibility on NAS/NMS systems permitted.

In general, the Platform Supply Vessels (PSV) used to deploy and retrieve bubble curtains are smaller and more readily available. They do however have less weather tolerance and will increase installation stand-by time, where otherwise piling operations could continue. Therefore, with NAS, adverse weather conditions will become a more frequently encountered barrier to construction.

Vessels are contracted on a global basis and UK developers are concerned that vessel availability may become a constraining factor for programmes, with supply and demand from competing oil and gas projects pushing prices up.

7. Vessel suitability

As noted already, the choice of NAS/NMS for any project is often driven not only by what is available but also by what is workable with foundation installation methods and any vessels that have already been contracted. Each NAS/NMS technology will have its own specific vessel or spatial requirements which may limit developer choice of NAS/NMS options. Some examples of these requirements are indicated below.

- Bubble curtains require a large deck space for compressors, bubble curtain hose handling and maintenance.
- Resonator systems require a specific compatible lifting device and are designed bespoke to a project's needs. Therefore, contracted vessels may not be suitable platforms or may need significant modification.
- Some types of resonators/screens/nets are 'consumable' and so a project may require two or three to be supplied for one construction season. For example, one system is supplied in five 40ft shipping containers, so carrying a

spare/replacement net on the vessel would not be feasible given the limited deck space on some vessels.
- Larger alternative hammers and use of noise reducing hammer attachments require a vessel of considerable size to cope with these technologies.

8. Supply chain considerations

Evidence gathered from developers indicates that supply chain lead in times for different NAS/NMS types are variable, and typical ranges are indicated below.

- Bubble curtains: 6 months to 1.5 years
- Alternative hammers/attachments: 2 years
- Resonators: 6 months to 2 years

However, it is often not the availability of the NAS/NMS itself which acts as the main limiting factor. Where modifications to accommodate NAS/NMS are required, these will have their own lead in times that need to be considered as part of the overall programme. For example, the upgrade and development of a bespoke monopile gripper that can accommodate a resonator/screen/net system can have a lead in time of an additional 2 years. Where these additional works do not align with overall construction programme this may significantly limit NAS choices available.

Many NAS/NMS technologies are relatively novel and may not be reliably proven operationally in an offshore environment. Therefore, although 'available', a technology may present too many unknowns in terms of performance, efficacy or operational safety to be considered.

9. Health and safety risks

The offshore operating environment is high risk compared with similar onshore construction. The introduction of a novel technology such as NAS/NMS presents new health and safety (H&S) risks and serves to increase the overall risk profile of a project. The main H&S risks presented by NAS/NMS considerations arise in general from the following:

- An increase in personnel numbers operating offshore;
- Increased vessels and vessel interactions;
- Deploying technologies which are unfamiliar or not well understood, either in how they are deployed or their operational limitations and constraints.

Similarly to other challenges discussed, the level of risk and types of risk are very specific to the type of NAS/NMS deployed. Below is a list of additional or elevated H&S risks that have been identified by developers as part of their NAS risk assessment process and shared through this evidence gathering exercise.

9.1 Alternative hammer/hammer attachments

- The set up of alternative hammer units and attachments can be complex operations and can only be undertaken onshore with additional H&S requirements built into processes.

9.2 Bubble curtains

- Additional vessels routinely operating in close proximity to each other significantly increases the HSE risk profile of installation. This is particularly the case when near the pile installation vessel. As such, operational limits (such as weather) of deployment and recovery are reduced to manage this increased risk. This is compounded by the fact that bubble curtain support vessels are often smaller and have lower thresholds for weather tolerance. This increases the risk of delays.
- The effectiveness of dynamic positioning thrusters can be reduced when vessels are caught within bubble streams, increasing navigational risks.
- To deploy and retrieve hoses the PSV will need to manoeuvre on a 360 degree heading. Any vessel manoeuvres introduce additional risks, especially when they involve constant course changes in close proximity to others and whilst handling gear in the water.
- Additional H&S requirements of personnel working on back deck during deployments/retrieval (incl. working with compressed air systems, slips, trips, falls and person overboard.).
- Additional back deck equipment (e.g. compressor banks) will require sea fastenings modifications to reduce back deck risks.
- Bubble curtain operation involves a support vessel connecting to a riser hose. There are health and safety risks involved in a vessel being connected to anything that is also attached to the sea floor, creating additional risks to navigation and to technicians working on the deck and also increased risk of contact with Unexploded Ordnance (UXO)

9.3 Resonators/screens/nets

- The set up and initial attachment of a resonator/screens is a complex operation. It can only be undertaken onshore with additional H&S requirements built into process.
- Safe operating current speeds are not fully understood for this relatively new technology and resonators are known to push against the pile in high currents, giving rise to safe handling risks.
- Two personnel are required to operate tensioned winches as winch tension requires regular adjustment during deployment, increasing working risks.

10. Carbon Costs

Increased carbon emissions will be incurred from the use of different NAS/NMS technologies.

For bubble curtains this is due to the additional vessels required and also from the need for continuous use of compressors during installation. For a single bubble curtain this is between 8-10 compressors and for a double bubble curtain this is between 25-50 compressors which need to run continuously during piling. The running of both the vessels and compressors comes with a significant additional fuel requirement of and is estimated to be 1.5 -2 tonnes/day. Although this is difficult currently to quantify precisely preliminary analysis indicates that carbon costs can increase significantly. Some projects estimate that the use of bubble curtains can double the installation carbon budget, whilst other projects suggest that this could **increase the overall carbon budget of a project by 8%**. This is misaligned with broader Government net zero commitments.

Non-diesel compressors can be used, but can add up to approximately £3 million to the cost of the project.

There will also be increased carbon costs overall from the extended programme caused by NAS/NMS, as described earlier in this note.

11. Conclusion

This note sets out the different issues from a developer perspective, including financial, supply chain, safety and carbon risks that need to be considered when assessing whether NAS/NMS is feasible and achievable for a project to deliver. The evidence presented draws on the breadth of construction experience from OWIC developers and demonstrates that Marine Noise policy, if interpreted in an overly restrictive way, risks both the financial viability of OW deployment and Clean Power 2030 targets. It is hoped that this evidence will be integrated into future development of marine noise policy to ensure that the likelihood of achieving the UK Government's Clean Power 2030 target is maximised, and that mitigation measures that wills support nature are cost-effective, proportionate and pragmatic

It is hoped that the evidence presented here can be used to support any consenting and licensing decisions currently in process to help decision makers understand the complexity of issues that developers need to accommodate alongside their regulatory commitments and requirements to mitigate and minimise disturbance when considering the suitability of a NAS/NMS technology for their projects. As highlighted in this note, factors which influence NAS/NMS selection and feasibility will vary considerably between projects. At any point in time, what is achievable for one project may not be achievable for another, and due to the very high costs involved concerns expressed by developers regarding project viability should be considered seriously.