Engineering AI Assistant

Offshore Wind & Digital Twin Teams

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Offshore Wind & Digital Twin Teams

Powered by large language model technology with offshore wind, metocean, structural monitoring, and simulation analytics context

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Page 1 — What It Does

Engineering Areas Covered

Floating & Fixed Offshore Wind

- **FOWT mooring analysis** — catenary mooring load workflow for semi-submersible FOWT; DNV-ST-0119 safety factor check (SF ≥ 1.6); wind thrust + wave + current combined loading
- **OrcaFlex model library** — ready-to-run 15 MW semi-sub FOWT and fixed wind turbine OrcaFlex templates; mooring line setup, vessel RAO import, environment configuration
- **Wind farm layout** — grid and stagger arrangement optimisation for N-turbine arrays; simplified Jensen wake model for AEP estimation; inter-array cable routing; installation sequence planning
- **Foundation selection** — monopile vs jacket comparison by water depth, soil conditions, and turbine rating; installation constraint checklist
- **Standards context** — DNV-ST-0119 (mooring), DNV-ST-0126 (support structures), IEC 61400-3-2 (offshore design load cases), DNV-OS-E301 (position mooring) — code clause look-up on demand

Structural Health Monitoring & Asset Integrity

- **Sensor suite configuration** — DNV-ST-0126 compliant sensor templates for offshore wind: blade root flapwise/edgewise strain gauges, tower mid-height accelerometer, foundation tilt sensors; warning/critical alert threshold setup
- **Fatigue analysis** — S-N curve selection (DNV-RP-C203), rainflow cycle counting, Miner's rule damage accumulation; frequency-domain fatigue from wave spectra
- **FFS for wind structures** — API 579-1 Level 1/2 assessment of tower or monopile wall loss; RSF screening, MAWP re-rating, remaining life projection
- **Signal processing** — windowed FFT, moving-average filtering, spectral analysis of OrcaFlex or measured time-history data; anomaly identification in simulation output

Metocean & Environmental Site Data

- **ERA5 historical hindcast** — Copernicus CDS streaming client: Hs, Tp, wind speed/direction, current at any global offshore location; 1940-present at 0.25° grid resolution; zero-storage date-range queries
- **NOAA NDBC real-time** — live and archived buoy data; station-level statistics; return period (10/50/100-yr Hs, Tp, Vw) via extreme value extrapolation
- **GEBCO bathymetry** — seabed depth at project site; array spacing vs water depth constraint checks
- **Wave spectra** — JONSWAP, Pierson-Moskowitz, directional spreading; sea state scatter diagrams for fatigue calculations
- **GIS field layout** — spatial layer management; coordinate transforms; Google Earth KML export; well/turbine location filtering and visualisation

Simulation Analytics & Digital Twin Dashboard

- **OrcaFlex results dashboard** — FastAPI backend: upload time-history CSV results → automatic component classification → statistical analysis (mean, std, extremes) → anomaly detection flagging → sensitivity study comparisons
- **Batch result processing** — extract envelope tables (max tension, curvature, VIV utilisation) across load cases; export summary tables to Excel or PDF
- **Wind installation vessel planning** — vessel database covering major contractors (Eneti Wind Osprey/Orca, DEME, Van Oord) with turbine lift capacity and availability data
- **Decommissioning and late-life** — cost model, P&A obligation quantification, regulatory framework (UK Energy Act, OSPAR)

Sample Conversations

QUESTION	TIME: MANUAL	TIME: AI
"Check DNV-ST-0119 mooring SF for 15 MW semi-sub at 120m WD, 50-yr storm"	1–2 hr	10 min
"Configure SHM sensor suite for a monopile foundation per DNV-ST-0126"	1–2 hr	10 min
"What ERA5 100-yr Hs and Tp are available for the Southern North Sea at 54°N 3°E?"	1–2 hr	5 min
"Optimise layout for 80-turbine 15 MW array, 1 km × 1.2 km spacing, Jensen wake"	4–8 hr	30 min
"Process OrcaFlex time-history CSV — flag anomalies in mooring line tension"	2–4 hr	20 min

Page 2 — Roadmap & Next Steps

Phased Deployment

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│  PHASE 1 — Desktop Q&A Demo          Week 1                      │
│  Live demo: FOWT mooring · metocean · SHM · OrcaFlex analytics   │
│  Cost: $0 additional · uses existing AI subscriptions            │
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│  PHASE 2 — Microsoft Teams Chatbot   Weeks 2–4                   │
│  Bots per team: wind engineering · operations & monitoring       │
│  Metocean queries, code lookups, anomaly alerts in Teams         │
│  Cost: ~$20–200/month · Azure Bot Service + Claude API           │
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│  PHASE 3 — Document Intelligence     Months 2–3                  │
│  Index project design bases, inspection reports, SHM logs        │
│  "Show fatigue damage trend for Tower 7 over the last 6 months"  │
│  Cost: ~$500–2,000/month · RAG backend + document index          │
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│  PHASE 4 — Analytics Platform        Months 4–6                  │
│  Simulation result ingestion + automated anomaly reporting       │
│  Site metocean vs design envelope comparison dashboard           │
│  Grows with every project, turbine, and inspection cycle added   │
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What the AI Does Not Do

- Does not replace the structural or offshore wind engineer
- Does not execute OrcaFlex, FAST/OpenFAST, or commercial software directly
- No live SCADA/IoT data stream ingestion in current implementation
- All outputs carry a disclaimer: *preliminary/informational, requires qualified engineer verification*
- No proprietary project or inspection data stored without explicit setup

Expected Returns

METRIC	CURRENT	WITH AI	SAVING
Metocean site data retrieval	1–2 hr	5 min	**92%**
FOWT mooring pre-check	1–2 hr	10–15 min	**85%**
Wind farm layout + wake estimate	4–8 hr	30–60 min	**85%**
SHM sensor suite configuration	1–2 hr	10–15 min	**85%**
Simulation anomaly identification	2–4 hr	20–30 min	**87%**
Code clause look-up (DNV/IEC)	15–30 min	1–2 min	**90%**

Pilot Proposal

1. **Week 1** — Live demo (30 min) with 3–5 real project questions from wind engineering and operations teams
2. **Week 2–3** — Pilot: design team + operations/monitoring team on active project work
3. **Week 4** — ROI review · decision on Teams chatbot (wind engineering bot + operations bot)
4. **Month 2+** — Full team rollout · SHM log and inspection record indexing

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Offshore wind engineering — foundations, moorings, fatigue, and metocean — in one assistant. Simulation analytics and real site data combined: the capability that accelerates project delivery.