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| IALA Guideline |

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guidance on safety of navigation and Search and Rescue (SAR) AROUND OFFSHORE renewable energy INSTALLATIONS

Edition xx

Revisions to this document are to be noted in the table prior to the issue of a revised document.

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# INTRODUCTION

This work offers guidance to all OREI stakeholders including potential offshore energy developers on safety of navigation, Search and Rescue (SAR) matters and ship operations in the vicinity of OREI. In this regard, this guidance addresses:

* The lighting and marking of OREIs.
* Search and Rescue and other emergency response.
* Safe navigation in and around OREIs*.*

# DOCUMENT PURPOSE

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# CONSIDERATIONS

There is guidance (international best practice) available for the lighting and marking of OREIs for safety of marine navigation purposes. The lighting and marking of OREIs should be in accordance with the latest edition of IALA Guideline G1162 (The marking of man-made offshore structures). G1162 The marking of offshore man-made structures - IALA AISM (iala-aism.org)

## Regulatory and Legal Framework

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# NAVIGATIONAL SAFETY

*This section is based broadly on policy documents published by the Maritime & Coastguard Agency UK (MCA). These documents include* [Offshore Renewable Energy Installations: Requirements, guidance & operational considerations for SAR & Emergency Response,](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1034158/OREI_SAR_Requirements_v3.pdf)[Marine Guidance Notice (MGN) 654.](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/980898/MGN_654_-_FINAL.pdf) *For further information on the safety of navigation within or in the vicinity of OREI, refer to these documents.*

1. Surface navigation may be permitted within the OREI area, if safe to do so. However, restrictions may be placed on the size and/or type of vessel allowed to navigate through an OREI area and their activities (e.g. fishing or tourism). This should be determined by the Administrations navigational safety team on a case-by-case basis, based on navigational safety risk assessments conducted by the developer. Considerations should include the number and layout of the turbines, and results of a risk assessment provided by the proponents.

1. During the planning stage, a traffic analysis of the area concerned should be undertaken. Traffic data over a period of at least 12 months should be used. This should include all the vessel types found in the area. Data should be used to model the impact OREI activities will have on the safety of navigation during the construction and operation phases. If there are numerous developments planned in an area a cumulative impact assessment should also be undertaken. AIS traffic data should be enhanced using visual surveys to identify non AIS carrying vessels.

1. The OREI developer should conduct a formal risk assessment to evaluate the safety of navigation within or near the OREI and assess whether:

a. Navigation near and /or within the site would be safe:

1. for all vessels, or
2. for specified vessel types, operations and/or sizes.
3. in all directions or areas, or
4. in specified directions or areas.
5. in specified tidal, weather or other conditions.

b**.** Navigation in and/or near the site should be prohibited or restricted:

1. for specified vessels types, operations and/or sizes,
2. in respect of specific activities,
3. in all areas or directions, or
4. in specified areas or directions, or
5. in specified tidal or weather conditions, or simply
6. recommended to be avoided.
7. **General:** When planning a voyage through or near an OREI, it remains the master’s responsibility to assess all hazards and risks, including the proximity to windfarms and turbines.

Turbines within a wind farm are generally spaced 500 metres or more apart depending on the size of the turbine.

### Obscuration of other vessels

Vessels, including remote or autonomous units, involved in turbine maintenance and safety duties may be encountered within or around a wind farm. Mariners should be alert to the likely presence of such vessels and be aware that the structures may occasionally obscure them. This is particularly relevant at night when other vessels navigating through or past installations may become obscured or confused with background lighting from turbines of other devices. IALA recommends all vessels carrying out maintenance be fitted with Class A AIS unit.

### Renewable Energy Infrastrucutre site vessels

Numerous vessels operate around offshore infrastructure including fast crew transfer vessels which may transit from shore bases, larger mother craft or accommodation platforms. Survey vessels and cable laying/maintenance vessels may also be encountered. All of these vessels are required to adhere to the International Regulations for the Prevention of Collisions at Sea.

A new mandatory safety code for ships carrying industrial personnel – aimed at ensuring the safety of people transported to work on offshore facilities by setting minimum safety standards, has been adopted by IMO's Maritime Safety Committee (MSC 106) and is expected to enter into force on 1 July 2024.

### Visibilty of AtoN Lighting

Offshore windfarms display AtoN as prescribed by the competent authority following IALA guideline G-1162. Offshore renewable enrgy sites also display navigational warning lights prescribed by the national aviation authority. These lights are normally red and have various characteristics depending on the national requirement, they are also higher powered and visible from longer ranges than marine AtoN so the mariner will see these first and should take care not to confuse these with smaller vessel navigation lights.

### Transformer stations and anchoring

In or adjacent to larger wind farms offshore electrical transformer-stations may be present. These are of similar appearance to small offshore production platforms. Submarine cables link turbines to this substation from where the generated power is exported to the shore. Whether all submarine cables are charted depends upon the scale of the chart; in some cases, only the export cable may be shown. Therefore, it is strongly recommended all vessels operating within a wind farm avoid anchoring except in emergencies as the anchor could easily become fouled. Anchoring prohibited areas should be provided to the HO for publication on nautical charts.

### Effect on Communications and Radar

Radar can be significantly affected. At close range turbines may produce multiple reflected and side lobe echoes that can mask real targets. The structures can also produce blind spots and shadow areas.

VHF maritime communication is not expected to be impacted by physical deployment of OREI but could be impacted by the associated VHF communication infrastructure deployed at these installations to support other systems. These radiocommunication capabilities could include command and control systems, emergency warning and information systems (EWIS), security communications or general radiocommunications (land mobile).

Operators of OREI should ensure radiocommunication site management is undertaken to prevent interference being caused to, or from, 161.975 MHz and 162.025 MHz.

### Charting

All windfarms will be charted by the Hydrographic Office (HO). Whether all submarine cables associated with the wind farm appear on a chart will depend on the scale of the chart. As with all submarine cables, mariners should note the hazards beneath them associated when anchoring or trawling.

Significant depth reductions may be encountered where cables cross or have additional protection laid on them where burial depths have not been achieved. This should be apparent to the mariner from accurate charting and taken into consideration when passage planning over cables.

### Decommissioning

The administration should be consulted at all stages of an OREI lifespan, including decommissioning.  When consulted, The administration will refer to The IMO Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone [IMO Res.A 672(16)](https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/AssemblyDocuments/A.672(16).pdf)

### Floating device tracking

1. Floating devices, including those suspended in the water column, must have suitable mooring arrangements for the environmental conditions to ensure the device(s) remains on station and does not become a navigation hazard through failure of its moorings.

1. Where possible, it is expected that floating energy installations are fitted with tracking devices so they can be monitored, particularly if they break free from their moorings.

1. The developer should have a plan in place for the notification, tracking, locating and recovery of such devices, should they break free. The Administration should be notified and updated until the installation is safely recovered.

### Safety Zones or Exclusion Zones

During all phases through the lifespan of the development, exclusion zones may be established on a permanent or temporary basis.

The nominal safety zone around an operational wind turbine is expected to have a 50-metre radius however due to the scale of coverage of charts and Electronic Navigational Charts (ENC’s), showing a limit of this size may not be achievable.

The establishment of safety zones for other types of OREI’s may be more prescriptive as wave and tidal devices may not be fixed in position, may extend horizontally for considerable distances on or below the surface and may have potentially dangerous moving parts. These types of devices can be difficult to detect both visually and by radar.

### Assessing distances between wind farm boundaries and shipping routes

1. The administration should discuss appropriate risk reduction measures with the developers. The administrations advice should be based on its navigational expertise, international best practice, and a navigational safety risk assessment (carried out by the developer).

1. Risk mitigation measures should be implemented to the Administrations satisfaction. These include, but are not limited to:

1. Ships routeing systems including Areas To Be Avoided (ATBA) and Traffic Separation Schemes (TSS’s)
2. Vessel Traffic Services
3. Visual and electronic aids to navigation
4. Safety zones

1. Guidelines have been developed by the UK’s MCA and could be followed:

[Safety of Navigation: Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response.](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/980898/MGN_654_-_FINAL.pdf)

### Interactive Boundaries

1. **Interactive Boundaries**
2. The below templates can be used for assessing distances between wind farm boundaries and shipping routes – see paragraph 11.



### Wind Farm Shipping Route Template

The wind farm “Shipping route” guidance template below is to be used as guidance and approval of distances between wind farm boundaries and shipping routes is on a case-by-case basis with the Administration and relevant navigation stakeholders. It is important to recognise that the template is not a prescriptive tool but needs intelligent application and advice will be provided on a case-by case basis.

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| --- | --- | --- | --- |
| **Distance of turbine boundary from shipping route (90% of traffic, as per Distance C)** | **Factors for**  **consideration** | **Risk** | **Tolerability** |
| <0.5nm    (<926m) | X-Band radar interference Vessels may generate multiple echoes on shore-based radars | **VERY HIGH** | **INTOLERABLE** |
| 0.5nm to <1nm    926m to <1852m | Mariners’ Ship Domain  (vessel size and manoeuvrability) | **HIGH** | **TOLERABLE IF**  **ALARP**    **Additional risk assessment and proposed mitigation measures required**    \*Descriptions of ALARP can be found in:     1. Health and Safety Executive (2001 ‘Reducing Risks, Protecting People’ 2. IMO (2018) MSC-MEPC.2/Circ.12/Rev.2 dated 9 April 2018, ‘Revised Guidelines for Formal Safety Assessment (FSA) in the IMO Rule-Making Process’ |
| 1nm to <2nm    1852m to <3704m | Minimum distance to parallel an IMO routeing measure, as per Distance B.    S-Band radar inference ARPA affected (or other automatic target tracking means) | **MEDIUM** |
| 2nm to 3.5nm    (3704m – 6482m) | Preferred distance to parallel boundary of an IMO routing measure, as per Distance B    Compliance with COLREG becomes less challenging | **LOW** |
| >3.5nm    (>6482m) | Minimum separation distance between turbines on opposite sides of a route | **LOW** | **BROADLY**  **ACCEPTABLE** |
| >5nm    (9260m) | Adjacent wind farm introduces cumulative effect    Minimum distance from TSS entry/exit | **VERY LOW** | **BROADLY**  **ACCEPTABLE** |

1. Distance from an IMO Routeing Measure is measured from the routeing boundary i.e. Distance B.
2. The Netherlands assessed sea room requirements using data supported by the PIANC assessment for channel design and the PIANC Interaction Between Offshore Wind Farms and Maritime Navigation (2018) report. In general, they strive for an obstacle free, or buffer, zone of 2nm between wind farms and shipping routes.

# SEARCH AND RESCUE (SAR)

*This section is based broadly on policy documents published by the Maritime & Coastguard Agency UK (MCA). These documents include* [Offshore Renewable Energy Installations: Requirements, guidance and operational considerations for SAR & Emergency Response](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1034158/OREI_SAR_Requirements_v3.pdf) *and* [Marine Guidance Notice (MGN) 654.](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/980898/MGN_654_-_FINAL.pdf) *For further information on SAR within or in the vicinity of OREI, Administrations should refer to these documents.*

1. A SAR response can be degraded due to the presence of OREI’s. Therefore, Administrations have a significant interest in their layout and operation.
2. It is vital OREI’s are sited, constructed, equipped, and operated so as to minimise their impact on any SAR or emergency response and salvage operation. OREI developers should be required to provide evidence of suitable risk mitigation measures in this regard.
3. Based on international experience and empirical evidence2, principal measures strongly recommended for effective SAR in / around any OREI are:

* Linear layout of individual turbines, with at least 2 lines of orientation (see appendix 2 for layout examples).
* SAR Lanes
* Helicopter refuge areas
* Clear and unique identification markings visible to surface vessels and SAR aircraft
* Hover reference marking of wind turbine blades
* Aviation hazard and aviation SAR lighting of wind turbines
* Lighting and marking of OREIs in accordance with IALA guidance
* Control and rapid shutdown of individual and groups of OREI devices (wind turbines in particular)

1. The layouts of all OREI’s with floating and/or surface piercing devices and structures must be designed to allow safe transit of surface vessels, including rescue craft and SAR helicopters through OREIs. Consideration should also be made for helicopter operations at low altitude in bad weather.

Multiple lines of orientation are ideal, as they provide alternative options for passage planning and SAR operations for vessels and aircraft to counter the effects of the environment (e.g. sea state, tide, and visibility) on manoeuvring.

1. Based on international experience, a preferred layout should have at least two lines of orientation. See appendix 2 for example.
2. Where a project proposes only one line of orientation, this should be discussed by developers with AMSA and a safety justification should be prepared to support this reduction and submitted to AMSA for consideration.
3. Perimeter turbines may have reduced spacing compared to internal turbines. The developers should demonstrate the impact such spacing will have on the safety of navigation and any SAR response.

## Layouts for SAR operations

1. For windfarms, SAR require a helicopter to be able to fly from one end of the windfarm to the other, or helicopter refuge area in the case of large windfarms. Whereby SAR helicopters will enter from outside the windfarm at altitudes below 500 feet SAR helicopters will either conduct searches amongst turbines or access a specific location within the field from low altitude. The lanes will also provide safer and more predictable paths through a windfarm for rescue vessels. These paths will be termed ‘SAR access lanes’. Spacing between internal turbines and those on the boundary of the ‘SAR access lanes’, should be discussed with AMSA during the design phase.
2. If weather conditions are such that a SAR helicopter has to fly under Instrument Meteorological Conditions (IMC) flight rules, using instrument navigation techniques and electronic systems, the aircraft will not be able to enter any wind turbine lane that is less than 500 metres wide (measured between blade tips, that are transverse to the turbine lanes, unless the blades can be rotated away from the lane to increase the spacing to 500 metres or more).
3. For rescue vessels, a vessel should be able to enter the array area from outside and proceed on a consistent track to exit the array without encountering any devices or structures on or close to that track. Minimum spacing between devices will depend on the size and overall shape of the array. Discussions with Administrations on the spacing between devices is therefore advised prior to final design approval.

### Control of OREI for SAR operations

1. Wind farms may be required to be shut down rapidly (individual turbines, a row or rows of turbines or part or whole field), to reduce visual distraction, physical collision and turbulence risk to SAR helicopters and/or rescue vessels during SAR operations. For example, during searches conducted within or passing through the wind farm or when winching persons from nacelles, vessels or the water. There may also be a requirement for turbines to be yawed to a favourable position for SAR operations. Whereby all hubs in adjacent rows are rotated outwards to maximise the available space between blades.
2. Surface, sub surface or seabed OREI’s, excluding cable arrays, unless compromised by the incident, may be required to be shut down or de-powered during surface rescue vessel/lifeboat operations to reduce the risks to SAR crafts. Where a surface OREI is to be approached by a SAR helicopter, it may be that the device must be shut down or otherwise stopped (if possible) to enable a safer rescue to be conducted e.g. to rescue a person from the water near to or on a device.
3. Administrations must be notified of any limitations associated with the control of turbines with respect to weather limitations, time delays for shutdown, manoeuvring of turbine nacelles and the reliability of control and indication circuits.
4. Control of all OREI’s should be available from a 24-hour contact point which has immediate access and control of all devices, which can quickly be communicated with by SAR.
5. Any request to shut down or position change of an OREI should be actioned within a reasonable amount of time i.e. within 10 minutes. Any delays or failure to carry out the instruction will have adverse effects to SAR operations. SAR helicopters and/or rescue vessels must be able to operate within or within the vicinity of the OREI.
6. If helicopter rescue is to take place from/to a WTG, the WTG blades will have to be feathered and the rotor brakes applied (and where feasible blades should be pinned). It may be possible for a SAR helicopter to winch from a nacelle with the blades in a variety of positions, however, the Retreating Blade Horizontal position (2.7) downwind or bunny ears (2.8) is normally preferred





### Windfarm helicopter refuge areas

1. Where windfarms are proposed be to very large eg. more than 10NM in any direction, Administrations may request a helicopter refuge area be included in the design within the windfarm. This will be based on the likelihood of serious SAR impacts.
2. This request will be assessed on a case-by-case basis during initial discussions between administrations and developers and will depend on the context of the development.

### Adjacent developments and extensions

1. Windfarms which are extended, or adjacent developments are constructed close to each other, could be perceived by an external observer as one windfarm. All developers should ensure that layouts are of the same general orientation.
2. Adjacent developments may create anomalies in both orientation and numbering, which may create confusion and/or distraction during SAR operations. Developers must provide Administrations with solutions for such occurrences.
3. It is possible that a helicopter refuge area will be requested between adjacent developments.

### Chart and position information

1. Accurate charts and positions (in WGS84 datum in decimal format latitude and longitude of degrees, minutes and decimal minutes to 4 decimal places) of all turbines/devices and structures within an OREI are vital to safe SAR response. Developers are requested to provide SAR providers and rescue vessel/ lifeboat providers with accurate charts of the OREI. This includes the OREI’s and its immediate area, with all turbines/devices clearly marked and with critical distances e.g. between turbines/devices and structures, and heights/depth of structures, marked.
2. Positional information should also be shared by the developer in a format that is compatible with the Flight Management System (FMS) of all aircraft of the Australian SAR helicopter service, and the rescue vessel/lifeboat service providers’ electronic chart plotting systems. This is to ensure that turbines’/devices and structures’ coordinates can be programmed into the FMS/Nav Plotter for use during SAR operations. Administrations can advise on this during the planning stages.
3. Finalised layouts should also be provided to Response Coordination Centre (RRC) Australia as a vector file e.g. ESRI ArcGIS shapefile or .csv file (or similar), including OREI positions and SAR lanes.
4. Specific positional information requested is:

* Clear indications on paper and electronic charts of the spacing between turbines/OREI devices in lateral and vertical planes including turbine and other structures heights/depths.
* For WTG two minimum distances must be shown: (i) between turbine towers and (ii) between blade tips, when the blades are transverse to a lane.
* For tide, wave, sea current devices and floating wind turbines, the minimum distance shown should be the narrowest distance expected between devices (depending on their size and shape and their likely movement by wave and tide forces). The ‘swinging’ radius of each device should also be shown (if this changes at various stages of the tide, this should also be indicated).
* Supply of latitude and longitude (in WGS84 datum in decimal format latitude and longitude of degrees, minutes and decimal minutes to 4 decimal places) of entry/exit positions and accurate drawings showing the SAR access lanes through wind farms/OREI devices agreed with AMSA. This includes position of access points (on the centre line of the SAR lane, 0.5nm from the boundary), bearings of the lanes and distance of the lane (between access points) and minimum width.

Example of a linear layout with 2 clear lines of orientation:



# OTHER CONSIDERATIONS

# DEFINITIONS

The definitions of terms used in this Guideline can be found in the International Dictionary of Marine Aids to Navigation (IALA Dictionary) at http://www.iala-aism.org/wiki/dictionary and were checked as correct at the time of going to print. Where conflict arises, the IALA Dictionary should be considered as the authoritative source of definitions used in IALA documents.

# ABBREVIATIONS

OREI Offshore Renewable Energy Infrastructure

# REFERENCES

* [Safety of Navigation: Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response.](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/980898/MGN_654_-_FINAL.pdf" \t "_blank)
* [Offshore Renewable Energy Installations: Requirements, guidance and operational considerations for SAR and Emergency Response](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1034158/OREI_SAR_Requirements_v3.pdf)
* [MGN 372 – Guidance to Mariners Operating in the Vicinity of UK OREI’s](https://www.gov.uk/government/publications/mgn-372-amendment-1-mf-guidance-to-mariners-operating-in-vicinity-of-uk-oreis)
* [MCA – The High-Speed Offshore Service Craft Code (HSOSC)](https://www.gov.uk/government/publications/the-high-speed-offshore-service-craft-code-hsosc)
* [G1162 The marking of offshore man-made structures - IALA AISM (iala-aism.org)](https://www.iala-aism.org/product/g1162/)
* [Methodology for Assessing Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI)](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/980900/MGN_654_Annex_1_NRA_Methodology_2021.pdf)
* ICAO-IMO JWG-SAR-24-IP.3 - Search and Rescue Helicopter Operations in Windfarms (United Kingdom)
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* <https://www.oir.gov.au/guidance-and-regulation/safety-and-protection-zones>[The Netherlands (Offshore Wind and Fisheries)](https://maritime-spatial-planning.ec.europa.eu/story-4-netherlands-offshore-wind-and-fisheries#:~:text=For%20a%20long%20time%2C%20wind,types%20of%20fishing%20to%20occur.)
* [The Netherlands (Offshore Wind and Transport)](https://maritime-spatial-planning.ec.europa.eu/story-2-netherlands-transport-and-offshore-wind)
* [Estonia (Transport and Offshore Wind)](https://maritime-spatial-planning.ec.europa.eu/story-3-estonia-transport-and-offshore-wind)
* [Vattenfall Shows Damage Caused by Cargo Ship Adrift at Hollandse Kust Zuid Offshore Wind Farm](https://maritime-spatial-planning.ec.europa.eu/story-3-estonia-transport-and-offshore-wind%22%20%EF%B7%9FHYPERLINK%20%22https:/www.offshorewind.biz/2022/02/02/vattenfall-shows-damage-caused-by-cargo-ship-adrift-at-hollandse-kust-zuid-offshore-wind-farm/)
* [Offshore Wind Farms Can Interfere with Ship Radar and Navigation, Says New Report](https://www.nationalacademies.org/news/2022/02/offshore-wind-farms-can-interfere-with-ship-radar-and-navigation-says-new-report)
* [Conflict fiche 7: Maritime transport and offshore wind – European MSP](https://maritime-spatial-planning.ec.europa.eu/sites/default/files/7_transport_offshore_wind_kg_1.pdf)
* [Offshore Electricity Infrastructure Act 2021](https://www.legislation.gov.au/Details/C2021A00120)
* [Small workboats used on offshore wind farms: combined report on Windcat 9 and Island Panther incidents](https://assets.publishing.service.gov.uk/media/547c6f44e5274a429000001b/W9IPReport_Web.pdf)
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* [THE SHIPPING INDUSTRY AND MARINE SPATIAL PLANNING](https://www.nautinst.org/uploads/assets/uploaded/299f934f-ee69-492e-8ada51abf26e8b19.pdf)
* [NCSR\_7-INF.15\_- Report\_from\_the\_World\_Association\_for\_Waterborne\_Transport\_Infrastructure\_\_PIANC\_\_on\_Inter...\_\_France\_and\_the\_Netherland...\_.pdf](https://www.gob.mx/cms/uploads/attachment/file/540757/NCSR_7-INF.15_-_Report_from_the_World_Association_for_Waterborne_Transport_Infrastructure__PIANC__on_Inter...__France_and_the_Netherland..._.pdf)
* [https://infrastructure.planninginspectorate.gov.ukHornsea-%20Safety Justification for Single Layout.pdf](https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-001993-%C3%98rsted%20Hornsea%20Project%20Three%20(UK)%20Ltd%20-Appendix%2026%20-%20Safety%20Justification%20for%20Single%20Line%20of%20Orientation%20Layout.pdf)