CATAPULT
Offshore Renewable Energy

Supply chain capability requirements for
UK Floating Offshore Wind Farms

INTER-ARRAY DYNAMIC CABLE SYSTEMS

A Workforce Foresighting Hub
call to action report

Date: February 2024

This Foresighting report and the data within has been produced as part of the Innovate UK Workforce Foresighting Hub programme. The dataset has been created as part of a development process using system v2.2.

If you would like further information, to provide feedback or to be involved in conducting workforce foresighting, please contact: info@iuk.wf-hub.org

Supply chain capability requirements for UK Floating Offshore Wind Farms Inter-Array Dynamic Cable Systems
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Date: 30/11/2023
Reference: TV000188-RPT-001
Status: Public

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WindFloat Atlantic project

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NOMENCLATURE

AC	Alternating current
AI	Artificial intelligence (in the case of foresighting, the 'GPT4' large language model, used to analyse and match capability statements and standards)
CoE	Centre of Excellence
DC	Dynamic cable or direct current (depending on context)
DCS	Dynamic cable system
Export cable	Subsea power transmission cable connecting a wind farm to shore
FE	Further education
FF	Fit Factor: The degree to which the capability statements within an existing IfATE course definition fit a given future occupational profile (from foresighting). A higher Fit Factor indicates a closer match
FOW	Floating offshore wind
GW	Gigawatts
HE	Higher education
HV	High voltage
HVDC	High voltage dynamic cable or high voltage direct current (depending on context).
HVMC	High Value Manufacturing Catapult.
IfATE	Institute for Apprenticeships and Technical Education – see www.instituteforapprenticeships.org
Inter-array cable	Cables running between and among offshore wind turbines.
NQF	National qualification framework
O&M	Operations and maintenance
P-FOP	Potential future occupational profile (see workforce foresighting nomenclature, below)
R&D	Research and development
SF	Surplus Factor: The degree to which the capability statements within an existing IfATE course definition are not contained within a given future occupational profile (from foresighting). A lower Surplus Factor indicates a closer match
TRL	Technology readiness level: A system used to measure and describe the maturity level of a technology in a manner that enables consistent comparison between different types of technology.

Guide to National Qualification Framework Levels

England & Wales	Scotland	Example Qualifications
1	4	GCSE grades 3-1, (D to G); NVQ level 1
2	5	GCSE grades 9-4 (A* to C), NVQ level 2
3	6	A level, AS level, NVQ level 3, T level
4	7	HNC, NVQ level 4, CertHE
5	8	DipHE, HND, foundation degree
6	9/10	Degree apprenticeship, bachelor's degree with honours, ordinary degree
7	11	Integrated or postgraduate master's degree, level 7 NVQ
8	12	Doctorate (PhD or DPhil)

Guide to Technology Readiness Levels

Technology Readiness Level	Definition – Common to all Renewable Energy sectors (European Commission. Directorate General for Research and Innovation., 2017)
1	Identification of new concept, applications and barriers
2	Definition of application, consideration of interfaces and commercial offer
3	Proof of concept prototype ready: concept is laboratory tested
4	Integrated small-scale prototype with auxiliary systems laboratory validated
5	Large-scale prototype completed with auxiliaries, refined commercial assessment
6	Technology pilot demonstrated in relevant environment; manufacturing strategy defined
7	Pilot demonstrated in operational environment; manufacturing approach demonstrated
8	Technology in its final form, low-rate production
9	System full operational and ready for commercialisation.

EXECUTIVE SUMMARY

Foreword from Sponsor - summary and call to action

The Offshore Wind Industry Council's Skills Intelligence Report, published in June 2023, identified that there are currently over 32,000 people in the Offshore Wind sector workforce. To meet the British Energy Security Strategy of 50GW in offshore wind by 2030, including 5GW of floating offshore wind, this workforce is forecast to increase to over 100,000 roles by 2030. This means 72,000 additional skilled roles. The survey also identified specific skills gaps associated with high level electrical technical and engineering skills, particularly electricity substations, high voltage and cables.

RenewableUK is therefore delighted to be sponsoring this Workforce Foresighting project focussing on HV Dynamic Inter-Array Cable Systems for Floating Offshore Wind, as a means to objectively identify future workforce capability requirements for this key technology challenge, and to focus discussion on pragmatic ways to achieve this.

Future power generation from offshore wind will rely on arrays that are in deeper water, further away from shore where the wind is stronger and more consistent. Fixed-bottom turbine installations are not viable at these sites. Thus, floating offshore wind forms a key and increasingly important component in the UK's future power generation capacity. This is recognised by the Offshore Renewable Energy (ORE) Catapult through its establishment of the Floating Offshore Wind Centre of Excellence in Aberdeen.

Since floating wind turbines are constantly moving due to ocean waves, the power cables connecting those turbines are also moving. These dynamic cable systems present some challenges in design, manufacture, installation, and maintenance, that are not present in static subsea power cable systems. Some 3000km of dynamic cable installation will be required by 2040.

Workforce foresighting is an approach to identifying the skills development that needs putting in place now, to realise the benefits of an emerging technology in the future. Coordinated groups of technologists, employers and educators assess the capability needs, and identify gaps in current skills development.

The combination of technology challenge, the scale of floating offshore wind demand, and low numbers of specialists in this field in the current workforce, means that the dynamic cable system is a topic well suited to the workforce foresighting approach. The technical scope of the dynamic cable system includes the cable itself, interconnectors, protection, buoyancy, and condition monitoring. The system life cycle considered covers design and engineering, production, installation and commissioning, and operations and maintenance.

This report sets out the findings of the workforce foresighting study and takes a pragmatic view that balances emerging technology needs with forecasting volume, and the capacity of the education and training sector to develop and launch new content. We look forward to working with ORE Catapult, industry stakeholders and others to support implementation of the proposed next steps to ensure we create a workforce well placed to effectively implement these new technologies in our sector.

Scott Young/Jane Cooper
RenewableUK

SUMMARY OF THE NATIONAL CHALLENGE

ORE Catapult anticipates a demand by 2040 for more than 3,000km of high voltage dynamic cable, to support deployment of 18.5GW of floating offshore wind generating capacity (Strang-Moran, 2021). This would translate to roughly 800km of cable to support 5GW of floating offshore wind by 2030. In addition to the cable itself, the overall system requires cable connectors and ancillary items such as bend stiffeners, tethers and buoyancy modules.

Some of the technologies and capabilities required in the supply chain to meet this challenge include:

- Designing for, and operating equipment at higher voltages: Projects increasing from 32kV to 66kV, and onwards to 132kV.
- Increasing the technology readiness level and scaling production of wet-mate connectors for connecting and disconnecting dynamic cables and components subsea (using remotely operated vehicles, for example).
- Developing methodologies and designing equipment to take advantage of the opportunity floating offshore wind presents for assembling turbines at shore, and towing out to an array – rather than assembly at sea (and conversely, for towing a turbine back to shore for servicing).
- Understanding the effects marine bio-fouling might have on the mass of a dynamic cable, and designing solutions to mitigate these effects.

Development of these capabilities in a relatively short timescale takes people with the appropriate knowledge, skills and experience. This is the necessary – but missing – foundation in achieving offshore wind targets in 2030 and beyond. The "development of human capital in adequate quantities" was identified by the European Wind Energy Association ('EWEA') as one of five challenges in the development of the offshore wind industry back in 2009 (Jacobsson & Karltorp, n.d.).

Results of the Study

The workforce foresighting cycle identified 155 future capabilities relevant to dynamic cable systems. Of these, 67 capabilities exist already in the UK IFATE standards, and 88 new capability statements were developed by the project. These capability statements were mapped against:

- Four sector job levels: Technician, senior technician, junior engineer, senior engineer.
- Four generic job functions: Design, manufacture, installation & commissioning, operations and maintenance.
- Three competence levels: Awareness; practitioner; expert.

The capabilities were initially grouped into 31 potential future occupational profiles ('P-FOPs') using a combination of the data schema in the foresight process and a bespoke AI model. With sector input these were mapped to 15 future occupational profiles across the four job levels

and aligned to the four generic job functions. Whilst further refinement of the P-FOPs and the capability spread is certainly possible, the working set of 15 P-FOPs was considered to provide a good basis to facilitate ongoing discussions and "taking action".

Participants

The following organisations participated in the project:

Table 1 - DCS Foresighting: Participating Organisations

Technologists	Employers	Educators
ORE Catapult JDR Cables Equinor Balmoral Tekmar Durham Energy Institute Newcastle University Renewable UK	JDR Cables Equinor Balmoral Proserve Tekmar ORE Catapult OPITO Global Underwater Hub Renewable UK	Newcastle University Durham University Teeside University Northumbria University Northumberland College Newcastle College Gateshead College Education Training Collective Post Training Services AIS Training OPITO

The lead technologists were ORE Catapult, Equinor, and JDR Cables; and the lead educator was Newcastle University.

The Cost of Doing Nothing

The UK maintains a world-leading position in terms of its offshore wind experience and installed capacity, but without continued focus on maintaining the pipeline of skills and talent into the sector, it will not be able to maintain this.

Without action now, it is likely that the capabilities and capacity of the workforce will be insufficient to meet the needs for achieving 2030 targets in floating offshore wind. There is little, if any, time to spare: If started now the full cycle of developing course content, recruiting learners, re-skilling and providing new employees with the opportunities to gain on-the-job experience, will take until 2030.

Stretching the installation of floating offshore wind projects over a longer timeframe – the inevitable consequence of doing nothing on skills now – would of course reduce the UK's power generation from clean energy sources and push 'net zero' targets at 2030 out of reach.

Other effects of delay are likely to include:

1. Delays in technology development and deployment.
2. Delays in scaling-up production.
3. Delays in offshore wind project development.
4. Increased offshore wind project costs.
5. Decreased operational efficiency.
6. Increased reliance on foreign expertise.
7. Deterioration of the UK's leadership in clean energy generation from offshore wind.

Calls to Action

Educators

The foresighting study findings suggest that the future need identified could be met by modifications to existing courses and degrees. A modular approach is more likely to be achievable within the required timescales, compared to wholesale course design.

There is also a key action to explore an online model for open access training modules, that can be used in parallel to facilitate direct conversations with education and industry training providers.

Where more specialist technical areas require deeper capabilities in lower numbers, there is a need for industry and academia to cooperate at PhD level. Marine bio-fouling for example was an example of a capability area identified through the foresight process, is likely to be a low volume / high specialism area.

Employers

Employers must act individually and collectively to ensure that the development of experienced staff meets industry needs, in support of the 2030 targets for offshore wind. Employers must become effective and open to up-skilling and re-skilling across industry sectors, and take action to develop a pipeline of future talent into the industry from schools, colleges and universities.

The higher operating voltages and dynamic requirement for the cable systems will require greater technical cooperation between partners of the supply chain, earlier in the project lifecycle – and indeed, at the design stage. Working groups and interface design groups, led by the industry prime contractors or developers, may become more common in the development of floating offshore wind projects.

The ORE Catapult Workforce Foresighting team will seek to engage with industry stakeholders to identify, or if necessary, develop sensible workforce demand forecasts. These stakeholders include RenewableUK, the UK Green Jobs Delivery Group[1], and the Offshore Wind Industry Council's 'Investment in Talent Group'[2].

Actions Underway

Several areas of engagement with education and industry have been initiated because of the foresighting study, in addition to work in parallel with and preceding this study:

- Working with a Northeast university on the development of a HV dynamic cable systems module / pathway in a degree apprenticeship.
- Investigating opportunities for ORE Catapult to leverage its Technology Development resources to inspire, educate, and train the current and future Offshore Wind workforce in HV Electrical technology, including HV dynamic cables.
- Using foresighting findings to help develop a new suite of HV electrical engineering professional courses for the Offshore Wind Sector.
- Working with sector bodies to identify robust and sensible methodologies to connect workforce foresighting with workforce forecasting. This will help to understand future labour market needs and enable appropriate action to be taken in developing education and training programmes.

[1] See www.gov.uk/government/groups/green-jobs-delivery-group

[2] See www.owic.org.uk/workstreams/people-%26-skills

1 INTRODUCTION

This report presents the process and outputs of a 'workforce foresighting' pilot study undertaken by the Offshore Renewable Energy (ORE) Catapult with industry and education participants, supported by the High Value Manufacturing Catapult ('HVMC'). RenewableUK are the principal industrial sponsor.

The study focussed on the future skills needs for inter-array dynamic cable systems in floating offshore wind farms. The UK is looking to deeper water offshore wind farm installations, where stronger winds offer increased power generation opportunities. Floating offshore wind creates the opportunity to install wind turbines in deeper water where traditional bottom-fixed wind is not economically feasible.

Floating wind turbines are in motion with sea waves so the cables connecting the turbines for electricity distribution are also dynamic, compared to the static cables in fixed-bottom offshore wind farms. Dynamic cables undergo different mechanical and electrical stresses, and place greater loads on connectors and interfaces. Industry participants in the foresighting process highlighted the importance of a whole-of-system approach, due to the additional consideration that component interfaces need in a floating wind system. This is a different approach to fixed offshore wind, and accordingly the required skills needs are less well understood. Emerging technological challenges and opportunities in the sector are also likely to drive new skills needs.

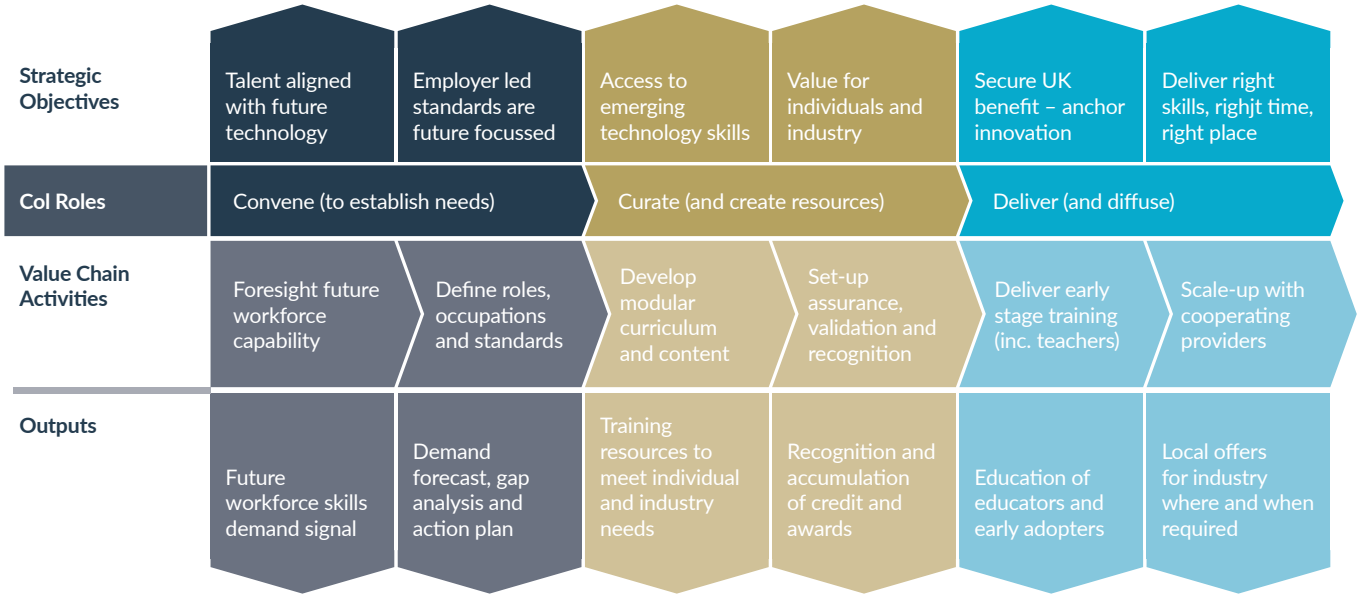
The study considered the capabilities that will be required throughout the dynamic cable system lifecycle from design, through manufacturing, installation, commissioning, and operation.

2 THE MISSION: 'PRE-EMPTING AND AVERTING FUTURE WORKFORCE CHALLENGES'.

2.1 The Skills Value Chain

The report "Manufacturing the Future Workforce" (Collier et al., 2020) recommended an approach to avoid shortfalls in workforce capabilities relating to future innovations. The solution recommended is referred to the as the Skills Value Chain (SVC). Although shown as a linear model, in practice the SVC contains feedback loops. The aim is that stakeholders share a common purpose and increase connectivity between innovation and skills development.

Figure 1 - The Skills Value Chain (Collier et al., 2020)



The first step of the value chain is to 'Foresight future workforce capability'; this is the genesis of the workforce foresighting programme, which is sponsored by Innovate UK and delivered through the eight industrial Catapult networks. The approach calls for technology, industry, education, and training partners to convene using government as a focal point, to "foresight and articulate future skills needs, standards and qualifications associated with emerging technologies" (Collier et al., 2020).

2.2 The purpose, output and outcome of workforce foresighting

The purpose of workforce foresighting is described in workforce hub guidance as follows:

- Mission: Pre-empt and avoid a national workforce capability shortfall
- Aim: To identify and address critical skills gaps in business as innovative and emerging technologies are adopted and deployed nationally

- Objectives: The workforce foresighting hub programme will:
  1. Develop a standardised open access process workforce foresighting in the UK
  2. Develop an open access system to support workforce foresighting in the UK
  3. Develop capability for those wanting to conduct workforce foresighting in the UK
  4. Provide a platform for those wanting to contribute to the development of the process
  5. Pilot the process, system and capability by conducting workforce foresighting in the UK
  6. Create an online 'hub' and associated branding and communications to encourage and enable participation.
- Outcomes: By the end of the programme, it will have:
  1. Developed a free-to-access process and associated support / coaching.
  2. Developed a system (including database) that the associated outputs (the reports) are free-to access.
  3. Developed a cohort of capable and active users of the above-mentioned process and system.
  4. Produced ~40 reports using the above-mentioned process, system and users.
  5. Created an online 'hub' including associated branding and communications to encourage and enable participation.

2.3 Approach used - principles and implementation

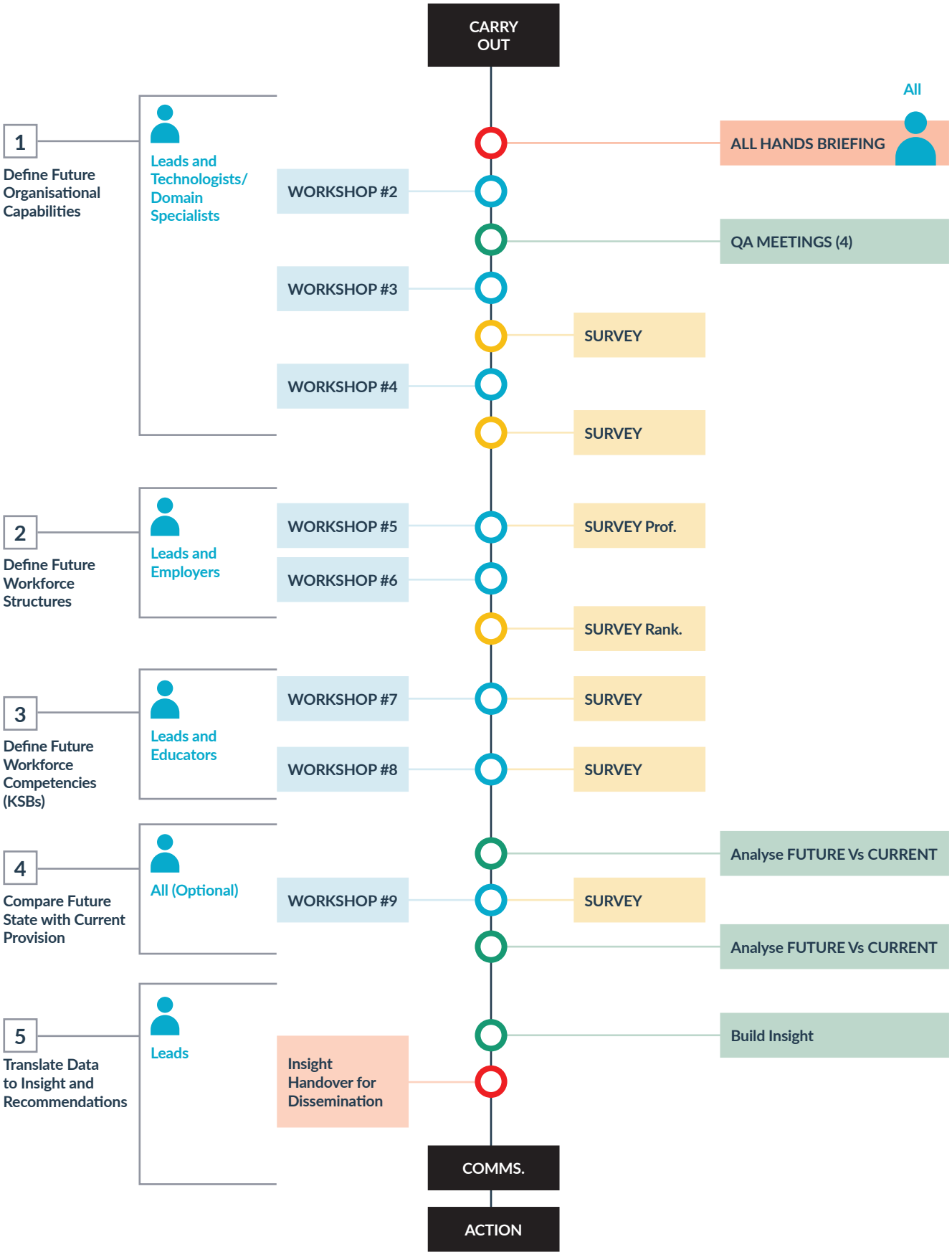
The core activity of workforce foresighting consists of convening three groups of specialists, with relevant subject expertise in specific areas, to participate in structured (Delphi style) facilitated workshops. Through these workshops, the groups will identify and capture the organisational capabilities required due to forthcoming innovation, align these capabilities with groups within the future workforce, and identify the necessary knowledge, skills, and behaviours.

The detailed process of workforce foresighting is evolving based on delivery and participant feedback, but consists of the following stages:

- Considering – collating initial topics being suggested for workforce foresighting ('what is the challenge?').
- Identifying – gaining further clarity and consensus for the topic ('when is it needed' and 'who needs it').
- Preparing – convening specialists and scheduling of workshops.
- Carrying out – conducting workshops with cohorts of specialists to capture capabilities.
- Communicating – the collaborative creation of a structured recommendations report.
- Causing action – the driving of action based on the recommendations (promoting progress down the rest of the skills value chain).

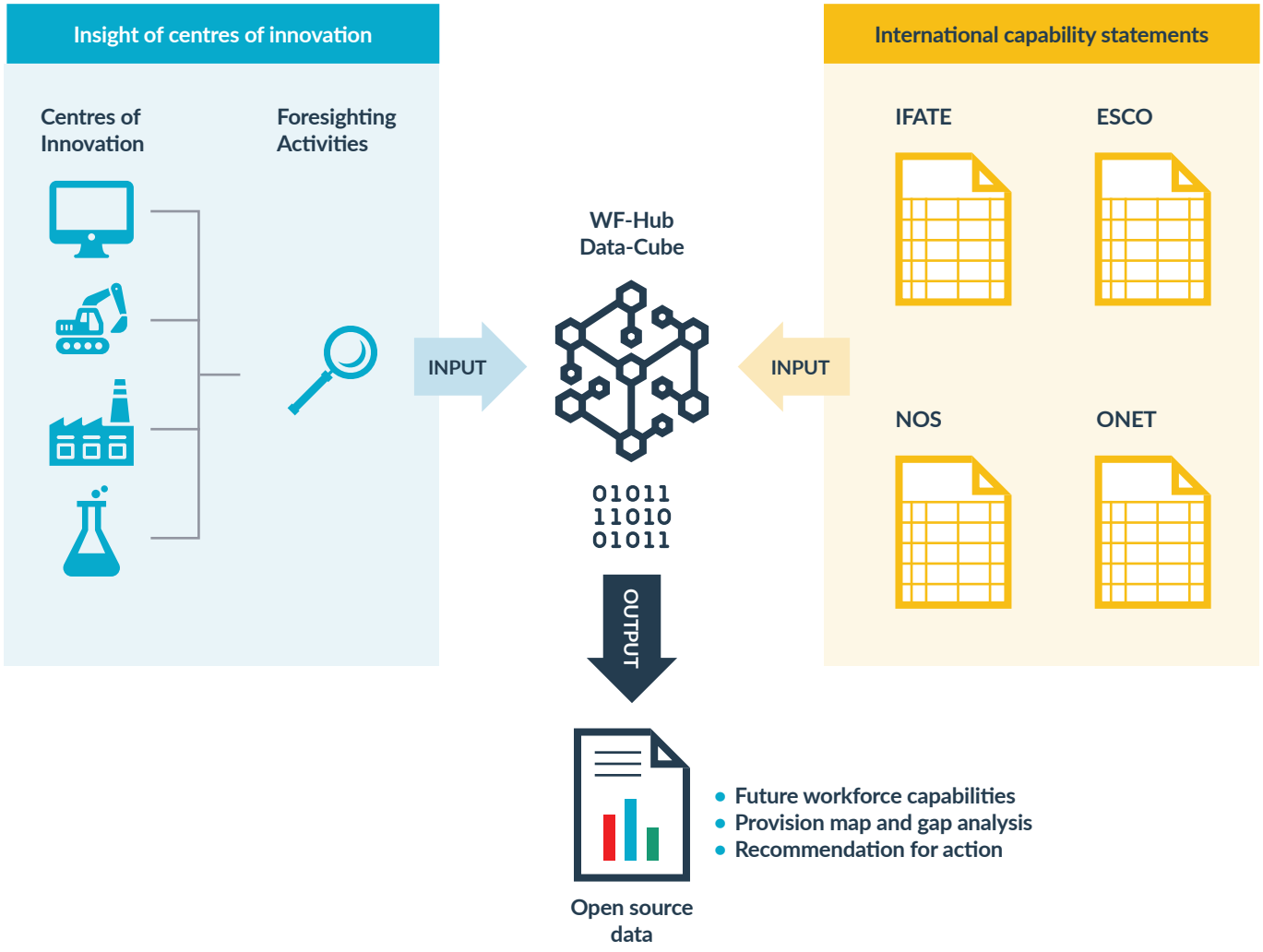
The ‘carrying out’ or action phase of workforce foresighting consists of a series of online workshops and surveys, as illustrated in Figure 2.

Figure 2 - ‘Tube Map’ of Workshops and Surveys (S. Picker, WF-Hub)



During the 'carrying out' phase, capabilities are defined and articulated using a classification system developed by the Workforce Foresighting Hub. This classification builds upon existing published and widely used national and international frameworks including the Occupational Information Network (ONet) US[3]; European Skills, Competences, Qualifications and Occupations (ESCO)[4]; National Occupational Standards, UK[5]; and the Institute for Apprenticeships and Technical Education (IfATE)[6], England. This classification has been used to build a data repository, referred to as the 'data cube' – see Figure 3 – which underpins the workshops and related activities of the carry out phase. Data is input using a common language, which means that any centre conducting similar activities can describe capabilities in a consistent format and vocabulary. The data cube integrates information from ONet, ESCO, NOS, IfATE and other open-source databases, again, using the same common language. The result being a database that is exponentially growing with rich data relating to future workforce capabilities.

Figure 3 - Workforce foresighting 'Data Cube' (M. Dury, WF-Hub)



[3] www.onetcenter.org

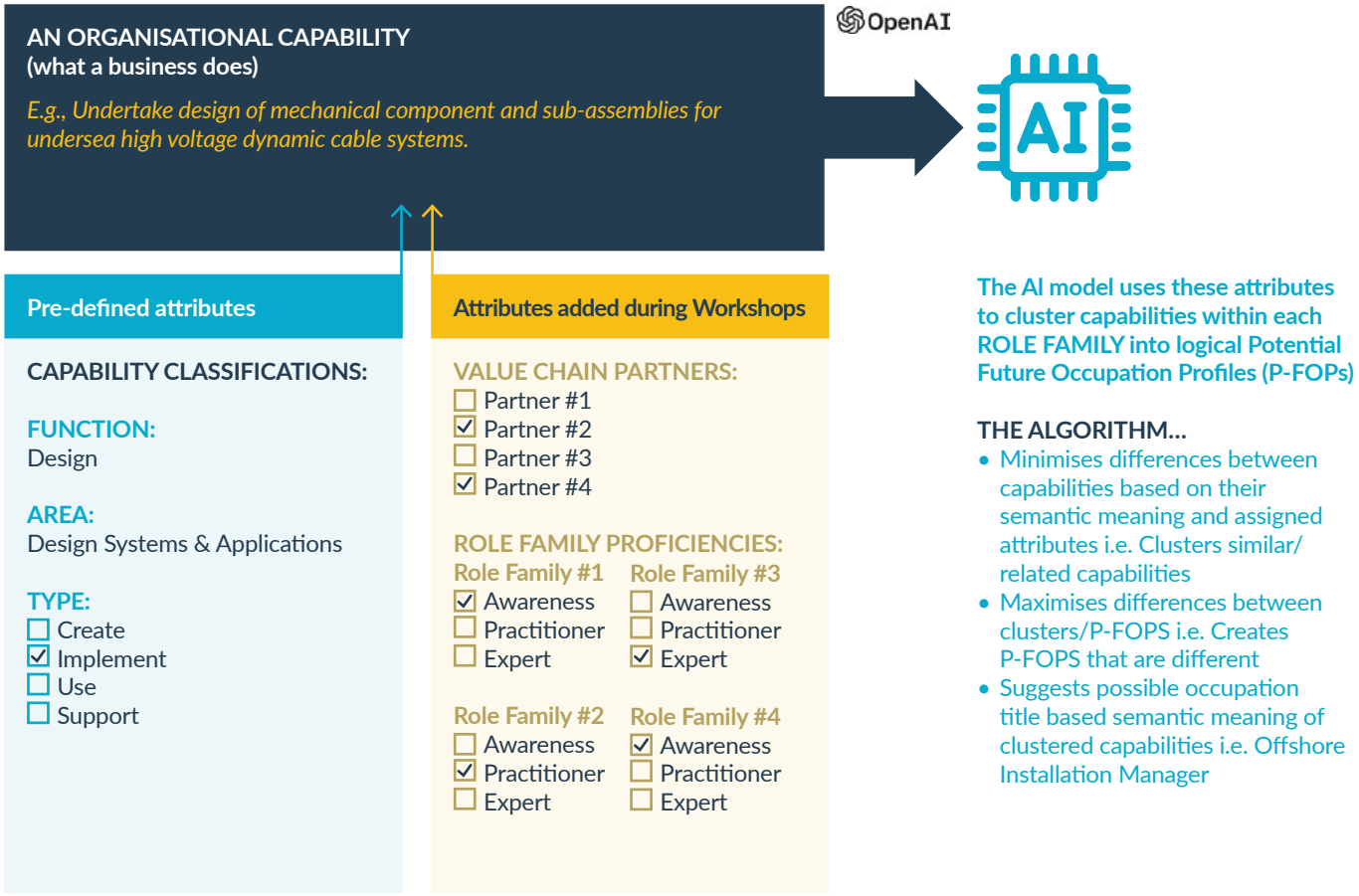
[4] https://esco.ec.europa.eu/en

[5] www.gov.uk/government/publications/national-occupational-standards

[6] www.instituteforapprenticeships.org

OpenAI / ChatGPT large language models are used to analyse workshop input in terms of capability statements, compare these to existing capabilities in the data-cube, and generate clusters of similar capabilities as potential future occupation profiles (see Figure 4).

Figure 4 - Use of AI to generate potential future occupational profiles (S. Picker, WF-Hub)



In the final workshop sessions and output, the data-cube is used to 'map' the future workforce capability requirements (P-FOPs) against the current education and training provision, providing a 'map and gap' analysis.

2.4 Foresighting vs Forecasting

Although this study is focussed on workforce foresighting (that is, the capabilities required) it is important to keep in mind parallel findings from forecasting (that is, required capacities and numbers). ORE Catapult is working with the Department for Energy Security and Net Zero ('DESNZ') and InnovateUK to make assessments and maintain thought leadership around offshore wind installation targets and the implications on educators, industry, and sector bodies. Forecasting, alongside foresighting, provides vital input to the sector, feeding into recruitment and development targets for employers, and consideration of economic class sizes and recruitment targets for educators. However, it is beyond the scope of the foresighting study to carry out independent forecasting, and as such readers should refer to referenced studies for detail on forecasting.

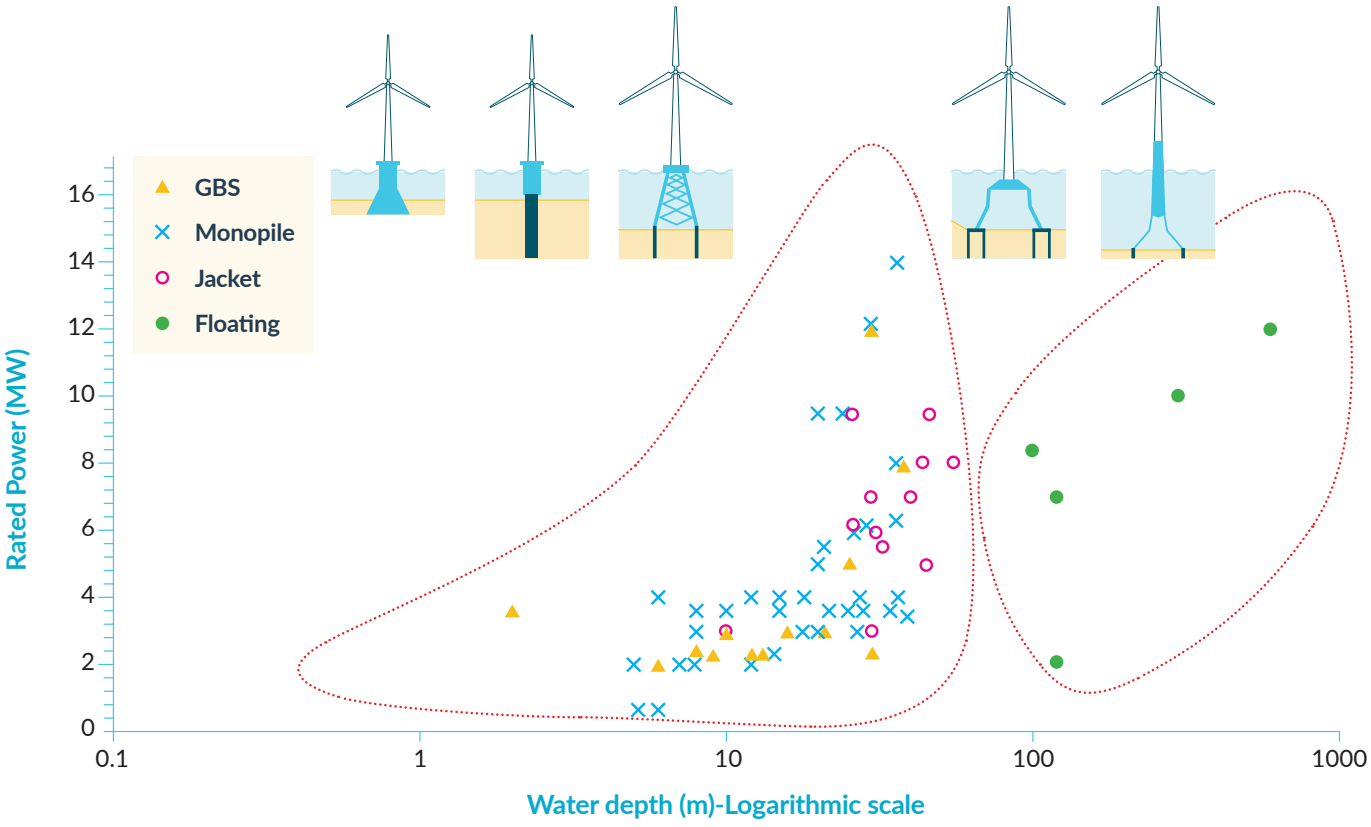
3 DEFINING THE FORESIGHTING CHALLENGE

3.1 Positioning and National Context: The Demand for Floating Offshore Wind Capacity

Offshore power generation from wind is a vital part of the UK's future energy security, and achievement of CO2 reduction targets. Around 100GW of offshore wind power generating capacity will be required by 2050 to achieve the UK government's 'net zero' targets. As installed capacity increases the UK will look to deeper water installations, where stronger winds offer increased power generation opportunities. As gravity and jacket foundations become unfeasible in deeper water, floating wind turbine capacity will increase (see Figure 5). It is expected that 50% of the 2050 capacity will be floating and 10% of the 2030 capacity (5GW floating out of 50GW total offshore wind capacity) (Tor, 2022).

This growth in offshore wind capacity is forecast to drive £43.6Bn gross value add to the UK economy by 2050, and create more than 29,000 jobs (ORE Catapult, 2021).

Figure 5 - Wind Turbine Foundation Types for Different Water Depths (Bhattacharya et al., 2021)



Offshore floating wind turbines are a promising technology for harnessing the potential of wind energy in deep waters, where fixed-bottom turbines are not feasible. The UK has a large and accessible offshore wind resource, and a strong track record of deploying offshore wind farms.

However, most of the existing projects are located in shallow waters, and the costs and challenges of expanding to deeper sites with fixed-bottom turbine foundations are significant.

Offshore floating wind turbines offer a solution to overcome these barriers, by enabling the installation of wind turbines at greater distances from the shore, where the wind speeds are higher and more consistent, and the visual and environmental impacts are lower. Removing the constraints from water depth also allows developers to select sites with the most optimal wind conditions.

The need for offshore floating wind turbines in the UK is driven by several factors, including net zero targets, increasing public demand for electricity from low-carbon sources, the declining costs and technological improvements of floating wind systems, and the potential for creating jobs and economic benefits in the offshore renewable sector. The trends in UK power generation from offshore floating wind turbines indicate a growing interest and investment in this emerging technology, with several projects in various stages of development, testing and operation.

Table 2 sets out notable floating offshore wind projects: The Hywind Scotland project, the world's first commercial-scale floating wind farm, which has been operating since 2017 with a capacity of 30 MW; the Kincardine project, which is expected to be completed by 2022 with a capacity of 50 MW. In addition, the UK Crown Estate has confirmed three project development areas for floating offshore wind in the Celtic Sea, as part of plans for Offshore Wind Leasing Round 5 – each with a potential capacity of up to 1.5GW.

The UK is leading in research and innovation in offshore floating wind, with several initiatives and collaborations to address the technical, economic, and social challenges of this technology. Offshore floating wind turbines have the potential to play a key role in the UK's energy transition, by providing a reliable, affordable, and sustainable source of electricity for the future.

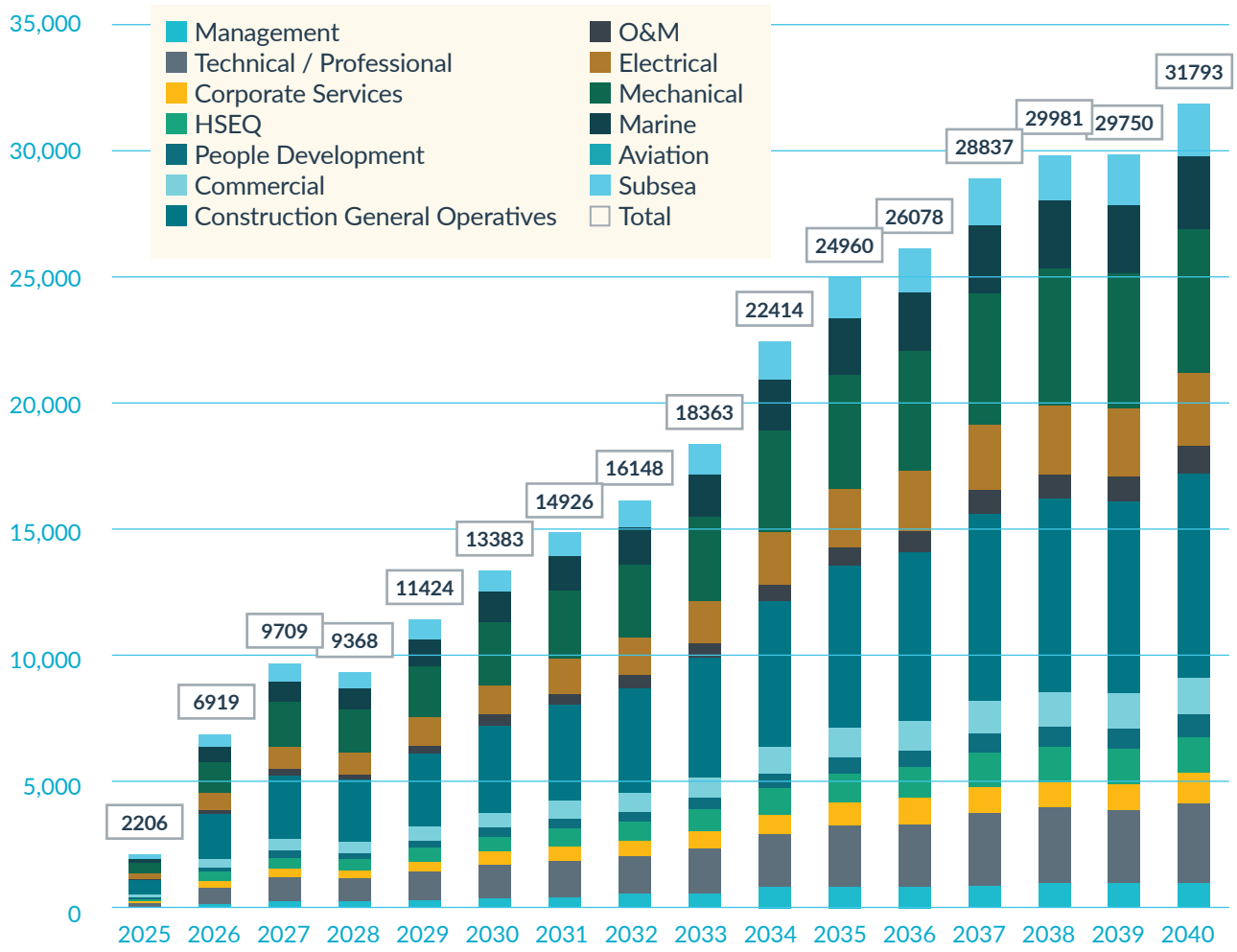
Table 2 - Notable Floating Offshore Wind Projects

Name	Location	Capacity (MW)	Turbines	Date	Depth Range	Distance to Shore	Developer
Hywind	Scotland	30	Siemens SG 6MW	2017	95-120m	25km	Equinor
Hywind	Tampen, Norway	88	Siemens SG 8.6MW	First power 2022; capacity 2023	260-300m	140km	Equinor
Kincardine	Scotland	50	5 x Vestas V164 9.5MW; 1x v80 2MW	First power 2018; capacity in 2021	60-80m	15km	Kincardine Offshore Wind Limited (KOWL)

3.2 Current and predicted scale in the UK

In the medium term, from present day to 2030, floating offshore wind will move from initial pilot projects to full commercial arrays. Opergy report that around 13,000 jobs across all skills areas will need to be created to support the required floating offshore wind capacity intended by 2030 (Dronfield et al., 2022). These findings are based upon the development and analysis of the work content of a hypothetical model 510MW floating offshore windfarm. Figure 6 shows Opergy's base case forecast. Opergy also note that in floating offshore wind, blue-collar skills needs represent around 70% of the total workforce, as compared to fixed-bottom wind where blue-collar needs represent around 45% of the total workforce.

Figure 6 - Active Roles by Job Family in UK Floating Offshore Wind (Dronfield et al., 2022)



ORE Catapult anticipates a demand for more than 3,000km of high voltage dynamic cable by 2040 to support the floating offshore wind generating capacity, along with the associated connectors and ancillary components (see Table 3). Assuming a linear / average deployment then we can expect that more than 800km of high voltage dynamic cable will be required by 2030 to support 5GW of installed capacity.

Table 3 - Expected demand for HV-DCS components in UK FOW Projects (Strang-Moran, 2021)

Unit	Unit	Accumulated up to 2040
Deployment	MW	18,524
Wind farms	No.	37
Turbines (15-20 MW turbines)	No.	990
Dynamic cables	No.	990
Dynamic cables	Km	3,031
Bouyancy modules	No.	29,702
Dynamic bend stiffeners	No.	1,730
Static bend restrictor	No.	250
Dynamic hang-off termination	No.	1,730
Static hang-off termination	No.	250
Pigtail termination	No.	1,980
Splice box termination	No.	1,980
Cable protection sleeve (touch down)	No.	1,730
Pull-in head	No.	1,730
I tube	No.	1,730
J tube	No.	250
Tethers	No.	1,204
Wet-mate connector	No.	135
Dry-mate connector	No.	270

3.3 Expected timing to impact workforce

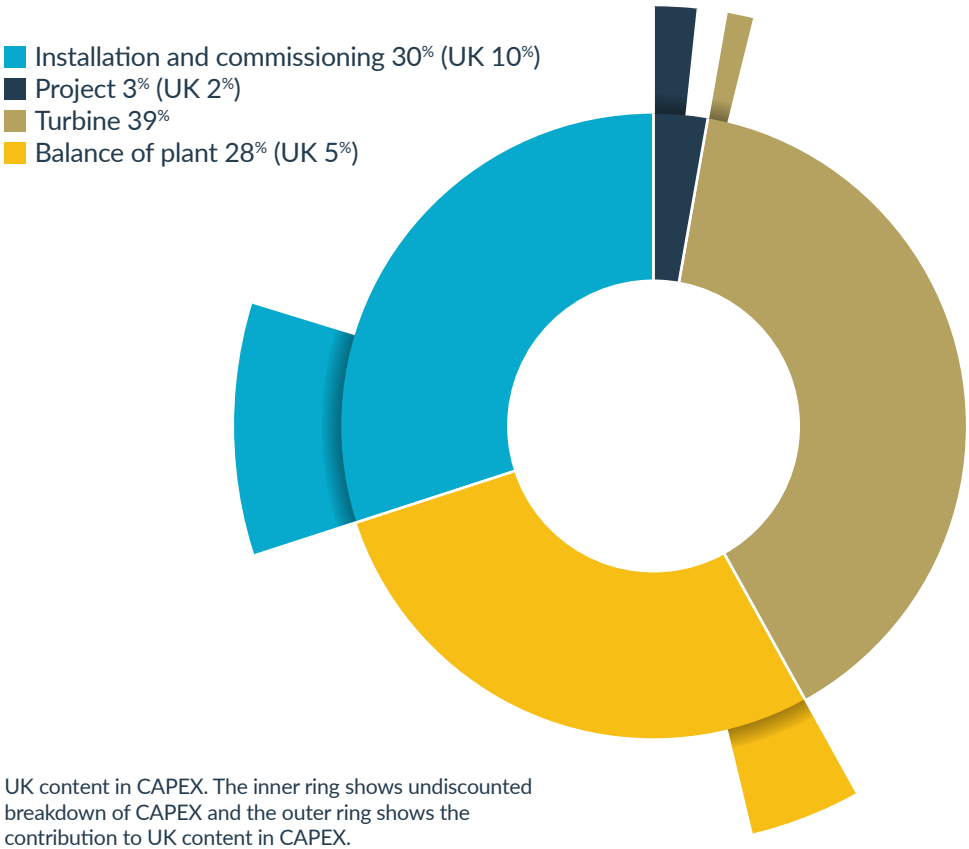
Completing the design and launch of courses and training provision in support of this foresighting topic is urgent, if 2030 targets for floating offshore wind installation are to be met. Learners need time to complete courses, move into the workforce, hone their experience, and become effective. Students will be selecting places for courses commencing in 2024 very shortly, and so now is the time to recruit and secure intake for apprenticeships and engineering degree courses.

There is a little more time for development and delivery of professional training and industry cross-skilling, but this too needs to be undertaken now so that the workforce pipeline is coming online at the same time as major FOW projects move into construction. Roles in planning and consenting are needed some two years or more before construction begins.

3.4 Choice of foresighting topic

When considering possible topics for workforce foresighting, ORE Catapult also considered the aspects of an offshore wind farm where the UK has an economic or technology edge. As illustrated within Figure 7 UK content within the turbine itself is typically around only 2.5% (or 1% of total capital expenditure), whereas in terms of the balance of plant the UK content is around 17% (or 5% of total capital expenditure).

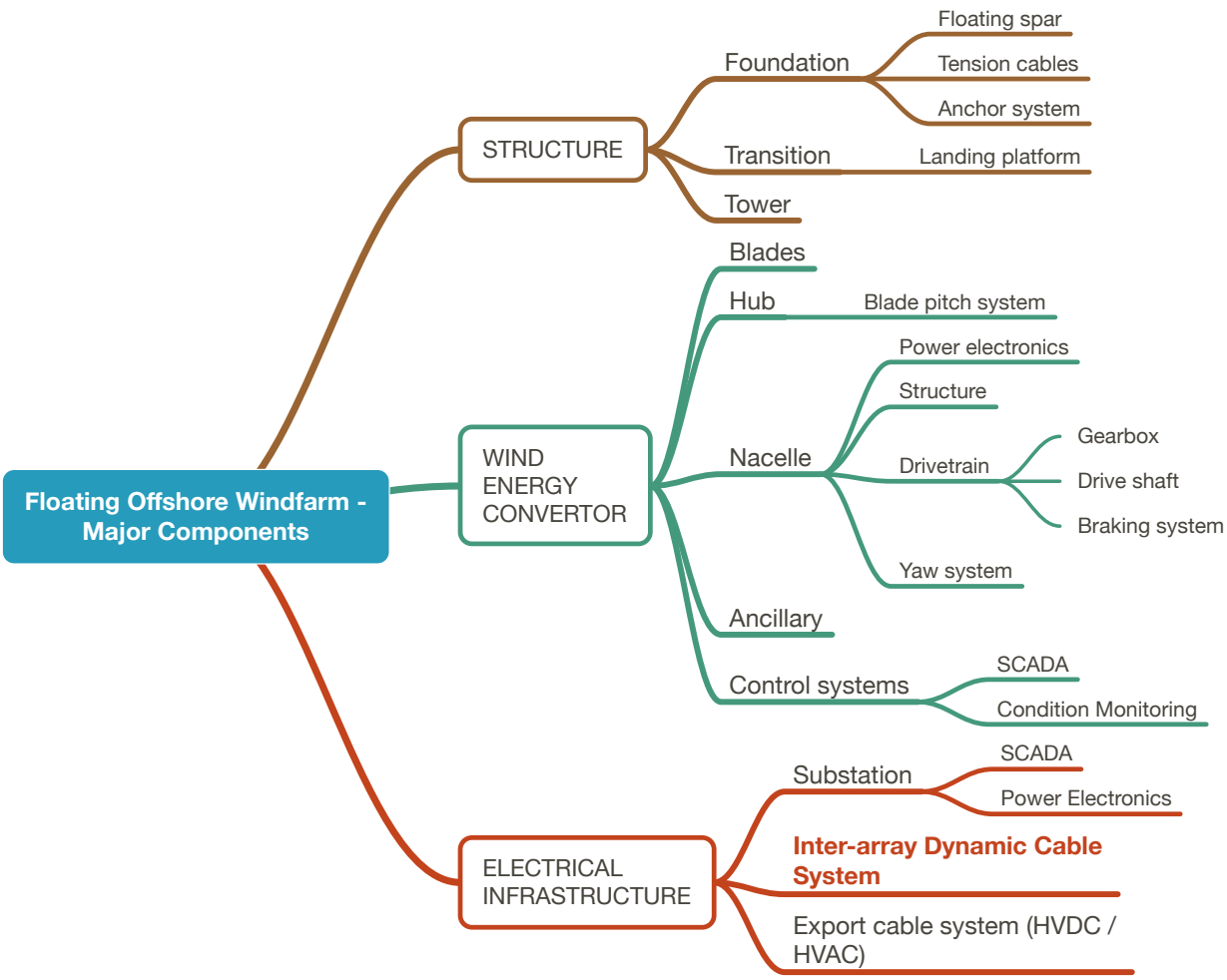
Figure 7 - UK Content in Offshore Wind Capital Expenditure by Percentage (Roberts & Valpy, 2015)



UK content in CAPEX. The inner ring shows undiscounted breakdown of CAPEX and the outer ring shows the contribution to UK content in CAPEX.

Of the high value major components in a wind farm, the wind turbine nacelle and drive train are typically German or Scandinavian, power electronics and substations are produced in Europe, blades are largely manufactured in Europe (with some UK supply emerging). Figure 8 shows the major components in a floating offshore wind farm installation.

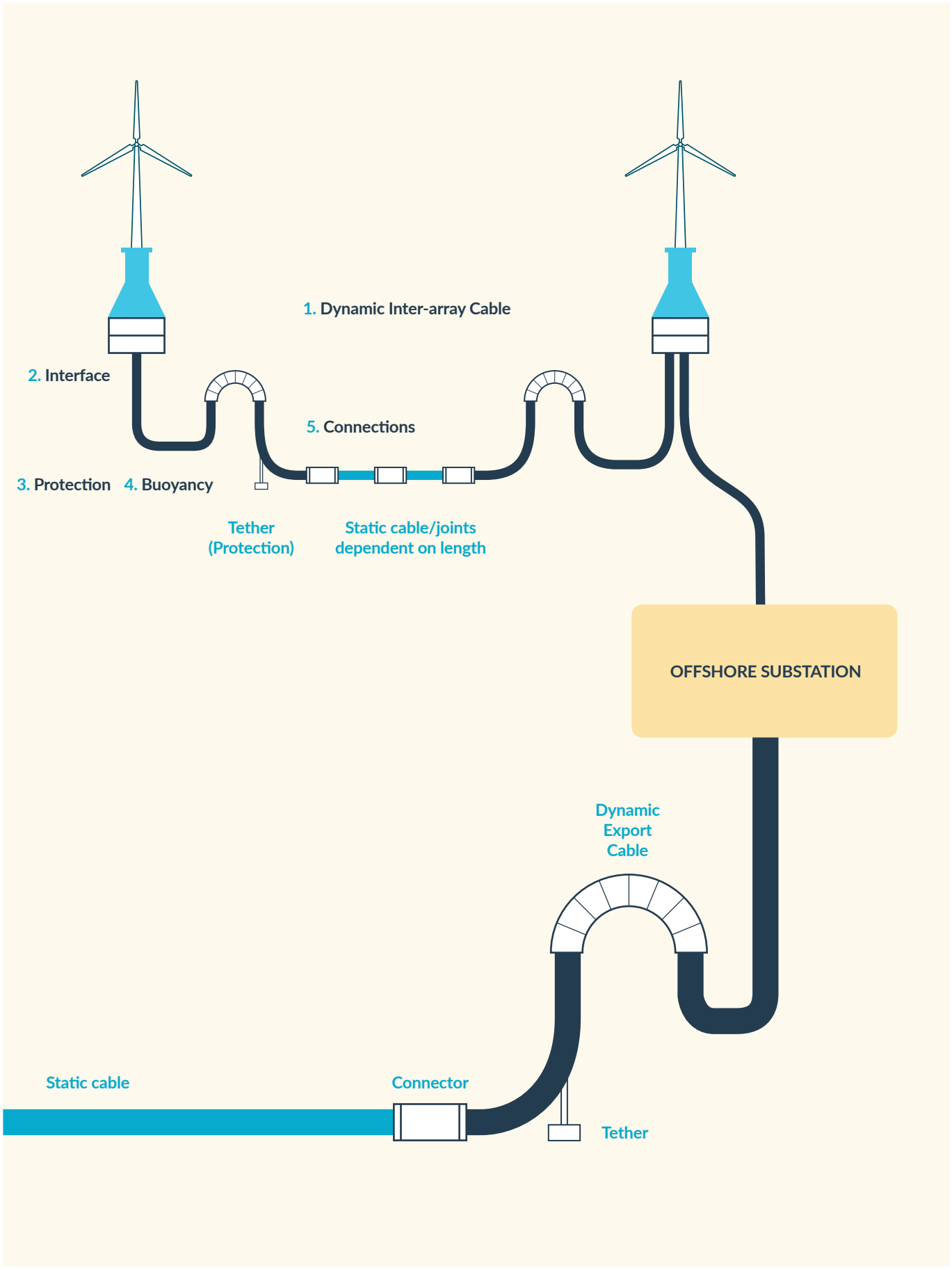
Figure 8 - Taxonomy of Floating Offshore Windfarm Major Components



There is however strong expertise in the UK for the design and manufacture of static wind farm inter-array cables and electrical connections, with high levels of technology readiness.

Therefore, for this initial project, foresighting was narrowed down to the area of dynamic power cable systems. This system comprises the dynamic cable, interfaces and protectors, connectors, bend restrictors and tethers between the wind turbines and the offshore substation. The export cable (from substation to shore) is out-of-scope.

Figure 9 - Schematic of a Floating Offshore Wind Farm and Cabling (Strang-Moran, 2021)



3.5 Who was invited and why

ORE Catapult's Technology Development facility is based in the northeast of England, alongside a cluster of offshore wind supply chain businesses. As the UK's leading manufacturer of subsea electrical cable, JDR were a natural partner to the study. Other employer and technologist participants were invited to cover a cross-section of the dynamic cable system. Equinor joined the study to provide perspective from a wind farm developer / operator point of view. The Global Underwater Hub and RenewableUK are industry-focussed groups with broad perspectives on the industry. Lastly, the educator group comprised members of the northeast energy cluster 'Energi Coast', including training providers OPITO, AIS and Port Training Services.

Table 4 - Foresighting study participating organisations, by group.

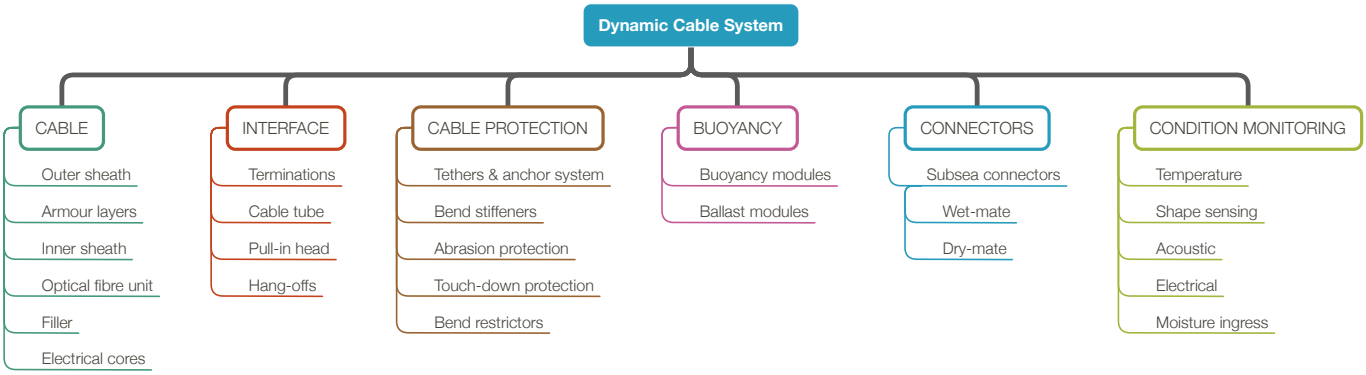
Technologists	Employers	Educators
ORE Catapult JDR Cables Equinor Balmoral Tekmar Durham Energy Institute Newcastle University Renewable UK	JDR Cables Equinor Balmoral Proserve Tekmar ORE Catapult OPITO Global Underwater Hub Renewable UK	Newcastle University Durham University Teeside University Northumbria University Northumberland College Newcastle College Gateshead College Education Training Collective Post Training Services AIS Training OPITO

4 RESULTS OF FORESIGHTING THIS TOPIC

4.1 Technology-led Differences to the Status Quo

The power cables connecting to floating offshore wind turbines are in motion due to ocean waves moving the wind turbine. These dynamic cable systems – including the cables themselves, connections, buoyancy, tethering and protection – are more complex than those in fixed-bottom turbine windfarms. There are technology and scaling challenges. The cables must withstand movement of the turbines, high tensile loads, and hydrodynamic stresses generated through water currents, tidal forces and waves. The cables must also carry higher levels of power.

Figure 10 – Taxonomy of the Dynamic Cable System (after Strang-Moran, 2021)



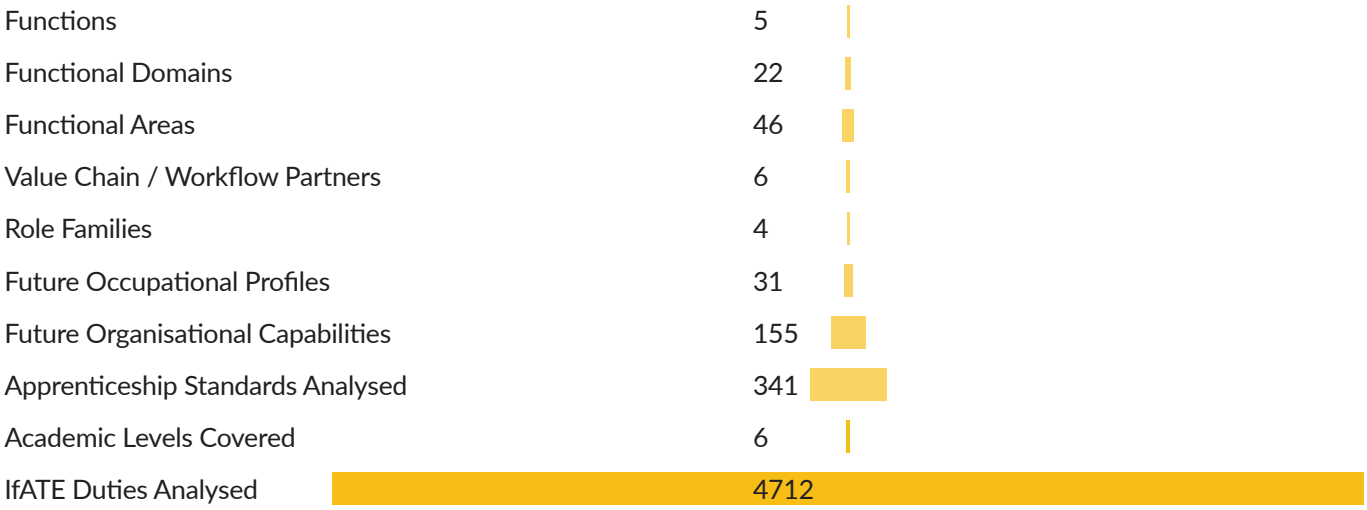
The ability to solve and scale technical and supply chain challenges, to provide reliable and available inter--array power connections, is one of the UK offshore sector's future challenges. This is recognised by the establishment of the Floating Wind Centre of Excellence (FLOWIC) in Aberdeen, in partnership with the Energy Transition Zone. This soon to be opened facility will play host to bespoke dynamic cable testing and validation equipment.

4.2 Foresighting Workshops Output

4.2.1 Preliminary Output, In Numbers

Artificial intelligence processing of workshop data analysed over 4,700 duty statements from the UK Institute for Apprenticeships and Technical Education (IfATE) database, across 341 apprenticeship standards. The initial output organised 155 capability statements that are equivalent to IfATE duty statements, resulting from the workshops, into 31 future occupational profiles ('FOPs') across the various domains and functional areas (see Figure 11). The FOPs are additionally categorised into Role Families (junior / senior engineer and junior / senior technician) and are applicable across six workflow / value chain partner groups: Research and technology organisations such as OREC, developer / operators, prime contractors, OEMs and SMEs, service providers, regulatory and compliance bodies.

Figure 11 - Data Collection Summary



The breakdown of functions, domains and capability areas, along with the count of capability statements within each area, is shown in Table 5.

Table 5 - Count of Capabilities by function, domain, and area

Function	Domain	Functional Area	Count of Capability Statements
DESIGN	Process Design & Implementation	Develop Processes	2
		Model Processes	1
	Product Evaluation	Evaluate Technical Performance	7
	Prototype Design & Development	Create Detailed Product Specification	3
		Design Systems & Applications	15
		Develop Prototypes	1
		Refine Designs	5
		Select Technologies	1
	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	1
	System/Equipment Design & Implementation	Configure Equipment	2
		Design Equipment	16
		Install Equipment	1
		Select Equipment	4
		Test Equipment & Systems	2
	Technical Research	Research & Develop Technologies	10

Unit	Domain	Functional Area	Count of Capability Statements
ENTERPRISE	Data Management	Manage Data Security	1
	Leadership & Strategy	Identify New Business Partnerships	1
		Manage Change & Transformation Programmes	3
	Product Management	Develop Specifications	2
	Regulatory Compliance	Monitor Regulation Changes	1
	Risk Management	Analyse Business Risks	1
IMPLEMENT	Manage Operations	Advise Others on Operations	1
		Analyse Operations Data	3
		Direct Operations	4
		Manage Operation Control Systems	4
		Resolve Operational Problems	1
	Plan Operations	Plan Operations	7
	Process Monitoring	Monitor Processes	1
	Product Processing	Finish Products	1
		Join Components	1
	System/Equipment Operation & Monitoring	Monitor Equipment	2
		Monitor Operations	11
		Operate Equipment	13
LOGISTICS	Supply Chain Management	Coordinate Logistics	5
		Work with Suppliers	2
	Supply Chain Operations	Move Supplies	1
SUPPORT	Customer Support	Handle Customer Problems & Inquiries	1
	Operator Support	Design and configure support systems	1
		Operate support systems	2
		Supervise Others	1
	Quality Control	Evaluate Product Characteristics & Quality	6
	System/Equipment Maintenance	Inspect Facilities & Equipment	1
		Maintain Facilities & Equipment	3
		Maintain Vehicles	1
		Repair Equipment	1
		Schedule Maintenance	1

4.3 Sensemaking and Refinement

The workforce foresighting process, at various stages through the workshop sequence, utilises a large language model artificial intelligence to parse and organise the content generated by workshop participants. The AI model can compare capability statements with existing standards more thoroughly and rapidly than human comparison could achieve. However, the AI output does require careful review: Refinement of the capability standards and the P-FOPs is described in the following two sections.

4.3.1 Refining the Capability Statements

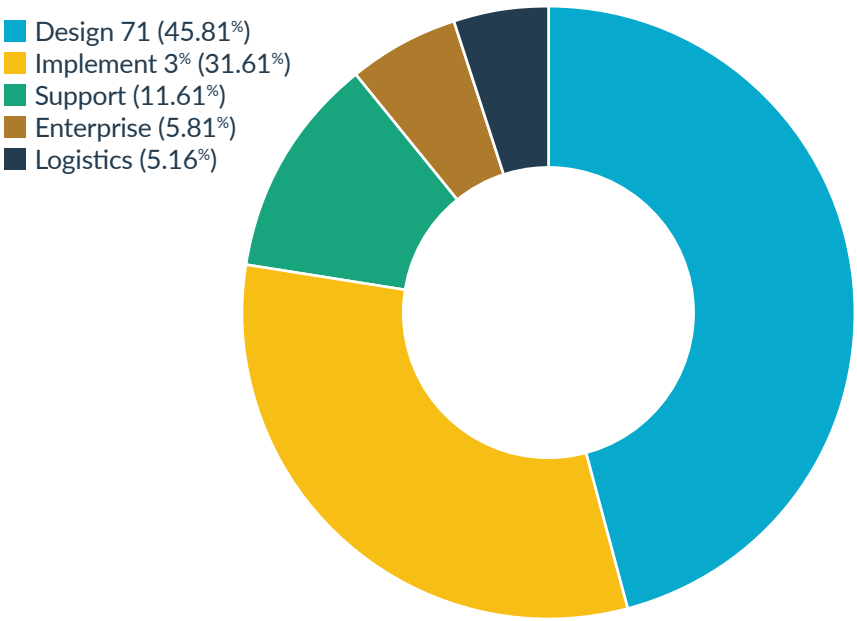
An example of a capability statement is: “Research and develop electrical and power solutions for subsea high voltage, dynamic cable systems”.

The capabilities identified through Technologist and Employer workshops were matched to existing IfATE duty statements by the AI model where possible; otherwise, new statements were generated. In both cases the statements were reviewed again by workshop participants. Of the 155 statements relating to dynamic cable systems, 88 were generated within the workshops by the team of expert Technologists and Employers.

Subsequent review and rationalisation of the capability statements, undertaken by the ORE Catapult skills team, slightly reduced the capability set (e.g. through removal of generic capabilities) and provided some correction and re-alignment of functions[7].

Figure 12 shows how the resulting capability statements are distributed across the supply chain and primary functions. As expected, the capability statements sit predominantly in the Design function (46%) followed by Implement (32%).

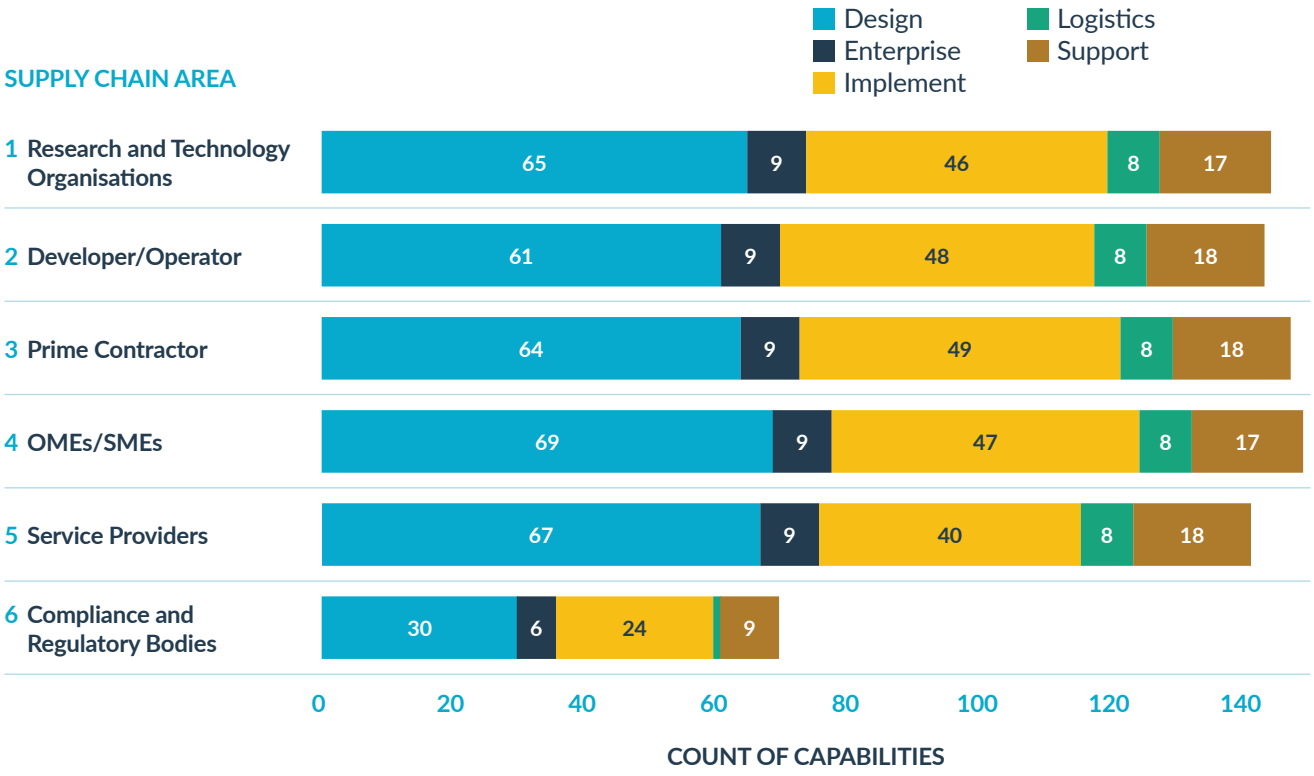
Figure 12 - Distribution of HV-DCS Capabilities by Primary Function



[7] The capability ID and changes to function assignment were: 188973 from DESIGN to ENTERPRISE; 188971 from IMPLEMENT to SUPPORT; 188952 from IMPLEMENT to DESIGN; 188953, 188905, 188938 from DESIGN to IMPLEMENT; 188928, 188924 from SUPPORT to DESIGN; 188922, 188923, 188921 from LOGISTICS to IMPLEMENT.

The presence of the capabilities within each area of the supply chain is shown in Figure 13 (again grouped by Function). There is a relatively similar volume and balance in the spread of capabilities across all areas of the supply chain except regulatory / compliance bodies. This may reflect the fact that regulatory and compliance bodies are not directly represented in foresighting.

Figure 13 - Distribution of Capabilities by Primary Function and Supply Chain Partners



4.3.2 Refining the Potential Future Occupational Profiles

The potential future occupational profile ('P-FOP') provides a means to group capabilities required by the future technology deployment, into job- or course-like groups.

The foresighting workshops and AI processing generated thirty-one P-FOPs. The ORE Catapult skills team along with input from industry, considered that this set was too broad to action practically. Additionally, the AI model generated distinct P-FOPs – in terms of their capability set – with very similar profile titles, for example:

- Subsea High Voltage Cable Systems Technician.
- Undersea High Voltage Dynamic Cable Systems Technician.
- Subsea Cable Systems Technician.

Distinguishing between these initial AI-generated P-FOPs was confusing in practice. This, along with the volume of P-FOPs, led the team to 're-cast' the capability statements into a reduced number of P-FOPs: The AI-generated set of thirty-one P-FOPs was reduced to a set of fifteen. No information was discarded – all capability statements were incorporated into the revised FOPs. The count of P-FOPs by role family and lifecycle is shown in Table 6.

Table 6 - Count of refined P-FOPs by Lifecyle and Role Family

Lifecycle Stage	Role Family 1 – Technician	Role Family 2 – Snr. Technician	Role Family 3 – Engineer	Role Family 4 – Snr. Engineer
Research, Develop	-	1	3	3
Design	-	-		
Production	1	1	1	1
Offshore (install / operate & maintain)	1	1	1	1

4.3.3 Consideration of Fit- and Surplus-Factors

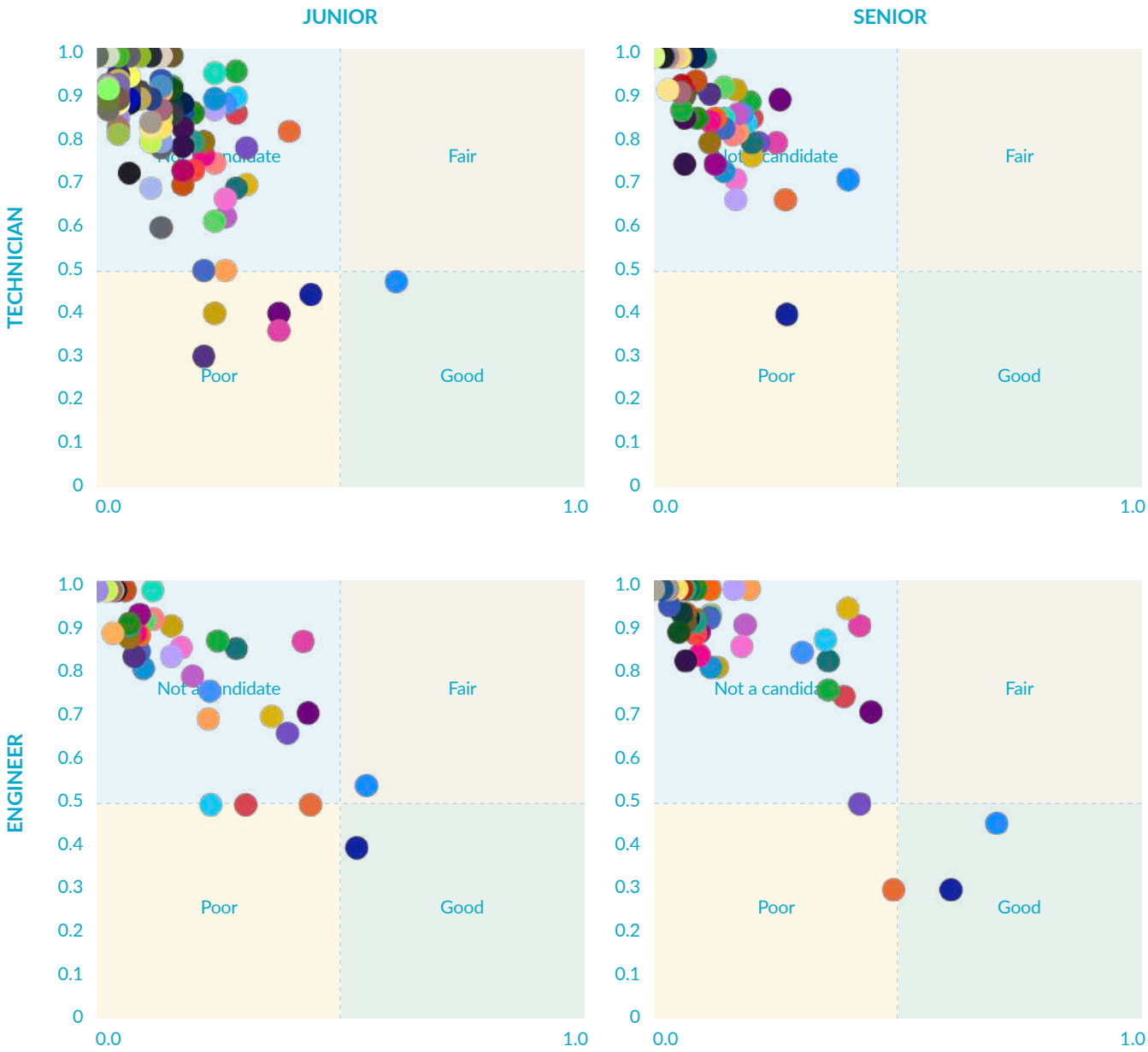
AI analysis of the 'data cube' generates an assessment of the degree to which a P-FOP is satisfied by an existing IfATE qualification. This is assessed in terms of:

- Fit Factor: Indicates the overlap between capabilities in the standard and those identified in the P-FOP. A score of 1 would indicate that the IfATE standard satisfies all of the capabilities in the P-FOP; a score of 0.5 would indicate that half the P-FOP capabilities are found in the IfATE standard.
- Surplus Factor: Indicates the amount of content in the IfATE standard that is surplus to the needs of the P-FOP. A score approaching 1 would indicate that the majority of the IfATE standard is not relevant to the P-FOP, a score approaching 0 indicates that nearly all of the IfATE standard is relevant to the P-FOP.

A good fit is therefore indicated by a high fit factor and low surplus factor.

Figure 14 shows graphically the fit factor / surplus factor analysis for IfATE capabilities against the HV DCS P-FOP role families. The vertical (y) axes show the surplus factor in each chart, and fit factor is indicated on the horizontal (x) axes.

Figure 14 – Fit vs Surplus Factor Analysis by Role Family



These charts suggest that there are few existing qualifications that are very good candidates for adoption or adaptation for HV DCS. It was generally found that a higher threshold on surplus factor is more useful in filtering out less relevant IfATE standards (e.g. 'stained glass craftsperson') whilst a slightly lower threshold on fit factor is useful to ensure relevant standards might be included. Standards with FF => 0.3 and SF < 0.5 are shown in Table 7.

Table 7 - Best IfATE Candidates for Adoption / Adaptation in HV DCS, by Fit / Surplus Factor Analysis

P-FOP Title	IfATE STD Title (ID)	#Duties in STD	#FOP Cap's in Std	Level	FF	SF
RF1 (Tech. 1)						
DCS Component Production Tech. 1	Creative industries production technician (12471)	19	22		0.48	0.47
Offshore HV DCS Tech.	Creative industries production technician (12471)	19	28		0.61	0.42
	Power industry overhead linesperson (12238)	18	20		0.44	0.33
	Installation and maintenance electrician (12023)	25	17	3	0.37	0.24
	Food and drink maintenance engineer (11875)	15	17	3	0.37	0.27
	Power industry substation fitter (12240)	20	14		0.30	0.30
RF2 (Tech. 2)						
DCS Component Production Tech. 2	Engineering manufacturing technician (11145)	14	19	4	0.40	0.36
RF3 (Eng. 1)						
Production Eng.1 - DCS Components	Electro-mechanical engineer (11206)	11	29	6	0.55	0.18
	Electrical or electronic technical support engineer (degree) (12036)	10	28	6	0.53	0.10
	Product design and development engineer (degree) (12038)	10	23	6	0.43	0.00
	Space systems engineer (11929)	14	17	6	0.32	0.14
	Manufacturing engineer (degree) (12037)	10	16	6	0.30	0.30
Subsea HV DCS Eng. - Electrical	Electro-mechanical engineer (11206)	11	17	6	0.55	0.18
	Space systems engineer (11929)	14	13	6	0.42	0.36
	Materials science technologist (degree) (11267)	12	12	6	0.39	0.50
	Robotics engineer (11713)	17	11	6	0.36	0.47
Subsea HV DCS Eng. - Mechanical	Electro-mechanical engineer (11206)	11	18	6	0.46	0.18
	Space systems engineer (11929)	14	14	6	0.36	0.29
Subsea HV DCS Eng. - Systems Integration	Electro-mechanical engineer (11206)	11	16	6	0.46	0.18
	Space systems engineer (11929)	14	15	6	0.43	0.29

P-FOP Title	IfATE STD Title (ID)	#Duties in STD	#FOP Cap's in Std	Level	FF	SF
RF4 (Eng. 2)						
Production Eng. 2 - DCS Components	Electro-mechanical engineer (11206)	11	30	6	0.70	0.27
	Electrical or electronic technical support engineer (degree) (12036)	10	26	6	0.61	0.10
	Product design and development engineer (degree) (12038)	10	21	6	0.49	0.00
	Space systems engineer (11929)	14	19	6	0.44	0.14
	Manufacturing engineer (degree) (12037)	10	18	6	0.42	0.20
	Materials process engineer (degree) (11229)	34	13	7	0.30	0.41
Subsea HV DCS Eng. 2 - Electrical	Electro-mechanical engineer (11206)	11	17	6	0.55	0.18
	Space systems engineer (11929)	14	13	6	0.42	0.36
	Materials science technologist (degree) (11267)	12	12	6	0.39	0.50
	Robotics engineer (11713)	17	11	6	0.36	0.47
	Electronic systems principal engineer (11302)	12	11	7	0.36	0.50
Subsea HV DCS Eng. 2 - Mechanical	Electro-mechanical engineer (11206)	11	18	6	0.46	0.18
	Space systems engineer (11929)	14	14	6	0.36	0.29
Subsea HV DCS Eng. 2 - Systems Integration	Electro-mechanical engineer (11206)	11	16	6	0.46	0.18
	Space systems engineer (11929)	14	15	6	0.43	0.29

4.4 Summary of Resulting Occupational Profiles

The following text provides a narrative summary of the P-FOPs defined through the workshops and sensemaking work. For the full capability lists under each P-FOP see Appendix 1.

A real-world job might incorporate several occupational profiles or only parts of one; similarly, a college course might be designed to address one or several occupational profiles alongside or independent of other pre-existing course material. These future occupational profiles – and more particularly the associated capability sets – therefore provide employers with building blocks to help in the design of future roles, and educators with building blocks to guide the development of course modules and content to prepare the future workforce.

4.4.1 Design Roles

Design occupational profiles appear in engineering role families. These each contain several core engineering and quality-of-performance capabilities (e.g. computer aided engineering and design, reporting, R&D activities, general approaches to design work) but capabilities newly developed through this foresighting cycle provide further focus. These include, for example:

- Subsea HV DCS Engineer – Electrical: Developing and using tools for the modelling of cables and interconnectors, research & development for DCS, high-voltage research, design and engineering.
- Subsea HV DCS Engineer – Mechanical: Developing and using tools for the modelling of cables and interconnectors, material selection, mechanical design of jointing solutions, effects of current flow / vortices, thermal and mechanical fatigue.
- Subsea HV DCS Engineer – Systems Integration: Planning inter-array configurations, environmental impact assessment, considerations for operations and maintenance, modelling of mooring systems, lifecycle cost of ownership.

In addition to the engineering role, a technician profile is also identified in the R&D domain:

- HV DCS Research & Development Technician 2: Awareness of (vs. practitioner) a range of engineering and technical aspects particular to HV-DCS.

4.4.2 Production Roles

Production occupational profiles appear in technician and engineering role families. These P-FOPs include general production and manufacturing engineering capabilities. Capabilities more particular to HV DCS include:

- Cable Systems Component Production Technician: Production of, and operation of specialist equipment relating to DCS components, equipment for in-situ repair of DCS, HV / power connectors, manufacture of equipment used in the installation of DCS (incl. ROV, vessel equipment).
- Production Engineer: Inspection of HV equipment, manufacture of equipment used in DCS installation, HV DCS test and validation activities.

4.4.3 Implementation, Operational and Maintenance Roles

Initially grouped separately, industry feedback led to the combining of implementation (e.g. build, install, commission) and O&M P-FOPs as a singular offshore role, given overlap in the respective skill sets, and good mobility of workers between these stages of the lifecycle. In addition to general offshore sector skills, the P-FOPs call for:

- Offshore HV DCS Technician: HV cable termination, cutting and joining, preparation and jointing of HV undersea cable, installation and commissioning of HV DCS.
- Offshore HV DCS Engineer: Installation and commissioning of HV DCS, inspection, design of access to site, modification of existing fleet for DCS, utilising smart O&M data, cable health and condition monitoring, digital twins.

5 CONCLUSIONS & RECOMMENDATIONS

5.1 Implications for Education

The capabilities and potential occupational profiles generated through the foresighting study suggest that, in general, modifications to existing courses and degrees are sufficient to meet future needs. A modular approach is more likely to be achievable within the required timescales, compared to wholesale course design. It is noted, that whilst there was a dominant focus on electrical engineering within the study, the groups did note that there is also a strong mechanical engineering content. HV dynamic cable system modules for HE and FE mechanical and electrical engineering courses can be developed with reference to the P-FOPs and capability sets for electrical, mechanical and systems integration engineering. An example of this would be the development of “Dynamic Cable” education modules which can build on existing mechanical or electrical engineering courses (eg a module in the introduction and use of Orcaflex in dynamic cable systems layout and design)

The approach in further education can be similar with adaptation of existing electrical- and mechanical- engineering courses. Other standards identified by the fit- / surplus-factor analysis may also be suitable for adaptation including power transmission, maintenance technician, and production / manufacturing technician roles.

Where there are more specialist technical areas that require capability development, these should be addressed through routes such as PhD sponsorships and engagement with industry. For example, the topic of marine bio-fouling is unlikely to require a high volume of practitioners, but rather a small number of experts. University-led PhD studies can investigate problems and technologies in detail, before professionals in industry and RTOs provide support to refine and scale up solutions. It is important that these types of specialist areas are identified in good time. A challenge for academia is to engage with industry proactively, supporting ongoing dialog so that research topics can be identified collaboratively.

5.2 Implications for Industry

Employers need to act individually and collectively to ensure that the development of experienced staff meets industry needs, in support of the 2030 targets for offshore wind. The volumes of some roles are very unlikely to be met fully by ‘bottom-up’ training through the HE/FE system and into the industry directly. There is a natural preference to rely on recruitment of ready-skilled staff from within the sector. Employers must become effective and open to up-skilling and re-skilling across industry sectors. As an example, the ‘creative industries production technician’ scores well in fit- and surplus- factor analysis, but the creative industries are far from the traditional hunting grounds for engineering recruitment.

It may be beneficial to the industry, to adopt the common language and references of the potential future occupational profiles and capabilities, in the description of roles

and vacancies. This will bring clarity in several areas, for example cross-sector mobility, the applicability of training and development routes to desired career / role paths, and recruitment of suitably qualified staff.

One of the discussions within the foresighting workshops for dynamic cable systems, was the increased need for taking a systems-level approach to design and engineering. Greater cooperation between parts of the supply chain, both in terms of engineering but also in terms of engineering talent, can only assist in this. Technical working groups and interface design groups, potentially led by the industry prime contractors or developers, may become more common in the development of floating offshore wind projects.

5.3 Future / additional foresighting requirements

Further cycles of foresighting on the dynamic cable topic may be beneficial as technology opportunities become clearer over time. It may also be beneficial during the next few years, to consider whether foresighting at a more detailed level (i.e. a narrower and more specific aspect of HV DCS) may be useful.

There are several other areas within future UK offshore wind that would benefit from skills foresighting – and arguably all are required to avoid any single points of failure that could undermine the broader set of targets and objectives. See §5.5.3 for suggested topics.

5.4 The cost of inaction

If there is a shortage of skilled engineers and offshore technicians, it could have several impacts on achieving the UK's target to install 50 GW of offshore wind, including 5GW of floating offshore wind by 2030:

- Delays in technology development and deployment: Lack of capacity and capability in the sector could inhibit the early lifecycle work of technology design and development work. Delays to testing and proving will impact new technology uptake in a sector that is generally risk-averse.
- Delays in scaling-up production: It takes time to scale up production of new technologies. This includes development of at-scale production methodologies, investment and installation of capital equipment, and recruitment and training of the workforce.
- Delays in project development: A shortage of skilled personnel will lead to delays throughout the lifecycle of offshore wind consenting, planning, construction and installation of offshore wind farms. This could result in projects taking longer to complete, causing delays in reaching the 50GW target.
- Potential scrapping of major projects: A shortage of skilled workers will act as a major supply chain bottleneck which on an international basis has already led to the cancelling of Orsted Oceanwinds project in the USA.

- Increased project costs: With a shortage of skilled workers, the demand for their services increases, leading to higher wages and overall project costs. This could make offshore wind projects financially less attractive and could impact the feasibility of achieving the target.
- Decreased operational efficiency: Skilled engineers and technicians play a crucial role in the operation and maintenance of offshore wind projects. A shortage of qualified personnel can lead to decreased operational efficiency and increased downtime due to a lack of timely maintenance or repairs.
- Increased reliance on foreign expertise: If there is a shortage of skilled workers domestically, the industry may need to rely on foreign expertise to meet the target. This could come with additional costs and logistical challenges.

5.5 Next Steps: Causing Action

5.5.1 Key Action 1: Industry Stakeholder Engagement

Within the Skills Value Chain, foresighting of future workforce requirements is the first critical step. The next key link in the value chain is Forecasting of future skills demand. This is an essential pre-requisite to enable sensible engagement with education and training providers, who will need an understanding of learner or trainee numbers to justify the development (or redevelopment) of education or training courses. While the offshore wind industry has excellent intelligence of future skills demand at a macro level[8] this does not currently drill down into specific technical areas, and more work is required to generate the HV Dynamic Cable workforce demand forecasts necessary to catalyse education and training providers to develop HV Dynamic Cable education and training materials to support the Future Occupational Profiles identified within the project.

The Independent Report of the Offshore Wind Champion, published in March 2023, contains the following key recommendation within its skills section (Pick, 2023):

> *"HMG and the Devolved Administrations should seek to integrate the outputs of the Green Jobs Delivery Group and equivalents with improved data and forecasting outputs from the Workforce Foresighting Hub (WFSH) being developed by InnovateUK and the Catapults, DfE's Unit for Future Skills and devolved equivalents to create a complete picture of future skills requirements to meet the needs of Offshore Wind (and adjacent technologies such as nuclear (power and submarines), EVs, Hydrogen and CCUS), address emerging workforce gaps, and to help guide local and regional skills and workforce delivery strategies."*

The first key action arising from this report is that the ORE Catapult Workforce Foresighting team will seek to engage with key industry stakeholders, including Renewable UK, the Offshore Wind Industry Council Investment in Talent Group and the Green Jobs Delivery Group to seek out robust existing Workforce Demand Forecasts in relation to HV Dynamic Cables, and if none exist, work with relevant industry bodies and experts to develop sensible demand forecasts.

[8] See, for example, the Offshore Wind Skills Intelligence Reports from May 2022 and June 2023 available at www.owic.org.uk/our-work/people-skills.

5.5.2 Key Action 2: Education Sector Engagement

Once robust Workforce Demand Forecasts have been developed or obtained, see Key Action 1, the ORE Catapult Workforce Foresighting team will actively engage with Further Education, Higher Education, Apprenticeship and Training Providers, plus industry representative groups, to initiate the development of new, or modified curriculum and training programmes to support the HV Dynamic cables technology challenge. The team will explore the relevance of a model in the style of the Emerging Skills Project[9] style model with open access training modules, and in parallel will facilitate direct conversations with educators and training providers.

5.5.3 Key Action 3: Future Workforce Foresighting Cycles

The UK Offshore Wind Industry faces top level technology challenges of (1) achieving 50GW of offshore wind power generating capacity by 2030, and (2) within this, 5GW of Floating Offshore Wind by 2030. These targets are key to the UK's drive to Net Zero and future energy security There are a number of key enabling technologies, including the topic of this Workforce Foresighting cycle, HV Dynamic Cables in Floating Offshore Wind. The Independent Report of the Offshore Wind Champion (Pick, 2023) identified Workforce Foresighting as a key tool which can contribute to solving the workforce and skills challenges associated with these technology challenges. ORE Catapult has identified a second Workforce Foresighting challenge for Offshore Wind, focussing on Robotics and Autonomous Systems for Offshore Wind Operations and Maintenance. Beyond this, it is recommended that support be provided to undertake a rolling programme of Workforce Foresighting cycles in support of the recommendations of the Offshore Wind Champion. These cycles may include, but not be limited to:

- Remote and autonomous systems for offshore wind operations & maintenance (planned) which may be further broken down into:
  - Remote and autonomous inspection.
  - Remote and autonomous intervention and repair.
- Developing UK content in turbine blade manufacture;
- Recycling and re-use of wind turbine blades;
- High voltage direct current in subsea cables for wind farm power export;
- HV Transformers and Switchgear
- Substructures and transition piece design, manufacture, and installation

[8] The Emerging Skills Project flowed from the HVMC-led foresighting study into Power Electronics, Drives and Motors (John Lanham et al., 2022) and includes online training modules and tools – see https://emergingskillsproject.com

5.5.4 Key Action 4: Cross-Sector Discussions for HV Electrical Skills

In parallel with preparation of this report, ORE Catapult have held conversations with key industry stakeholders and groups including the UK's Green Jobs Delivery Group3. These conversations have identified a potentially broader demand for high voltage electrical skills across a range of technologies, including drives, transformers, and switchgear; and sectors – including electricity transmission and distribution.

This foresighting report will be used to facilitate further conversations with these groups, and act as a catalyst for a wider view of HV electrical engineering skills. These conversations should also feed into Key Action 2 - to develop a suite of education and training modules that support transferable skills across a range of HV electrical activities.

5.5.5 Quick Wins

As a result of early discussions, several work packages are already underway on opportunities for action within education, industry training and trade body sectors. These include:

- Degree Apprenticeship design: A working group at a leading Northeast Russell Group university is to look at the potential for incorporating the HV DCS foresighting findings within a degree apprenticeship as an optional pathway. This option will be available to students after completion of the core content, alongside other modules around electrification and sustainable manufacturing.
- HV Electrical Engineering professional course provision: An early opportunity has arisen to use the outputs from the HV Dynamic Cable Systems project as the inputs to an industry-led project, with a national energy sector training and development organisation. This will develop a new suite of HV electrical engineering professional courses for the Offshore Wind Sector and assist in the migration of employment from offshore 'brown energy' roles in the O&G sector, over to the green energy sector.
- Leveraging ORE Catapult's HV Resources: Investigating opportunities to use ORE Catapult's Blyth-based Technology Development resources and technical expertise to inspire, educate and train the current and future Offshore Wind workforce in HV Electrical technology, including HV dynamic cables.

The above 'trailblazer' activities should lead to further, similar initiatives within educator, employer and industry groups. Some coordination between all these moving parts is necessary and ORE Catapult should be well placed to act in this capacity, additionally now being charged to do so by Innovate UK.

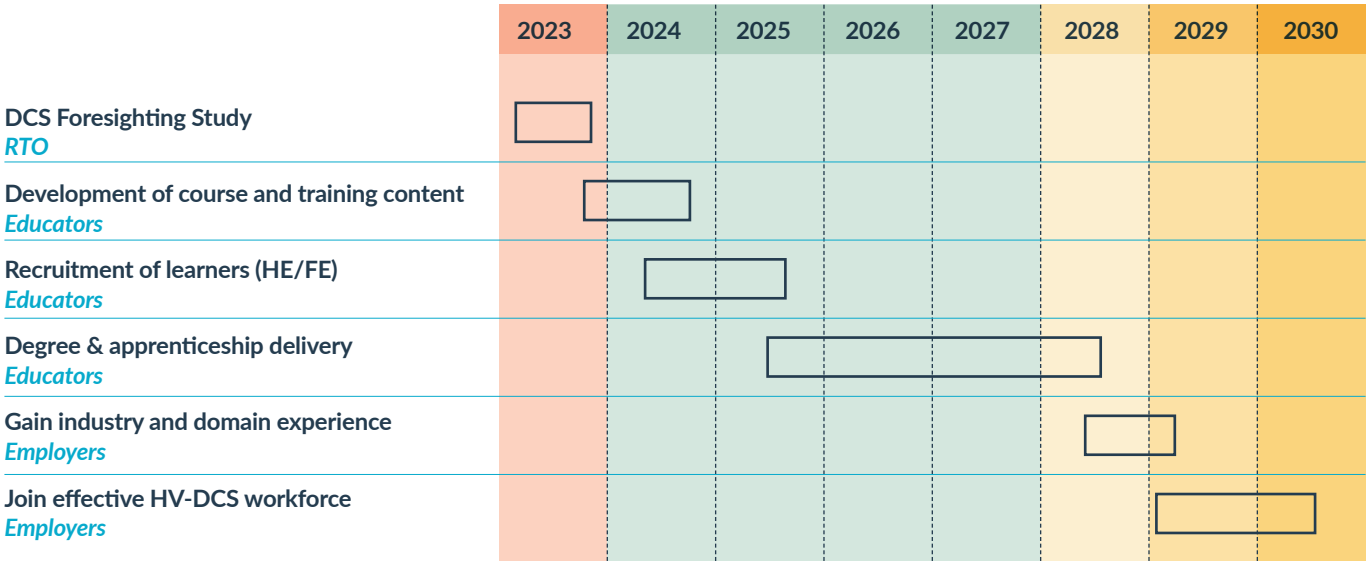
5.6 Timeline

The lifecycle for developing and running academic course content may typically include:

- Budgeting and market analysis to determine demand.
- Course content design.
- Review and sign-off by training providers.
- Review and sign off by qualifications and standards bodies.
- Marketing of content to learners and educational institutions / course providers.
- Recruitment and onboarding of learners.
- Teaching, learning and coursework.
- Assessment and certification.

The cycle is further complicated by the drum beat of academic term times. Private course provision – such as industry training courses – is not dissimilar in stages, though may progress more rapidly in some areas (e.g. delivery) and more slowly in others (e.g. industry acceptance, certification and accreditation). In summary, this all takes considerable time. Action is needed now to ensure that input from foresighting can be delivered into industry via training and education, in timescales that support UK 2030 targets in floating offshore wind. A simplified though indicative timeline is shown in Figure 15.

Figure 15 - Indicative Timeline for DCS Workforce Effectiveness



5.7 Learning points from this foresighting cycle

This foresighting study has been the pilot study within the Offshore Renewable Energy Catapult and as such several learning points have been discussed. Working with the Foresighting Hub at the High Value Manufacturing Catapult (Manufacturing Technology Centre), the foresighting process can continually be updated and improved for future cycles. Some areas for further consideration include:

- Human sensemaking is an important step within Foresighting. This occurs both between activities and workshops, and to process the output from the 'data-cube'.
- Learning how to work with AI is a work in progress.
- It may be useful to 'seed' the process, as opposed to starting with a completely blank sheet of paper. For example, it was always very likely that mechanical and electrical engineering would feature in HV DCS – therefore these capability sets could have been incorporated initially.
- Another useful 'seed' input would be job vacancies from employers, in related disciplines and roles.
- It is relatively easy to identify 'Type I' errors in workshop input and model output, that is – inclusion of data that doesn't make sense, or may have been misinterpreted. It is much harder to identify 'Type II' errors in the process – the omission of data that could be useful and important. Broad participation good quality input into workshops, and review of stages, is currently the best way to control for this.

The above points will be drawn into future ORE Catapult workforce foresighting projects.

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7 APPENDIX 1: POTENTIAL FUTURE OCCUPATIONAL PROFILES AND CAPABILITIES

This appendix presents the resulting capability sets defined by the foresighting process and arranged into four role families: Technician 1, technician 2, engineer 1, and engineer 2. The capabilities with the role at 'expert' and 'practitioner' levels are listed. The 'awareness' level capabilities are omitted here since 'awareness' level capabilities can generally be acquired on the job, whereas those capabilities at 'practitioner' or 'expert' level require some prior education, training or experience.

7.1 Role Family 1 (Technician)

7.1.1 Cable Systems Component Production Technician 1

ID	Capability statement: Cable Systems Component Production Technician 1	Function	Domain	Area	Type	Level
128790	Prepare, review, or maintain maintenance schedules, design documentation, or operational reports or charts.	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
151140	Review program specifications or blueprints to determine and set machine operations and sequencing, finished workpiece dimensions, or numerical control sequences.	DESIGN	System/ Equipment Design & Implementation	Configure Equipment	Maintain	Practitioner
188894	Analyse job orders, drawings, blueprints, specifications and design data to determine manufacturing process data i.e. production processes, tool selection, machine speeds, and feed rates.	DESIGN	System/ Equipment Design & Implementation	Configure Equipment	Use	Practitioner
188952	Undertake high volume manufacturing of high voltage / power connectors with inclusion of fibre optic connectors	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Implement	Practitioner
188953	Manufacture equipment for the installation of cable systems e.g. vessels, vessel equipment, ROVs and other subsea equipment.	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Implement	Practitioner

ID	Capability statement: Cable Systems Component Production Technician 1	Function	Domain	Area	Type	Level
154880	Select electromechanical equipment, materials, components, or systems to meet functional specifications.	DESIGN	System/ Equipment Design & Implementation	Select Equipment	Implement	Practitioner
33440	Confer with supervisors or engineers to plan or review work activities or to resolve production problems.	IMPLEMENT	Manage Operations	Resolve Operational Problems	Use	Practitioner
120250	Plan sequences of calibration tests according to equipment specifications and scientific principles.	IMPLEMENT	Plan Operations	Plan Operations	Implement	Practitioner
137550	Read specifications, blueprints, and work orders to determine setups as well as to plan production sequences.	IMPLEMENT	Plan Operations	Plan Operations	Use	Practitioner
188938	Manufacture equipment for in-situ repair of dynamic cable systems	IMPLEMENT	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner
136570	Read and interpret schematic drawings, diagrams, blueprints, specifications, work orders, or reports to determine materials requirements or assembly instructions.	IMPLEMENT	System/Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188912	Operate specialist manufacturing process equipment for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188913	Operate specialist manufacturing equipment for the production of flotation and bouancy devices for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188914	Operate specialist manufacturing equipment for the production of bend stiffner systems for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188915	Operate specialist manufacturing equipment for the production of subsea connectors for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188916	Operate specialist manufacturing equipment for the production of condition monitoring equipment for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner

ID	Capability statement: Cable Systems Component Production Technician 1	Function	Domain	Area	Type	Level
188917	Carry out test and validation activities within production / manufacture of components and sub-systems for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188924	Design implement, maintain, or improve equipment, facilities, components, products, or systems for commercial, industrial, or domestic purposes.	SUPPORT	Operator Support	Design and configure support systems	Use	Practitioner

7.1.2 Offshore HV Cable Systems Technician

ID	Capability Statement: Offshore HV Cable Systems Technician	Function	Domain	Area	Type	Level
83220	Integrate electrical systems with renewable energy systems to improve overall efficiency.	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
188905	Monitor, analyse and initiate action using condition monitoring data.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Practitioner
2010	Adjust, repair, or replace electrical or electronic components to correct defects and to ensure conformance to specifications.	DESIGN	System/ Equipment Design & Implementation	Install Equipment	Use	Practitioner
104930	Observe machines on trial runs or conduct computer simulations to ensure that programs and machinery will function properly and produce items that meet specifications.	DESIGN	System/ Equipment Design & Implementation	Test Equipment & Systems	Use	Practitioner
188971	Analyse and manage condition monitoring data	IMPLEMENT	Manage Operations	Analyse Operations Data	Use	Practitioner
188889	Characterise optical fiber using optical time-domain reflectometer (OTDR)	IMPLEMENT	Product Processing	Join Components	Implement	Practitioner
188891	Terminate cut and join HV intra-array dynamic cabling systems	IMPLEMENT	Manage Operations	Direct Operations	Implement	Practitioner
188964	Optimise installation process for cost and safety.	IMPLEMENT	Process Monitoring	Monitor Processes	Implement	Practitioner

ID	Capability Statement: Offshore HV Cable Systems Technician	Function	Domain	Area	Type	Level
104950	Observe meters, gauges, or machine operations to ensure that soldering or brazing processes meet specifications.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Equipment	Use	Practitioner
188907	Observe the operation of machinery or equipment to diagnose malfunctions	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Equipment	Use	Practitioner
58320	Document procedures for hardware and software installation and use.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Implement	Practitioner
78120	Inspect completed installations and observe operations to ensure conformance to design and equipment specifications and compliance with operational, safety, or environmental standards.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Maintain	Practitioner
92770	Maintain records of engineering department activities, including expense records and details of equipment maintenance and repairs.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Maintain	Practitioner
141230	Record repairs and maintenance performed.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Use	Practitioner
188908	Observe and test the operation of machinery or equipment to diagnose malfunctions, using relevant test equipment.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Use	Practitioner
188972	Deploy or use condition monitoring systems for dynamic cable systems	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Use	Practitioner
163330	Study blueprints or manufacturers' manuals to determine correct installation or operation of machinery.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188909	Undertake preparation, splicing and jointing of HV undersea cables using appropriate tools and equipment.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188910	Cut cables using master templates, measuring instruments, and cable cutters or saws.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188911	Prepare metal surfaces or workpieces using appropriate hand tools and equipment.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner

ID	Capability Statement: Offshore HV Cable Systems Technician	Function	Domain	Area	Type	Level
188918	Deploy appropriate construction equipment to complete installations, derricks, trenchers, or cable ploughs.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Use	Practitioner
188919	Marshall equipment at docks prior to shipping.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Use	Practitioner
188920	Load equipment to vessels for transportation to site	LOGISTICS	Supply Chain Management	Coordinate Logistics	Use	Practitioner
188921	Install subsea high voltage cable systems and/or components.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Use	Practitioner
188922	Commission subsea high voltage cable systems and/or components.	LOGISTICS	Supply Chain Management	Work with Suppliers	Use	Practitioner
188923	Handover to operator subsea high voltage cable systems and/or components.	LOGISTICS	Supply Chain Management	Work with Suppliers	Use	Practitioner
188966	Understand the risks related to incorrect cable storage, handling and transport and how it can lead to damage further down the lifecycle	LOGISTICS	Supply Chain Operations	Move Supplies	Implement	Practitioner
188974	Utilise Smart Operations and Maintenance data analysis and machine learning to better understand cable health during installation	SUPPORT	Operator Support	Operate support systems	Use	Practitioner
56290	Disassemble and reassemble equipment for inspection.	SUPPORT	System/ Equipment Maintenance	Maintain Facilities & Equipment	Use	Practitioner
116050	Perform preventative maintenance or minor repairs on machines.	SUPPORT	System/ Equipment Maintenance	Maintain Facilities & Equipment	Use	Practitioner
188928	Develop and implement operational, maintenance, or testing procedures for high voltage electrical components, equipment, or systems.	SUPPORT	System/ Equipment Maintenance	Maintain Facilities & Equipment	Implement	Practitioner
160850	Splice and repair ropes, wire cables, or cordage, using marlinespikes, wire cutters, twine, and hand tools.	SUPPORT	System/ Equipment Maintenance	Maintain Vehicles	Use	Practitioner
188969	Undertake in-situ repair of dynamic cable systems	SUPPORT	System/ Equipment Maintenance	Repair Equipment	Implement	Practitioner
153020	Schedule maintenance for industrial machines and equipment, and keep equipment service records.	SUPPORT	System/ Equipment Maintenance	Schedule Maintenance	Implement	Practitioner

7.2 Role family 2 (Senior Technician)

7.2.1 Cable Systems Component Production Technician 2

ID	Capability Statement: Cable Systems Component Production Technician 2	Function	Domain	Area	Type	Level
82490	Instruct customers in the installation, repair, or maintenance of products.	IMPLEMENT	Manage Operations	Advise Others On Operations	Implement	Expert
54940	Direct or coordinate activities concerned with manufacture, construction, installation, maintenance, operation, or modification of electronic equipment, products, or systems.	IMPLEMENT	Manage Operations	Direct Operations	Use	Expert
33440	Confer with supervisors or engineers to plan or review work activities or to resolve production problems.	IMPLEMENT	Manage Operations	Resolve Operational Problems	Use	Expert
120250	Plan sequences of calibration tests according to equipment specifications and scientific principles.	IMPLEMENT	Plan Operations	Plan Operations	Implement	Expert
136570	Read and interpret schematic drawings, diagrams, blueprints, specifications, work orders, or reports to determine materials requirements or assembly instructions.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
137550	Read specifications, blueprints, and work orders to determine setups as well as to plan production sequences.	IMPLEMENT	Plan Operations	Plan Operations	Use	Expert
188912	Operate specialist manufacturing process equipment for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
188924	Design implement, maintain, or improve equipment, facilities, components, products, or systems for commercial, industrial, or domestic purposes.	SUPPORT	Operator Support	Design and configure support systems	Use	Expert
188938	Manufacture equipment for in-situ repair of dynamic cable systems	IMPLEMENT	System/ Equipment Design & Implementation	Design Equipment	Create	Expert
188952	Undertake high volume manufacturing of high voltage / power connectors with inclusion of fibre optic connectors	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Implement	Expert

ID	Capability Statement: Cable Systems Component Production Technician 2	Function	Domain	Area	Type	Level
96390	Measure dimensions of finished workpieces to ensure conformance to specifications, using precision measuring instruments, templates, and fixtures.	SUPPORT	Quality Control	Evaluate Product Characteristics & Quality	Use	Expert
188892	Document technical specifications and operating standards for high voltage distribution equipment.	DESIGN	Prototype Design & Development	Develop Prototypes	Implement	Practitioner
76030	Implement system renovation projects in collaboration with technical staff, engineering consultants, installers, and vendors.	IMPLEMENT	Manage Operations	Direct Operations	Use	Practitioner
124980	Prepare engineering sketches or specifications for construction, relocation, or installation of equipment, facilities, products, or systems.	DESIGN	Prototype Design & Development	Create Detailed Product Specification	Implement	Practitioner
174970	Use computer-aided design (CAD) software to prepare or evaluate network diagrams, floor plans, or site configurations for existing facilities, renovations, or new systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
128790	Prepare, review, or maintain maintenance schedules, design documentation, or operational reports or charts.	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
151140	Review program specifications or blueprints to determine and set machine operations and sequencing, finished workpiece dimensions, or numerical control sequences.	DESIGN	System/ Equipment Design & Implementation	Configure Equipment	Maintain	Practitioner
154880	Select electromechanical equipment, materials, components, or systems to meet functional specifications.	DESIGN	System/ Equipment Design & Implementation	Select Equipment	Implement	Practitioner
188894	Analyse job orders, drawings, blueprints, specifications and design data to determine manufacturing process data i.e.production processes, tool selection, machine speeds, and feed rates.	DESIGN	System/ Equipment Design & Implementation	Configure Equipment	Use	Practitioner

ID	Capability Statement: Cable Systems Component Production Technician 2	Function	Domain	Area	Type	Level
188913	Operate specialist manufacturing equipment for the production of flotation and bouancy devices for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188914	Operate specialist manufacturing equipment for the production of bend stiffner systems for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188915	Operate specialist manufacturing equipment for the production of subsea connectors for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188916	Operate specialist manufacturing equipment for the production of condition monitoring equipment for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188917	Carry out test and validation activities within production / manufacture of components and sub-systems for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188953	Manufacture equipment for the installation of cable systems e.g. vessels, vessel equipment, ROVs and other subsea equipment.	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Implement	Practitioner
188984	Coordinate the selection and implementation of quality control equipment	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Use	Practitioner

7.2.2 Offshore HV Cable Systems Technician 2

ID	Capability Statement: Offshore HV Cable Systems Technician 2	Function	Domain	Area	Type	Level
188982	Provide technical support or instruction to staff or customers regarding equipment standards	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
188905	Monitor, analyse and initiate action using condition monitoring data.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Practitioner
83220	Integrate electrical systems with renewable energy systems to improve overall efficiency.	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
2010	Adjust, repair, or replace electrical or electronic components to correct defects and to ensure conformance to specifications.	DESIGN	System/ Equipment Design & Implementation	Install Equipment	Use	Expert
155740	Select, calibrate, or operate equipment used in the non-destructive testing of products or materials.	DESIGN	System/ Equipment Design & Implementation	Select Equipment	Use	Expert
104930	Observe machines on trial runs or conduct computer simulations to ensure that programs and machinery will function properly and produce items that meet specifications.	DESIGN	System/ Equipment Design & Implementation	Test Equipment & Systems	Use	Practitioner
188971	Analyse and manage condition monitoring data	IMPLEMENT	Manage Operations	Analyse Operations Data	Use	Practitioner
188891	Terminate cut and join HV intra-array dynamic cabling systems	IMPLEMENT	Manage Operations	Direct Operations	Implement	Expert
54940	Direct or coordinate activities concerned with manufacture, construction, installation, maintenance, operation, or modification of electronic equipment, products, or systems.	IMPLEMENT	Manage Operations	Direct Operations	Use	Practitioner
188964	Optimise installation process for cost and safety.	IMPLEMENT	Process Monitoring	Monitor Processes	Implement	Expert
92280	Maintain or repair measurement devices or equipment used for calibration testing.	IMPLEMENT	Product Processing	Finish Products	Maintain	Expert
188889	Characterise optical fiber using optical time-domain reflectometer (OTDR)	IMPLEMENT	Product Processing	Join Components	Implement	Practitioner
188907	Observe the operation of machinery or equipment to diagnose malfunctions	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Equipment	Use	Expert

ID	Capability Statement: Offshore HV Cable Systems Technician 2	Function	Domain	Area	Type	Level
104950	Observe meters, gauges, or machine operations to ensure that soldering or brazing processes meet specifications.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Equipment	Use	Expert
141230	Record repairs and maintenance performed.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Use	Expert
188908	Observe and test the operation of machinery or equipment to diagnose malfunctions, using relevant test equipment.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Use	Expert
188972	Deploy or use condition monitoring systems for dynamic cable systems	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Use	Expert
58320	Document procedures for hardware and software installation and use.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Implement	Practitioner
78120	Inspect completed installations and observe operations to ensure conformance to design and equipment specifications and compliance with operational, safety, or environmental standards.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Maintain	Practitioner
92770	Maintain records of engineering department activities, including expense records and details of equipment maintenance and repairs.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Maintain	Practitioner
188909	Undertake preparation, splicing and jointing of HV undersea cables using appropraite tools and equipment.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
188910	Cut cables using master templates, measuring instruments, and cable cutters or saws.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
188911	Prepare metal surfaces or workpieces using appropraite hand tools and equipment.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
163330	Study blueprints or manufacturers' manuals to determine correct installation or operation of machinery.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
188978	Observe validation activities within production / manufacture of components and sub-systems for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner

ID	Capability Statement: Offshore HV Cable Systems Technician 2	Function	Domain	Area	Type	Level
188921	Install subsea high voltage cable systems and/or components.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Use	Expert
188918	Deploy appropraite construction equipment to complete installations, derricks, trenchers, or cable ploughs.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Use	Practitioner
188919	Marshall equipment at docks prior to shipping.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Use	Practitioner
188920	Load equipment to vessels for transportation to site	LOGISTICS	Supply Chain Management	Coordinate Logistics	Use	Practitioner
188922	Commission subsea high voltage cable systems and/or components.	LOGISTICS	Supply Chain Management	Work with Suppliers	Use	Expert
188923	Handover to operator subsea high voltage cable systems and/or components.	LOGISTICS	Supply Chain Management	Work with Suppliers	Use	Practitioner
188966	Understand the risks related to incorrect cable storage, handling and transport and how it can lead to damage further down the lifecycle	LOGISTICS	Supply Chain Operations	Move Supplies	Implement	Expert
188968	Utilise Smart Operations and Maintenance data analysis and machine learning to better understand cable health.	SUPPORT	Operator Support	Operate support systems	Implement	Practitioner
188974	Utilise Smart Operations and Maintenance data analysis and machine learning to better understand cable health during installation	SUPPORT	Operator Support	Operate support systems	Use	Practitioner
188927	Oversee workers in line with safe off-shore working practices - BOSIET and relevant off-shore Health and Safety certifications.	SUPPORT	Operator Support	Supervise Others	Use	Expert
175980	Verify part dimensions or clearances using precision measuring instruments to ensure conformance to specifications.	SUPPORT	Quality Control	Evaluate Product Characteristics & Quality	Maintain	Expert
188930	Test products and equipment after repair or assembly to ensure proper performance and compliance with manufacturers' specifications.	SUPPORT	Quality Control	Evaluate Product Characteristics & Quality	Implement	Expert
116050	Perform preventative maintenance or minor repairs on machines.	SUPPORT	System/ Equipment Maintenance	Maintain Facilities & Equipment	Use	Expert

ID	Capability Statement: Offshore HV Cable Systems Technician 2	Function	Domain	Area	Type	Level
56290	Disassemble and reassemble equipment for inspection.	SUPPORT	System/ Equipment Maintenance	Maintain Facilities & Equipment	Use	Expert
188928	Develop and implement operational, maintenance, or testing procedures for high voltage electrical components, equipment, or systems.	SUPPORT	System/ Equipment Maintenance	Maintain Facilities & Equipment	Implement	Expert
160850	Splice and repair ropes, wire cables, or cordage, using marlinespikes, wire cutters, twine, and hand tools.	SUPPORT	System/ Equipment Maintenance	Maintain Vehicles	Use	Expert
188969	Undertake in-situ repair of dynamic cable systems	SUPPORT	System/ Equipment Maintenance	Repair Equipment	Implement	Expert
153020	Schedule maintenance for industrial machines and equipment and keep equipment service records.	SUPPORT	System/ Equipment Maintenance	Schedule Maintenance	Implement	Expert

7.2.3 Cable Systems Research & Development Technician 2

ID	Capability Statement: Cable Systems Research and Development Technician 2	Function	Domain	Area	Type	Level
104930	Observe machines on trial runs or conduct computer simulations to ensure that programs and machinery will function properly and produce items that meet specifications.	DESIGN	System/ Equipment Design & Implementation	Test Equipment & Systems	Use	Practitioner
188905	Monitor, analyse and initiate action using condition monitoring data.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Practitioner
32430	Confer with engineers, customers, or others to discuss existing or potential engineering projects or products.	ENTERPRISE	Product Management	Develop Specifications	Use	Practitioner
168750	Test and evaluate hardware and software to determine efficiency, reliability, or compatibility with existing systems.	ENTERPRISE	Leadership & Strategy	Manage Change & Transformation Programmes	Implement	Practitioner
188932	Undertake environmental impact assessments to ensure compliance of design and system solutions	ENTERPRISE	Regulatory Compliance	Monitor Regulation Changes	Implement	Practitioner

ID	Capability Statement: Cable Systems Research and Development Technician 2	Function	Domain	Area	Type	Level
188956	Demonstrate operation of new systems/components prior to mass rollout	DESIGN	Product Evaluation	Evaluate Technical Performance	Implement	Practitioner
188973	Develop innovative technology qualification processes and field integration programmes	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Practitioner
188981	Use for mission-specific and research and development projects. For example, providing inputs on vibration test levels and interpreting other test performance data for project teams.	DESIGN	Prototype Design & Development	Refine Designs	Use	Practitioner

7.3 Role Family 3 (Engineer)

7.3.1 Subsea HV Dynamic Cable Systems Engineer – Integration

ID	Capability Statement: Subsea HV DCS Engineer - Systems Integration	Function	Domain	Area	Type	Level
188936	Analyse component failures to identify design improvements.	DESIGN	Prototype Design & Development	Refine Designs	Create	Practitioner
188958	Develop tools to model failure costs vs the cost of quality and identify mitigating measures. eg location of each Wind Turbine Generator and analyse location specific conditions. cable directions relative to WTG etc	DESIGN	Process Design & Implementation	Model Processes	Create	Practitioner
107180	Operate computer-assisted engineering or design software or equipment to perform engineering tasks.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
188937	Establish the appropriate routing for cables optimisation	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Implement	Practitioner
35300	Consult with users, administrators, and engineers to identify business and technical requirements for proposed system modifications or technology purchases.	DESIGN	Process Design & Implementation	Develop Processes	Implement	Practitioner
188959	Research and develop condition monitoring systems for dynamic cable systems	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Practitioner

ID	Capability Statement: Subsea HV DCS Engineer - Systems Integration	Function	Domain	Area	Type	Level
188957	Develop Digital Twin of cable system, moorings and substructure including data science / system modelling.	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Expert
188956	Demonstrate operation of new systems/components prior to mass rollout	DESIGN	Product Evaluation	Evaluate Technical Performance	Implement	Practitioner
188973	Develop innovative technology qualification processes and field integration programmes	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Practitioner
188905	Monitor, analyse and initiate action using condition monitoring data.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Expert
181527	Create and utilise technical analyses models or simulations to predict the performance of products or systems. This includes modelling and analysis of electrical circuit behaviour and of mechanical behaviour (for example structural strength, kinematics, dynamic response).	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
124770	Prepare documentation containing information such as confidential descriptions or specifications of proprietary hardware or software, product development or introduction schedules, product costs, or information about product performance weaknesses.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Practitioner
188668	Provide engineering support for mission-specific and research and development projects. For example, providing inputs on vibration test levels and interpreting other test performance data for project teams.	DESIGN	Prototype Design & Development	Refine Designs	Use	Practitioner
188981	Use for mission-specific and research and development projects. For example, providing inputs on vibration test levels and interpreting other test performance data for project teams.	DESIGN	Prototype Design & Development	Refine Designs	Use	Practitioner

ID	Capability Statement: Subsea HV DCS Engineer - Systems Integration	Function	Domain	Area	Type	Level
149480	Review and evaluate requests from engineers, managers, and technicians for system modifications.	DESIGN	Prototype Design & Development	Select Technologies	Maintain	Practitioner
188960	Develop lifecycle models of total cost of ownership, ie from design, manufacture installation, shipping, handling etc.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Create	Practitioner
188950	Adapt existing O&G (Oil & Gas) standards that are relevant to equipment design, qualification and performance requirements eg API17L	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner
188939	Design systems to meet Operations & Maintenance needs ie. tow-to-port and plug & play	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner
188893	Plan inter-array configuration of electric power generating systems.	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner
188941	Understand redundancy requirements for Inter Array Cabling strings with regards to cable failures as well as tow-to-port	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner
188980	Support inter-array configuration of electric power generating systems.	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner
188942	Use an integrated approach to design of cable systems - ie ancillary equipment in the design of systems and early discussions on optimisation and performance	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner
47920	Develop and qualify new testing methods.	DESIGN	System/ Equipment Design & Implementation	Test Equipment & Systems	Create	Practitioner
188933	Develop integrated lifecycle tools for the modelling of electrical/mechanical charactersitics of cables and interconnectors	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner
188979	Use integrated lifecycle tools for the modelling of electrical/mechanical charactersitics of cables and interconnectors	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner

ID	Capability Statement: Subsea HV DCS Engineer - Systems Integration	Function	Domain	Area	Type	Level
120030	Plan or implement research methodology or procedures to apply principles of mechanical and electrical theory to engineering projects.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Practitioner
128120	Prepare technical reports for use by engineering, management, or sales personnel.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Expert
188962	Establish a collaborative approach for open sharing of lessons learnt, failure reviews and Root Cause Analysis so the industry benefits and all move forward similar to the aerospace industry.	ENTERPRISE	Leadership & Strategy	Identify New Business Partnerships	Create	Practitioner
188963	Develop integrated supply chain partnerships / industry forum for exchange of best-practice/collaboration	ENTERPRISE	Leadership & Strategy	Manage Change & Transformation Programmes	Create	Practitioner
32430	Confer with engineers, customers, or others to discuss existing or potential engineering projects or products.	ENTERPRISE	Product Management	Develop Specifications	Use	Expert
125920	Prepare necessary criteria, procedures, reports, or plans for successful conduct of the project with consideration given to site preparation, facility validation, installation, quality assurance, or testing.	ENTERPRISE	Product Management	Develop Specifications	Implement	Practitioner
188932	Undertake environmental impact assessments to ensure compliance of design and system solutions	ENTERPRISE	Regulatory Compliance	Monitor Regulation Changes	Implement	Practitioner
58480	Document testing procedures, methodologies, or criteria.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Implement	Practitioner

7.3.2 Subsea HV Cable Systems Engineer – Mechanical

ID	Capability Statement: Subsea HV DCS Engineer - Mechanical	Function	Domain	Area	Type	Level
128120	Prepare technical reports for use by engineering, management, or sales personnel.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Expert
188905	Monitor, analyse and initiate action using condition monitoring data.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Expert
32430	Confer with engineers, customers, or others to discuss existing or potential engineering projects or products.	ENTERPRISE	Product Management	Develop Specifications	Use	Expert
107180	Operate computer-assisted engineering or design software or equipment to perform engineering tasks.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
35300	Consult with users, administrators, and engineers to identify business and technical requirements for proposed system modifications or technology purchases.	DESIGN	Process Design & Implementation	Develop Processes	Implement	Practitioner
47920	Develop and qualify new testing methods.	DESIGN	System/ Equipment Design & Implementation	Test Equipment & Systems	Create	Practitioner
125920	Prepare necessary criteria, procedures, reports, or plans for successful conduct of the project with consideration given to site preparation, facility validation, installation, quality assurance, or testing.	ENTERPRISE	Product Management	Develop Specifications	Implement	Practitioner
149480	Review and evaluate requests from engineers, managers, and technicians for system modifications.	DESIGN	Prototype Design & Development	Select Technologies	Maintain	Practitioner
181527	Create and utilise technical analyses models or simulations to predict the performance of products or systems. This includes modelling and analysis of electrical circuit behaviour and of mechanical behaviour (for example structural strength, kinematics, dynamic response).	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner

ID	Capability Statement: Subsea HV DCS Engineer - Mechanical	Function	Domain	Area	Type	Level
188668	Provide engineering support for mission-specific and research and development projects. For example, providing inputs on vibration test levels and interpreting other test performance data for project teams.	DESIGN	Prototype Design & Development	Refine Designs	Use	Practitioner
188956	Demonstrate operation of new systems/components prior to mass rollout	DESIGN	Product Evaluation	Evaluate Technical Performance	Implement	Practitioner
188973	Develop innovative technology qualification processes and field integration programmes	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Practitioner
188981	Use for mission-specific and research and development projects. For example, providing inputs on vibration test levels and interpreting other test performance data for project teams.	DESIGN	Prototype Design & Development	Refine Designs	Use	Practitioner
188936	Analyse component failures to identify design improvements.	DESIGN	Prototype Design & Development	Refine Designs	Create	Practitioner
188959	Research and develop condition monitoring systems for dynamic cable systems	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Practitioner
58480	Document testing procedures, methodologies, or criteria.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Implement	Practitioner
120030	Plan or implement research methodology or procedures to apply principles of mechanical and electrical theory to engineering projects.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Practitioner
124770	Prepare documentation containing information such as confidential descriptions or specifications of proprietary hardware or software, product development or introduction schedules, product costs, or information about product performance weaknesses.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Practitioner
188933	Develop integrated lifecycle tools for the modelling of electrical/mechanical characteristics of cables and interconnectors	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner

ID	Capability Statement: Subsea HV DCS Engineer - Mechanical	Function	Domain	Area	Type	Level
188979	Use integrated lifecycle tools for the modelling of electrical/mechanical characteristics of cables and interconnectors	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner
188903	Research and develop mechanical and mechanical sub-assembly solutions for undersea high voltage, dynamic cable systems.	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner
188955	Use tools such as Orcaflex, UFLEX and COMSOL to better understand both thermal and mechanical fatigue with different material types.	DESIGN	Product Evaluation	Evaluate Technical Performance	Use	Practitioner
188946	Design for recycling - reuse of cable materials after decommissioning etc	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner
188948	Design solutions for in-situ repair of cable systems	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner
188949	Design and Manufacture for de-commissioning/ removal of cable systems	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner
188900	Research and develop mechanical solutions for undersea high voltage, dynamic cable systems.	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner
188906	Design undersea elements to minimise the impact of marine fouling.	DESIGN	Prototype Design & Development	Refine Designs	Create	Practitioner
188985	Support design of mechanical component and sub-assemblies for undersea high voltage dynamic cable systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Create	Practitioner
188896	Undertake mechanical system design of undersea high voltage, dynamic cable systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Create	Practitioner
155100	Select materials for use based on strength, colour, texture, balance, weight, size, malleability and other characteristics.	DESIGN	System/ Equipment Design & Implementation	Select Equipment	Implement	Practitioner
188890	Design solutions to join different connector types used with dynamic cable systems	DESIGN	Prototype Design & Development	Create Detailed Product Specification	Create	Practitioner
188951	Design cable systems with bespoke consideration of mooring configurations	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner

ID	Capability Statement: Subsea HV DCS Engineer - Mechanical	Function	Domain	Area	Type	Level
188899	Undertake design of mechanical component and sub-assemblies for undersea high voltage dynamic cable systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Create	Practitioner
188935	Research development to understand the effects of vortex-induced vibrations due to turbulent flow from waves and/ or currents on cable dynamics in combination of floater dynamics	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner
188940	Design equipment for installation of cable system (on vessel and subsea intervention)	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Practitioner

7.3.3 Subsea HV Dynamic Cable Systems Engineer – Electrical

ID	Capability Statement: Subsea HV DCS Engineer - Electrical	Function	Domain	Area	Type	Level
128120	Prepare technical reports for use by engineering, management, or sales personnel.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Expert
188905	Monitor, analyse and initiate action using condition monitoring data.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Expert
32430	Confer with engineers, customers, or others to discuss existing or potential engineering projects or products.	ENTERPRISE	Product Management	Develop Specifications	Use	Expert
107180	Operate computer-assisted engineering or design software or equipment to perform engineering tasks.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
35300	Consult with users, administrators, and engineers to identify business and technical requirements for proposed system modifications or technology purchases.	DESIGN	Process Design & Implementation	Develop Processes	Implement	Practitioner
47920	Develop and qualify new testing methods.	DESIGN	System/ Equipment Design & Implementation	Test Equipment & Systems	Create	Practitioner

ID	Capability Statement: Subsea HV DCS Engineer - Electrical	Function	Domain	Area	Type	Level
125920	Prepare necessary criteria, procedures, reports, or plans for successful conduct of the project with consideration given to site preparation, facility validation, installation, quality assurance, or testing.	ENTERPRISE	Product Management	Develop Specifications	Implement	Practitioner
149480	Review and evaluate requests from engineers, managers, and technicians for system modifications.	DESIGN	Prototype Design & Development	Select Technologies	Maintain	Practitioner
181527	Create and utilise technical analyses models or simulations to predict the performance of products or systems. This includes modelling and analysis of electrical circuit behaviour and of mechanical behaviour (for example structural strength, kinematics, dynamic response).	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
188668	Provide engineering support for mission-specific and research and development projects. For example, providing inputs on vibration test levels and interpreting other test performance data for project teams.	DESIGN	Prototype Design & Development	Refine Designs	Use	Practitioner
188956	Demonstrate operation of new systems/components prior to mass rollout	DESIGN	Product Evaluation	Evaluate Technical Performance	Implement	Practitioner
188973	Develop innovative technology qualification processes and field integration programmes	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Practitioner
188981	Use for mission-specific and research and development projects. For example, providing inputs on vibration test levels and interpreting other test performance data for project teams.	DESIGN	Prototype Design & Development	Refine Designs	Use	Practitioner
188936	Analyse component failures to identify design improvements.	DESIGN	Prototype Design & Development	Refine Designs	Create	Practitioner
188959	Research and develop condition monitoring systems for dynamic cable systems	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Practitioner

ID	Capability Statement: Subsea HV DCS Engineer - Electrical	Function	Domain	Area	Type	Level
58480	Document testing procedures, methodologies, or criteria.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Implement	Practitioner
120030	Plan or implement research methodology or procedures to apply principles of mechanical and electrical theory to engineering projects.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Practitioner
124770	Prepare documentation containing information such as confidential descriptions or specifications of proprietary hardware or software, product development or introduction schedules, product costs, or information about product performance weaknesses.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Practitioner
188933	Develop integrated lifecycle tools for the modelling of electrical/mechanical charactersitics of cables and interconnectors	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner
188979	Use integrated lifecycle tools for the modelling of electrical/mechanical charactersitics of cables and interconnectors	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner
188902	Research and develop optimised high voltage electrical and power systems for undersea high voltage, dynamic cable systems.	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner
83220	Integrate electrical systems with renewable energy systems to improve overall efficiency.	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
188901	Research and develop electrical and power solutions for undersea high voltage, dynamic cable systems.	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner
188892	Document technical specifications and operating standards for high voltage distribution equipment.	DESIGN	Prototype Design & Development	Develop Prototypes	Implement	Practitioner
188928	Develop and implement operational, maintenance, or testing procedures for high voltage electrical components, equipment, or systems.	SUPPORT	System/ Equipment Maintenance	Maintain Facilities & Equipment	Implement	Practitioner

ID	Capability Statement: Subsea HV DCS Engineer - Electrical	Function	Domain	Area	Type	Level
188983	Review electromechanical equipment, materials, components, or systems to meet functional specifications	DESIGN	System/ Equipment Design & Implementation	Select Equipment	Implement	Practitioner
26180	Compile data and write reports regarding existing or potential electrical engineering studies or projects.	IMPLEMENT	Manage Operations	Analyse Operations Data	Use	Practitioner
188897	Undertake electrical and power design of undersea high voltage dynamic cable systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Create	Practitioner
188898	Undertake high voltage design and optimisation of undersea high voltage dynamic cable systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Create	Practitioner

7.3.4 Production Engineer 1 – Cable System Components

ID	Capability Statement: Production Engineer1 - Cable Systems Components	Function	Domain	Area	Type	Level
104930	Observe machines on trial runs or conduct computer simulations to ensure that programs and machinery will function properly and produce items that meet specifications.	DESIGN	System/ Equipment Design & Implementation	Test Equipment & Systems	Use	Expert
76030	Implement system renovation projects in collaboration with technical staff, engineering consultants, installers, and vendors.	IMPLEMENT	Manage Operations	Direct Operations	Use	Expert
124980	Prepare engineering sketches or specifications for construction, relocation, or installation of equipment, facilities, products, or systems.	DESIGN	Prototype Design & Development	Create Detailed Product Specification	Implement	Expert
174970	Use computer-aided design (CAD) software to prepare or evaluate network diagrams, floor plans, or site configurations for existing facilities, renovations, or new systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Expert

ID	Capability Statement: Production Engineer1 - Cable Systems Components	Function	Domain	Area	Type	Level
154880	Select electromechanical equipment, materials, components, or systems to meet functional specifications.	DESIGN	System/ Equipment Design & Implementation	Select Equipment	Implement	Expert
188917	Carry out test and validation activities within production / manufacture of components and sub-systems for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
128120	Prepare technical reports for use by engineering, management, or sales personnel.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Practitioner
107180	Operate computer-assisted engineering or design software or equipment to perform engineering tasks.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
47920	Develop and qualify new testing methods.	DESIGN	System/ Equipment Design & Implementation	Test Equipment & Systems	Create	Practitioner
120030	Plan or implement research methodology or procedures to apply principles of mechanical and electrical theory to engineering projects.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Practitioner
83220	Integrate electrical systems with renewable energy systems to improve overall efficiency.	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
26180	Compile data and write reports regarding existing or potential electrical engineering studies or projects.	IMPLEMENT	Manage Operations	Analyse Operations Data	Use	Practitioner
188978	Observe validation activities within production / manufacture of components and sub-systems for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
54940	Direct or coordinate activities concerned with manufacture, construction, installation, maintenance, operation, or modification of electronic equipment, products, or systems.	IMPLEMENT	Manage Operations	Direct Operations	Use	Practitioner
124100	Prepare budget or cost estimates for equipment, construction, or installation projects or control expenditures.	ENTERPRISE	Leadership & Strategy	Manage Change & Transformation Programmes	Implement	Practitioner

ID	Capability Statement: Production Engineer1 - Cable Systems Components	Function	Domain	Area	Type	Level
126670	Prepare plans, estimates, design and construction schedules, and contract specifications, including any special provisions.	IMPLEMENT	Plan Operations	Plan Operations	Implement	Practitioner
127800	Prepare specifications for purchases of materials or equipment.	IMPLEMENT	Plan Operations	Plan Operations	Implement	Practitioner
128100	Prepare technical drawings, specifications of electrical systems, or topographical maps to ensure that installation and operations conform to standards and customer requirements.	DESIGN	Prototype Design & Development	Create Detailed Product Specification	Implement	Practitioner
188976	Plan sequences of tests according to equipment specifications and scientific principles.	IMPLEMENT	Plan Operations	Plan Operations	Implement	Practitioner
39160	Create and implement inspection and testing criteria or procedures.	DESIGN	Process Design & Implementation	Develop Processes	Create	Practitioner
55040	Direct or coordinate manufacturing, construction, installation, maintenance, support, documentation, or testing activities to ensure compliance with specifications, codes, or customer requirements.	IMPLEMENT	Manage Operations	Direct Operations	Use	Practitioner
114120	Perform detailed calculations to compute and establish manufacturing, construction, or installation standards or specifications.	IMPLEMENT	Plan Operations	Plan Operations	Use	Practitioner
188953	Manufacture equipment for the installation of cable systems e.g. vessels, vessel equipment, ROVs and other subsea equipment.	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Implement	Practitioner
188984	Coordinate the selection and implementation of quality control equipment	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Use	Practitioner
55390	Direct product testing activities throughout production cycles.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Use	Practitioner
83880	Interpret test results, compare them to established specifications and control limits, and make recommendations on appropriateness of data for release.	IMPLEMENT	Manage Operations	Analyse Operations Data	Use	Practitioner

ID	Capability Statement: Production Engineer1 - Cable Systems Components	Function	Domain	Area	Type	Level
188929	Inspect high voltage electrical instruments, products, or systems to ensure conformance to specifications, safety standards, or applicable codes or regulations.	SUPPORT	Quality Control	Evaluate Product Characteristics & Quality	Use	Practitioner
188977	Observe product testing activities throughout production cycles	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Use	Practitioner

7.3.5 Offshore Engineer – Dynamic Cable Systems

ID	Capability Statement: Offshore Engineer - HV Dynamic Cable Systems	Function	Domain	Area	Type	Level
188907	Observe the operation of machinery or equipment to diagnose malfunctions	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Equipment	Use	Expert
58320	Document procedures for hardware and software installation and use.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Implement	Expert
78120	Inspect completed installations and observe operations to ensure conformance to design and equipment specifications and compliance with operational, safety, or environmental standards.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Maintain	Expert
82490	Instruct customers in the installation, repair, or maintenance of products.	IMPLEMENT	Manage Operations	Advise Others On Operations	Implement	Practitioner
124100	Prepare budget or cost estimates for equipment, construction, or installation projects or control expenditures.	ENTERPRISE	Leadership & Strategy	Manage Change & Transformation Programmes	Implement	Practitioner
188929	Inspect high voltage electrical instruments, products, or systems to ensure conformance to specifications, safety standards, or applicable codes or regulations.	SUPPORT	Quality Control	Evaluate Product Characteristics & Quality	Use	Practitioner
188982	Provide technical support or instruction to staff or customers regarding equipment standards	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
58480	Document testing procedures, methodologies, or criteria.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Implement	Practitioner

ID	Capability Statement: Offshore Engineer - HV Dynamic Cable Systems	Function	Domain	Area	Type	Level
188928	Develop and implement operational, maintenance, or testing procedures for high voltage electrical components, equipment, or systems.	SUPPORT	System/ Equipment Maintenance	Maintain Facilities & Equipment	Implement	Practitioner
188967	Create a cable reliability database to identify common faults.	SUPPORT	Quality Control	Evaluate Product Characteristics & Quality	Create	Practitioner
188964	Optimise installation process for cost and safety.	IMPLEMENT	Process Monitoring	Monitor Processes	Implement	Practitioner
188966	Understand the risks related to incorrect cable storage, handling and transport and how it can lead to damage further down the lifecycle	LOGISTICS	Supply Chain Operations	Move Supplies	Implement	Practitioner
188968	Utilise Smart Operations and Maintenance data analysis and machine learning to better understand cable health.	SUPPORT	Operator Support	Operate support systems	Implement	Practitioner
83110	Instruct vendors or contractors on quality guidelines, testing procedures, or ways to eliminate deficiencies.	SUPPORT	Customer Support	Handle Customer Problems & Inquiries	Implement	Practitioner
163330	Study blueprints or manufacturers' manuals to determine correct installation or operation of machinery.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188908	Observe and test the operation of machinery or equipment to diagnose malfunctions, using relevant test equipment.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Use	Practitioner
188921	Install subsea high voltage cable systems and/or components.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Use	Practitioner
188922	Commission subsea high voltage cable systems and/or components.	LOGISTICS	Supply Chain Management	Work with Suppliers	Use	Practitioner
188930	Test products and equipment after repair or assembly to ensure proper performance and compliance with manufacturers' specifications.	SUPPORT	Quality Control	Evaluate Product Characteristics & Quality	Implement	Practitioner
188972	Deploy or use condition monitoring systems for dynamic cable systems	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Use	Practitioner

ID	Capability Statement: Offshore Engineer - HV Dynamic Cable Systems	Function	Domain	Area	Type	Level
92770	Maintain records of engineering department activities, including expense records and details of equipment maintenance and repairs.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Maintain	Practitioner
188923	Handover to operator subsea high voltage cable systems and/or components.	LOGISTICS	Supply Chain Management	Work with Suppliers	Use	Practitioner
188971	Analyse and manage condition monitoring data	IMPLEMENT	Manage Operations	Analyse Operations Data	Use	Practitioner
188974	Utilise Smart Operations and Maintenance data analysis and machine learning to better understand cable health during installation	SUPPORT	Operator Support	Operate support systems	Use	Practitioner
188965	Modify existing fleet to accommodate needs of dynamic cable systems.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Implement	Practitioner
188943	Design best approaches for access to sites (vessel?)	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	`

7.4 Role Family 4 (Senior Engineer)

7.4.1 Subsea HV Dynamic Cable Systems Engineer 2 – Mechanical

ID	Capability Statement: Subsea HV DCS Engineer 2 - Mechanical	Function	Domain	Area	Type	Level
107180	Operate computer-assisted engineering or design software or equipment to perform engineering tasks.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
32430	Confer with engineers, customers, or others to discuss existing or potential engineering projects or products.	ENTERPRISE	Product Management	Develop Specifications	Use	Expert
149480	Review and evaluate requests from engineers, managers, and technicians for system modifications.	DESIGN	Prototype Design & Development	Select Technologies	Maintain	Expert
120030	Plan or implement research methodology or procedures to apply principles of mechanical and electrical theory to engineering projects.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Expert

ID	Capability Statement: Subsea HV DCS Engineer 2 - Mechanical	Function	Domain	Area	Type	Level
188956	Demonstrate operation of new systems/components prior to mass rollout	DESIGN	Product Evaluation	Evaluate Technical Performance	Implement	Expert
128120	Prepare technical reports for use by engineering, management, or sales personnel.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Expert
188905	Monitor, analyse and initiate action using condition monitoring data.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Expert
188973	Develop innovative technology qualification processes and field integration programmes	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Expert
188981	Use for mission-specific and research and development projects. For example, providing inputs on vibration test levels and interpreting other test performance data for project teams.	DESIGN	Prototype Design & Development	Refine Designs	Use	Expert
188936	Analyse component failures to identify design improvements.	DESIGN	Prototype Design & Development	Refine Designs	Create	Expert
188959	Research and develop condition monitoring systems for dynamic cable systems	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Expert
188979	Use integrated lifecycle tools for the modelling of electrical/mechanical charactersitics of cables and interconnectors	DESIGN	Technical Research	Research & Develop Technologies	Create	Expert
188890	Design solutions to join different connector types used with dynamic cable systems	DESIGN	Prototype Design & Development	Create Detailed Product Specification	Create	Expert
188940	Design equipment for installation of cable system (on vessel and subsea intervention)	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Expert
188955	Use tools such as Orcaflex, UFLEX and COMSOL to better understand both thermal and mechanical fatigue with different material types.	DESIGN	Product Evaluation	Evaluate Technical Performance	Use	Expert
188946	Design for recycling - reuse of cable materials after decommissioning etc	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Expert
188948	Design solutions for in-situ repair of cable systems	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Expert

ID	Capability Statement: Subsea HV DCS Engineer 2 - Mechanical	Function	Domain	Area	Type	Level
188949	Design and Manufacture for de-commissioning/ removal of cable systems	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Expert
188951	Design cable systems with bespoke consideration of mooring configurations	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Expert
188904	Research and develop marine errosion, corrosion and fouling models for undersea high voltage, dynamic cable systems.	DESIGN	Technical Research	Research & Develop Technologies	Create	Expert
188903	Research and develop mechanical and mechanical sub-assembly solutions for undersea high voltage, dynamic cable systems.	DESIGN	Technical Research	Research & Develop Technologies	Create	Expert
188900	Research and develop mechanical solutions for undersea high voltage, dynamic cable systems.	DESIGN	Technical Research	Research & Develop Technologies	Create	Expert
188906	Design undersea elements to minimise the impact of marine fouling.	DESIGN	Prototype Design & Development	Refine Designs	Create	Expert
188985	Support design of mechanical component and sub-assemblies for undersea high voltage dynamic cable systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Create	Expert
188896	Undertake mechanical system design of undersea high voltage, dynamic cable systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Create	Expert
155100	Select materials for use based on strength, colour, texture, balance, weight, size, malleability and other characteristics.	DESIGN	System/ Equipment Design & Implementation	Select Equipment	Implement	Expert
188899	Undertake design of mechanical component and sub-assemblies for undersea high voltage dynamic cable systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Create	Expert
188935	Research and development to understand the effects of vortex-induced vibrations due to turbulent flow from waves and/ or currents on cable dynamics in combination of floater dynamics	DESIGN	Technical Research	Research & Develop Technologies	Create	Expert

7.4.2 Subsea HV Dynamic Cable Systems Engineer 2 – Electrical

ID	Capability Statement: Subsea HV DCS Engineer 2 - Electrical	Function	Domain	Area	Type	Level
107180	Operate computer-assisted engineering or design software or equipment to perform engineering tasks.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
32430	Confer with engineers, customers, or others to discuss existing or potential engineering projects or products.	ENTERPRISE	Product Management	Develop Specifications	Use	Expert
149480	Review and evaluate requests from engineers, managers, and technicians for system modifications.	DESIGN	Prototype Design & Development	Select Technologies	Maintain	Expert
120030	Plan or implement research methodology or procedures to apply principles of mechanical and electrical theory to engineering projects.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Expert
188892	Document technical specifications and operating standards for high voltage distribution equipment.	DESIGN	Prototype Design & Development	Develop Prototypes	Implement	Expert
188956	Demonstrate operation of new systems/components prior to mass rollout	DESIGN	Product Evaluation	Evaluate Technical Performance	Implement	Expert
128120	Prepare technical reports for use by engineering, management, or sales personnel.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Expert
188905	Monitor, analyse and initiate action using condition monitoring data.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Expert
188973	Develop innovative technology qualification processes and field integration programmes	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Expert
188981	Use for mission-specific and research and development projects. For example, providing inputs on vibration test levels and interpreting other test performance data for project teams.	DESIGN	Prototype Design & Development	Refine Designs	Use	Expert
188936	Analyse component failures to identify design improvements.	DESIGN	Prototype Design & Development	Refine Designs	Create	Expert
188959	Research and develop condition monitoring systems for dynamic cable systems	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Expert

ID	Capability Statement: Subsea HV DCS Engineer 2 - Electrical	Function	Domain	Area	Type	Level
188979	Use integrated lifecycle tools for the modelling of electrical/mechanical charactersitics of cables and interconnectors	DESIGN	Technical Research	Research & Develop Technologies	Create	Expert
83220	Integrate electrical systems with renewable energy systems to improve overall efficiency.	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Expert
188902	Research and develop optimised high voltage electrical and power systems for undersea high voltage, dynamic cable systems.	DESIGN	Technical Research	Research & Develop Technologies	Create	Expert
188901	Research and develop electrical and power solutions for undersea high voltage, dynamic cable systems.	DESIGN	Technical Research	Research & Develop Technologies	Create	Expert
188983	Review electromechanical equipment, materials, components, or systems to meet functional specifications	DESIGN	System/ Equipment Design & Implementation	Select Equipment	Implement	Expert
188897	Undertake electrical and power design of undersea high voltage dynamic cable systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Create	Expert
188898	Undertake high voltage design and optimisation of undersea high voltage dynamic cable systems.	DESIGN	Prototype Design & Development	Design Systems & Applications	Create	Expert
181527	Create and utilise technical analyses models or simulations to predict the performance of products or systems. This includes modelling and analysis of electrical circuit behaviour and of mechanical behaviour (for example structural strength, kinematics, dynamic response).	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Practitioner
188668	Provide engineering support for mission-specific and research and development projects. For example, providing inputs on vibration test levels and interpreting other test performance data for project teams.	DESIGN	Prototype Design & Development	Refine Designs	Use	Practitioner

ID	Capability Statement: Subsea HV DCS Engineer 2 - Electrical	Function	Domain	Area	Type	Level
124770	Prepare documentation containing information such as confidential descriptions or specifications of proprietary hardware or software, product development or introduction schedules, product costs, or information about product performance weaknesses.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Practitioner
26180	Compile data and write reports regarding existing or potential electrical engineering studies or projects.	IMPLEMENT	Manage Operations	Analyse Operations Data	Use	Practitioner
47920	Develop and qualify new testing methods.	DESIGN	System/ Equipment Design & Implementation	Test Equipment & Systems	Create	Practitioner
58480	Document testing procedures, methodologies, or criteria.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Implement	Practitioner
188933	Develop integrated lifecycle tools for the modelling of electrical/mechanical charactersitics of cables and interconnectors	DESIGN	Technical Research	Research & Develop Technologies	Create	Practitioner
35300	Consult with users, administrators, and engineers to identify business and technical requirements for proposed system modifications or technology purchases.	DESIGN	Process Design & Implementation	Develop Processes	Implement	Practitioner
125920	Prepare necessary criteria, procedures, reports, or plans for successful conduct of the project with consideration given to site preparation, facility validation, installation, quality assurance, or testing.	ENTERPRISE	Product Management	Develop Specifications	Implement	Practitioner

7.4.3 Production Engineer 2 - Subsea Cable Systems Components

ID	Capability Statement: Production Engineer 2 - Cable Systems Components	Function	Domain	Area	Type	Level
107180	Operate computer-assisted engineering or design software or equipment to perform engineering tasks.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
120030	Plan or implement research methodology or procedures to apply principles of mechanical and electrical theory to engineering projects.	DESIGN	Technical Research	Research & Develop Technologies	Implement	Expert
188668	Provide engineering support for mission-specific and research and development projects. For example, providing inputs on vibration test levels and interpreting other test performance data for project teams.	DESIGN	Prototype Design & Development	Refine Designs	Use	Expert
124770	Prepare documentation containing information such as confidential descriptions or specifications of proprietary hardware or software, product development or introduction schedules, product costs, or information about product performance weaknesses.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Expert
26180	Compile data and write reports regarding existing or potential electrical engineering studies or projects.	IMPLEMENT	Manage Operations	Analyse Operations Data	Use	Expert
188928	Develop and implement operational, maintenance, or testing procedures for high voltage electrical components, equipment, or systems.	SUPPORT	System/ Equipment Maintenance	Maintain Facilities & Equipment	Implement	Expert
124100	Prepare budget or cost estimates for equipment, construction, or installation projects or control expenditures.	ENTERPRISE	Leadership & Strategy	Manage Change & Transformation Programmes	Implement	Expert

ID	Capability Statement: Production Engineer 2 - Cable Systems Components	Function	Domain	Area	Type	Level
33440	Confer with supervisors or engineers to plan or review work activities or to resolve production problems.	IMPLEMENT	Manage Operations	Resolve Operational Problems	Use	Expert
188924	Design implement, maintain, or improve equipment, facilities, components, products, or systems for commercial, industrial, or domestic purposes.	SUPPORT	Operator Support	Design and configure support systems	Use	Expert
128790	Prepare, review, or maintain maintenance schedules, design documentation, or operational reports or charts.	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Expert
135090	Provide technical support or instruction to staff or customers regarding electronics equipment standards.	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Expert
76030	Implement system renovation projects in collaboration with technical staff, engineering consultants, installers, and vendors.	IMPLEMENT	Manage Operations	Direct Operations	Use	Expert
124980	Prepare engineering sketches or specifications for construction, relocation, or installation of equipment, facilities, products, or systems.	DESIGN	Prototype Design & Development	Create Detailed Product Specification	Implement	Expert
154880	Select electromechanical equipment, materials, components, or systems to meet functional specifications.	DESIGN	System/ Equipment Design & Implementation	Select Equipment	Implement	Expert
54940	Direct or coordinate activities concerned with manufacture, construction, installation, maintenance, operation, or modification of electronic equipment, products, or systems.	IMPLEMENT	Manage Operations	Direct Operations	Use	Expert
126670	Prepare plans, estimates, design and construction schedules, and contract specifications, including any special provisions.	IMPLEMENT	Plan Operations	Plan Operations	Implement	Expert

ID	Capability Statement: Production Engineer 2 - Cable Systems Components	Function	Domain	Area	Type	Level
127800	Prepare specifications for purchases of materials or equipment.	IMPLEMENT	Plan Operations	Plan Operations	Implement	Expert
128100	Prepare technical drawings, specifications of electrical systems, or topographical maps to ensure that installation and operations conform to standards and customer requirements.	DESIGN	Prototype Design & Development	Create Detailed Product Specification	Implement	Expert
188976	Plan sequences of tests according to equipment specifications and scientific principles.	IMPLEMENT	Plan Operations	Plan Operations	Implement	Expert
39160	Create and implement inspection and testing criteria or procedures.	DESIGN	Process Design & Implementation	Develop Processes	Create	Expert
55040	Direct or coordinate manufacturing, construction, installation, maintenance, support, documentation, or testing activities to ensure compliance with specifications, codes, or customer requirements.	IMPLEMENT	Manage Operations	Direct Operations	Use	Expert
114120	Perform detailed calculations to compute and establish manufacturing, construction, or installation standards or specifications.	IMPLEMENT	Plan Operations	Plan Operations	Use	Expert
55390	Direct product testing activities throughout production cycles.	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Use	Expert
83880	Interpret test results, compare them to established specifications and control limits, and make recommendations on appropriateness of data for release.	IMPLEMENT	Manage Operations	Analyse Operations Data	Use	Expert
188977	Observe product testing activities throughout production cycles	IMPLEMENT	Manage Operations	Manage Operation Control Systems	Use	Expert
43380	Design electronic components, software, products, or systems for commercial, industrial, medical, military, or scientific applications.	DESIGN	Prototype Design & Development	Design Systems & Applications	Create	Expert

ID	Capability Statement: Production Engineer 2 - Cable Systems Components	Function	Domain	Area	Type	Level
136570	Read and interpret schematic drawings, diagrams, blueprints, specifications, work orders, or reports to determine materials requirements or assembly instructions.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
188917	Carry out test and validation activities within production / manufacture of components and sub-systems for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
47920	Develop and qualify new testing methods.	DESIGN	System/ Equipment Design & Implementation	Test Equipment & Systems	Create	Practitioner
188929	Inspect high voltage electrical instruments, products, or systems to ensure conformance to specifications, safety standards, or applicable codes or regulations.	SUPPORT	Quality Control	Evaluate Product Characteristics & Quality	Use	Practitioner

7.4.4 Offshore Engineer 2 – Cable Systems

ID	Capability Statement: Offshore Engineer 2 - Cable Systems	Function	Domain	Area	Type	Level
54940	Direct or coordinate activities concerned with manufacture, construction, installation, maintenance, operation, or modification of electronic equipment, products, or systems.	IMPLEMENT	Manage Operations	Direct Operations	Use	Expert
188929	Inspect high voltage electrical instruments, products, or systems to ensure conformance to specifications, safety standards, or applicable codes or regulations.	SUPPORT	Quality Control	Evaluate Product Characteristics & Quality	Use	Expert
188982	Provide technical support or instruction to staff or customers regarding equipment standards	DESIGN	Prototype Design & Development	Design Systems & Applications	Use	Expert
188905	Monitor, analyse and initiate action using condition monitoring data.	DESIGN	Prototype Design & Development	Design Systems & Applications	Implement	Expert
188936	Analyse component failures to identify design improvements.	DESIGN	Prototype Design & Development	Refine Designs	Create	Expert

ID	Capability Statement: Offshore Engineer 2 - Cable Systems	Function	Domain	Area	Type	Level
188959	Research and develop condition monitoring systems for dynamic cable systems	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Expert
188979	Use integrated lifecycle tools for the modelling of electrical/mechanical charactersitics of cables and interconnectors	DESIGN	Technical Research	Research & Develop Technologies	Create	Expert
188978	Observe validation activities within production / manufacture of components and sub-systems for high voltage, dynamic undersea cables.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Expert
155100	Select materials for use based on strength, colour, texture, balance, weight, size, malleability and other characteristics.	DESIGN	System/ Equipment Design & Implementation	Select Equipment	Implement	Expert
188935	Research development to understand the effects of vortex-induced vibrations due to turbulent flow from waves and/ or currents on cable dynamics in combination of floater dynamics	DESIGN	Technical Research	Research & Develop Technologies	Create	Expert
188960	Develop lifecycle models of total cost of ownership, ie from design, manufacture installation, shipping, handling etc.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Create	Expert
188957	Develop Digital Twin of cable system, moorings and substructure including data science / system modelling.	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Expert
188958	Develop tools to model failure costs vs the cost of quality and identify mitigating measures. eg location of each Wind Turbine Generator and analyse location specific conditions. cable directions relative to WTG etc	DESIGN	Process Design & Implementation	Model Processes	Create	Expert
58320	Document procedures for hardware and software installation and use.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Implement	Expert
78120	Inspect completed installations and observe operations to ensure conformance to design and equipment specifications and compliance with operational, safety, or environmental standards.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Maintain	Expert

ID	Capability Statement: Offshore Engineer 2 - Cable Systems	Function	Domain	Area	Type	Level
188967	Create a cable reliability database to identify common faults.	SUPPORT	Quality Control	Evaluate Product Characteristics & Quality	Create	Expert
188964	Optimise installation process for cost and safety.	IMPLEMENT	Process Monitoring	Monitor Processes	Implement	Expert
188966	Understand the risks related to incorrect cable storage, handling and transport and how it can lead to damage further down the lifecycle	LOGISTICS	Supply Chain Operations	Move Supplies	Implement	Expert
188968	Utilise Smart Operations and Maintenance data analysis and machine learning to better understand cable health.	SUPPORT	Operator Support	Operate support systems	Implement	Expert
188908	Observe and test the operation of machinery or equipment to diagnose malfunctions, using relevant test equipment.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Use	Expert
188921	Install subsea high voltage cable systems and/or components.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Use	Expert
188923	Handover to operator subsea high voltage cable systems and/or components.	LOGISTICS	Supply Chain Management	Work with Suppliers	Use	Expert
188971	Analyse and manage condition monitoring data	IMPLEMENT	Manage Operations	Analyse Operations Data	Use	Expert
188965	Modify existing fleet to accommodate needs of dynamic cable systems.	LOGISTICS	Supply Chain Management	Coordinate Logistics	Implement	Expert
26780	Complete documentation needed to support testing procedures, including data capture forms, equipment logbooks, or inventory forms.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Use	Expert
188947	Use Metocean Data reviews to provide more accurate behavioural data to feed into system global analysis	DESIGN	Prototype Design & Development	Refine Designs	Use	Expert
188892	Document technical specifications and operating standards for high voltage distribution equipment.	DESIGN	Prototype Design & Development	Develop Prototypes	Implement	Practitioner
58480	Document testing procedures, methodologies, or criteria.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Implement	Practitioner

ID	Capability Statement: Offshore Engineer 2 - Cable Systems	Function	Domain	Area	Type	Level
163330	Study blueprints or manufacturers' manuals to determine correct installation or operation of machinery.	IMPLEMENT	System/ Equipment Operation & Monitoring	Operate Equipment	Use	Practitioner
188930	Test products and equipment after repair or assembly to ensure proper performance and compliance with manufacturers' specifications.	SUPPORT	Quality Control	Evaluate Product Characteristics & Quality	Implement	Practitioner
188972	Deploy or use condition monitoring systems for dynamic cable systems	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Use	Practitioner
92770	Maintain records of engineering department activities, including expense records and details of equipment maintenance and repairs.	IMPLEMENT	System/ Equipment Operation & Monitoring	Monitor Operations	Maintain	Practitioner
188974	Utilise Smart Operations and Maintenance data analysis and machine learning to better understand cable health during installation	SUPPORT	Operator Support	Operate support systems	Use	Practitioner
188927	Oversee workers in line with safe off-shore working practices - BOSIET and relevant off-shore Health and Safety certifications.	SUPPORT	Operator Support	Supervise Others	Use	Practitioner
188889	Characterise optical fibre using optical time-domain reflectometer (OTDR)	IMPLEMENT	Product Processing	Join Components	Implement	Practitioner

7.4.5 Dynamic Cable Systems Engineer 2 – Systems Integration

ID	Title	Function	Domain	Area	Type	Level
188893	Plan inter-array configuration of electric power generating systems.	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Expert
188932	Undertake environmental impact assessments to ensure compliance of design and system solutions	ENTERPRISE	Regulatory Compliance	Monitor Regulation Changes	Implement	Expert
188937	Establish the appropriate routing for cables optimisation	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Implement	Expert
188939	Design systems to meet Operations & Maintenance needs e.g. tow-to-port, plug-and-play	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Expert

ID	Title	Function	Domain	Area	Type	Level
188941	Understand redundancy requirements for Inter Array Cabling strings with regards to cable failures as well as tow-to-port	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Expert
188942	Use an integrated approach to design of cable systems - ie ancillary equipment in the design of systems and early discussions on optimisation and performance	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Expert
188950	Adapt existing O&G (Oil & Gas) standards that are relevant to equipment design, qualification and performance requirements eg API17L	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Expert
188957	Develop Digital Twin of cable system, moorings and substructure including data science / system modelling.	DESIGN	Product Evaluation	Evaluate Technical Performance	Create	Expert
188958	Develop tools to model failure costs vs the cost of quality and identify mitigating measures. eg location of each Wind Turbine Generator and analyse location specific conditions. cable directions relative to WTG etc	DESIGN	Process Design & Implementation	Model Processes	Create	Expert
188960	Develop lifecycle models of total cost of ownership, ie from design, manufacture installation, shipping, handling etc.	DESIGN	Supply Chain Design & Implementation	Develop Supply Chain Models & Systems	Create	Expert
188962	Establish a collaborative approach for open sharing of lessons learnt, failure reviews and Root Cause Analysis so the industry benefits and all move forward similar to the aerospace industry.	ENTERPRISE	Leadership & Strategy	Identify New Business Partnerships	Create	Expert
188963	Develop integrated supply chain partnerships / industry forum for exchange of best-practice/collaboration	ENTERPRISE	Leadership & Strategy	Manage Change & Transformation Programmes	Create	Expert
188980	Support inter-array configuration of electric power generating systems.	DESIGN	System/ Equipment Design & Implementation	Design Equipment	Create	Expert

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