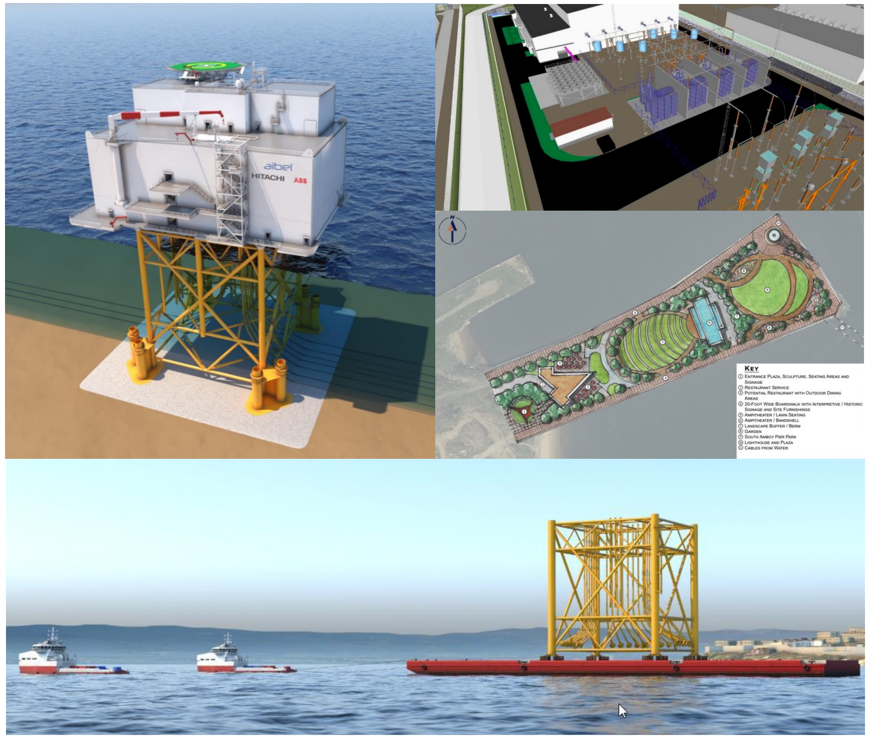
# New Jersey’s nation leading 2021 Offshore Wind Transmission Solicitation

## Review of APT proposals submitted for the 2021 SAA Proposal Window to Support NJ OSW




PJM Teams Meeting November 16, 2021

ATLANTIC POWER TRANSMISSION LLC
*A Blackstone Infrastructure Partners Portfolio Company*

# Questions provided by PJM

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2. Describe proposal(s)
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8. Confirm contact information for questions following meeting

# Atlantic Power Transmission Alliance presentation to PJM

- **Andy Geissbuehler**, APT Chief Executive Officer
- **Stephen Boyle**, APT Director, RTO and Government Affairs
- **Neil Habig**, APT Director, Development
- **Bryan Hom**, Investment Professional, Blackstone Infrastructure Partners
- **Roger Rosenqvist**, Hitachi Energy, Vice President, Business Development
- **Lars Henrik Hosoey**, Aibel AS, Head of Business Development & Sales, Offshore Wind
- **Morten Langnes**, Nexans AS, Sales Manager Submarine HV Cables

# Introduction – project summary

Atlantic Power Transmission submitted to NJBPU & PJM an SAA transmission solution:

- One, two, or three 1200 MW HVDC offshore wind transmission systems
- Ability to connect up to 3600 MW into the 500KV backbone of PJM's power grid
- APT's three independently operating systems interconnect into the Deans substation
- APT's three systems are fully undergrounded and use a shared cable corridor both offshore and onshore
- APT's proposal provides price certainty for a 40-year economic life and is delivered by an Alliance of proven transmission firms



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# Introduction – project mission

We are committed & able to secure all resources and manage the risks to safely and reliably construct & operate the transmission solution to support New Jersey's clean energy leadership

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# Question 1 (1) – Introduction of Atlantic Power Transmission (APT)

- "APT" is a Blackstone Infrastructure Partners Portfolio Company, dedicated to develop, construct and long-term operate reliable transmission facilities to enable US offshore wind energy
- The APT leadership team brings a solid track record of large scale energy projects with first-hand experience in US and global offshore wind.
- APT has formed an Alliance with three leading transmission infrastructure companies: Hitachi Energy, Aibel and Nexans
- The Alliances delivers superior electrical design, the global OSW transmission learning curve secured production capacity.
- Experienced permitting and right-of-way firms have been engaged to de-risk the project development and execution.
- APT is a sister company of Transmission Developers Inc. (TDI), also a Blackstone Infrastructure Partners Portfolio Company, which has been awarded the Champlain Hudson Power Express, delivering 1250 MW to NYC.

# Question 1 (2) – Introduction of APT owner Blackstone Infrastructure Partners

*Offshore Wind / HVDC Transmission*

Transmission Developers Inc.
A Blackstone Portfolio Company


**Champlain Hudson Power Express**

- ~338-mile buried transmission line
- Will transport 1,250+ MWs of clean energy from the U.S.-Canadian border to New York

TDI New England


**New England Clean Energy Power Link**

- ~154-mile underwater and underground transmission line
- 1,000 MW high voltage direct current (HVDC)

GRIDLIANCE

**GridLiance**

- Operates 700+ miles of transmission lines and related substation facilities in six states across 3 RTOs

*Relevant Large-Scale Greenfield Projects*

CHENIERE

**Cheniere Energy**

- Liquefied natural gas facility
- Constructed the first LNG liquefaction facility in the continental US at Sabine Pass

Ventika

**Ventika**

- 252MW wind farm in Mexico

WindMW

**Meerwind Süd | Ost Project**

- 288 MW offshore wind project in the German North Sea
- Powers 360K German homes

Blackstone's buy and hold model aims to deploy permanent capital and targets long-term ownership opportunities



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# Question 1 (3) – APT relevant project experience - CHPE

- New York Authorities selected Blackstone's Champlain Hudson Power Express project to deliver clean hydro power into NYC.
- 1,250 MW HVDC from the U.S. - Canadian border to Queens NY
- 338 miles of transmission line, 60% in waterways and 40% buried underground
- Project fully permitted and in execution, completion anticipated by 2025


APT & TDI, as part of the Blackstone family, regularly collaborate on transmission best practices



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# Question 1 (4) – APT team and partners' relevant OSW project experience

- Block Island 5 x 6 MW (RI)
- VOWTAP 2 x 6 MW (VA)
- Vineyard Wind 800 MW (MA)
- Meerwind 288 MW (Germany)
- Globally more than 20 GW of offshore wind experience within the APT Alliance, including the 3 x 1200 MW HVDC project at Dogger Bank (UK) under construction for Equinor.



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# Question 1 (5) – APT's Alliance Partner approach

## Hitachi Energy


## Aibel


## Nexans Subsea & Land Systems


- Large turnkey project track record in offshore wind and offshore energy
- Proven interface management
- Inhouse manufacturing facilities and vessels
- US presence / US facilities

- Alliance approach with committed resources & capacity and provides predictability and agility
- Proven Hitachi ABB – Aibel interfacing process (joint transmission projects over a period of 18 years)
- Committed and integrated team to deliver for New Jersey, in collaboration with local businesses and unions

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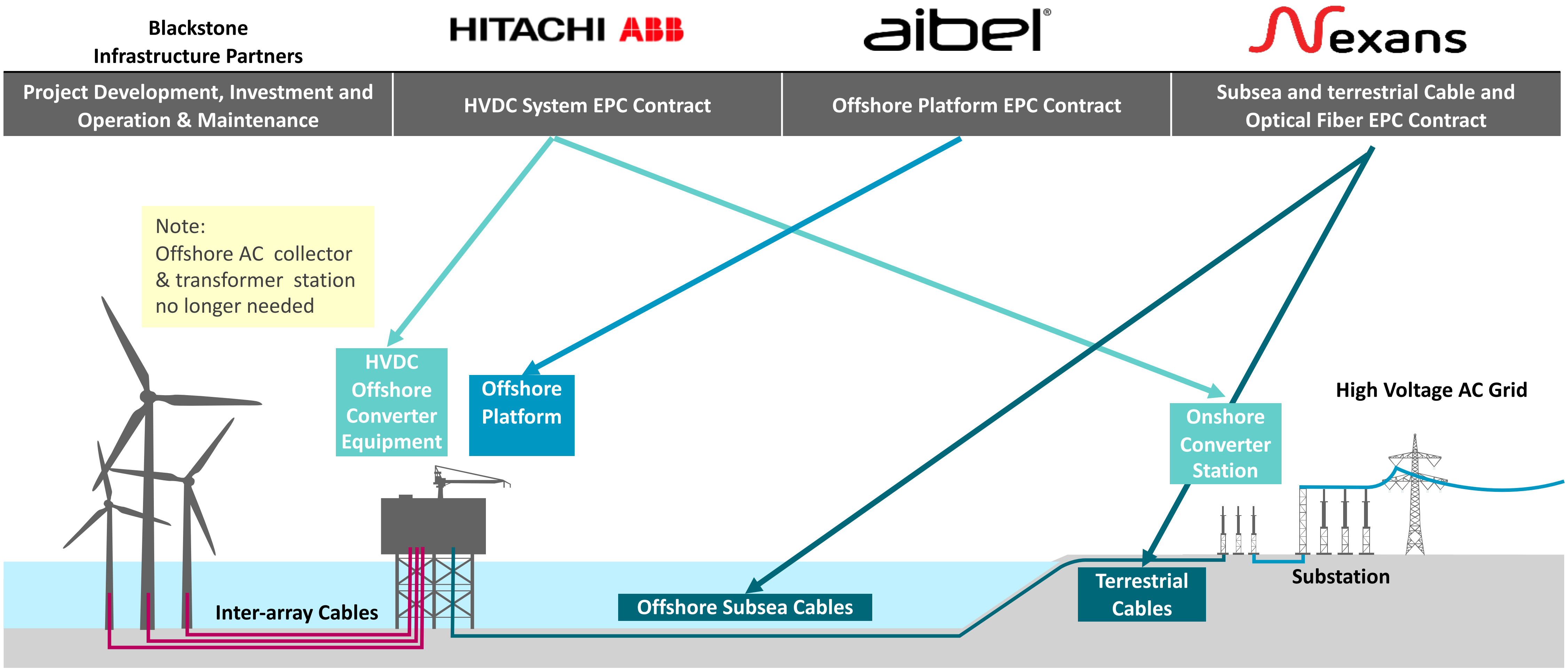
# Question 1 (6) – APT's Alliance Partner scope overview



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# Question 1 (7) – APT Alliance Partner Hitachi Energy

## The Four Pillars of the World's #1 Power Grids Business

Grid Integration

- ~15,000 systems operating around the world
- Leader in FACTS and power quality
- Leader in HVDC systems with 130+ GW installed

Grid Automation

- Supporting 50% of the top 250 global electric utilities with leading portfolio
- ~US $4 trillion mission critical infrastructure assets managed with our software solutions
- ~480 million electricity consumers

High Voltage Products

- Up to 1,200 kilovolts AC and 1,100 kilovolts DC, leading portfolio
- One in every four high-voltage switchgear installed in the world
- Over 100 locations worldwide provide 24/7 service support

Transformers

- Complete range of power, distribution, traction transformers, components, services
- Up to 1,200 kV AC and 1,100 kV DC, leading portfolio
- ~60 factories around the world and ~30 service centers

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# Question 1 (8) – APT Alliance Partner Hitachi Energy

## Reference projects | Renewable energy integration

- HVDC VSC technology (HVDC Light®) for offshore and onshore stations for the Dogger Bank A, B and C projects in the United Kingdom (3 × 1,200 MW, ±320 kV)
- Onshore and offshore HVDC Light® converter stations for DolWin 1, 2 and 5 projects in Germany (800 MW, 916 MW, 900 MW, ±320 KV)
- Onshore HVDC Light® converter stations for NordLink and North Sea Link projects between Norway and Germany and between Norway and the UK (1,400 MW, ±525 kV)

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# Question 1 (9) – APT Alliance Partner Aibel

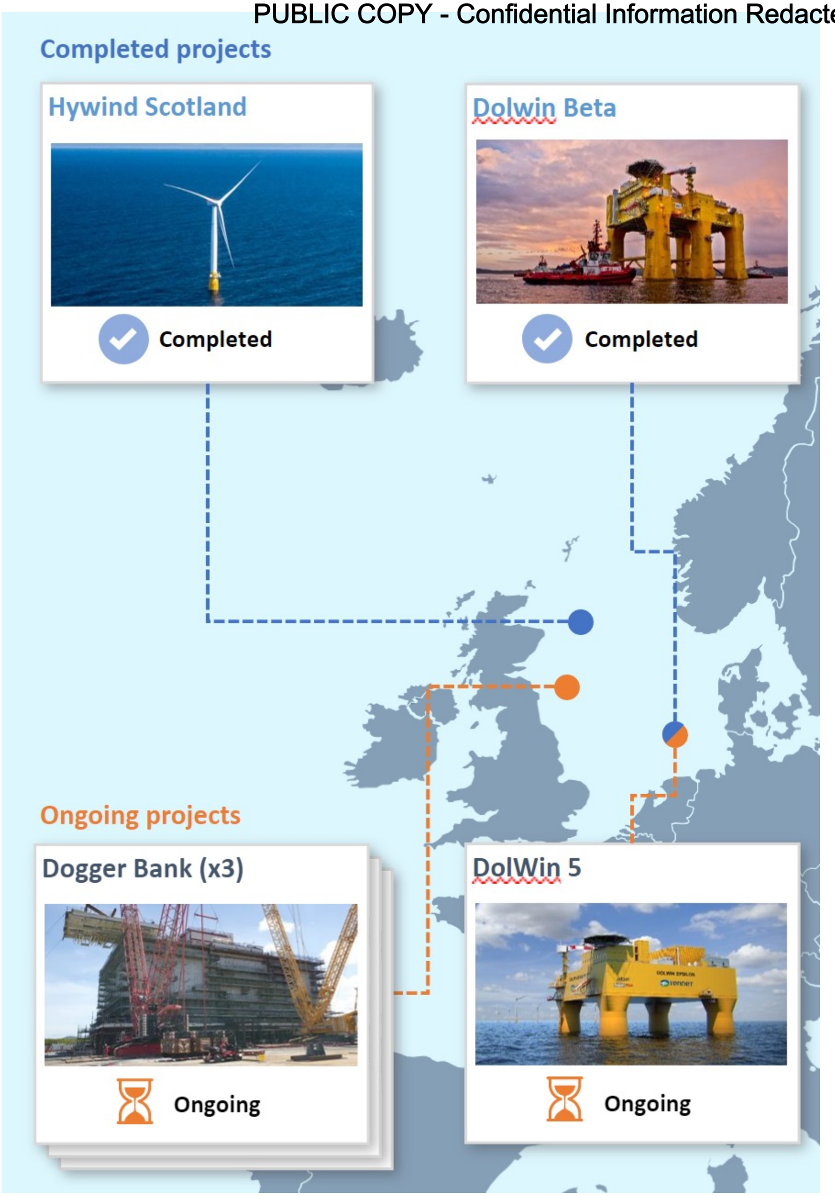
## Leading offshore wind EPC supplier

### Aibel and the Dogger Bank Wind Farm

- Dogger Bank Wind Farm is an offshore wind farm being developed in three phases – Dogger Bank A, B and C – located off the east coast of England
- The wind farm will become the world's largest offshore wind farm when operational, with a combined capacity of 3.6 GW
- Aibel has developed integrated solutions and established an efficient supply chain together with Hitachi Energy
- Aibel is a turnkey supplier of the converter platforms for each farm, taking the electricity generated by the turbines and converting it from AC current to HVDC – a UK offshore wind first

### Standardising HVDC

| | | | |
|---|---|---|---|
| **Project** |  |  |  |
| **Awarded** | 2019 | 2019 | 2021 |
| **Delivery** | 2023 | 2024 | 2025 |

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# Question 1 (10) – APT Alliance Partner Nexans




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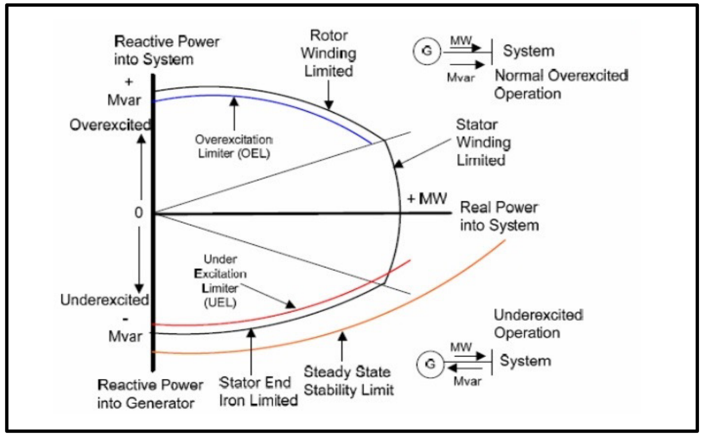
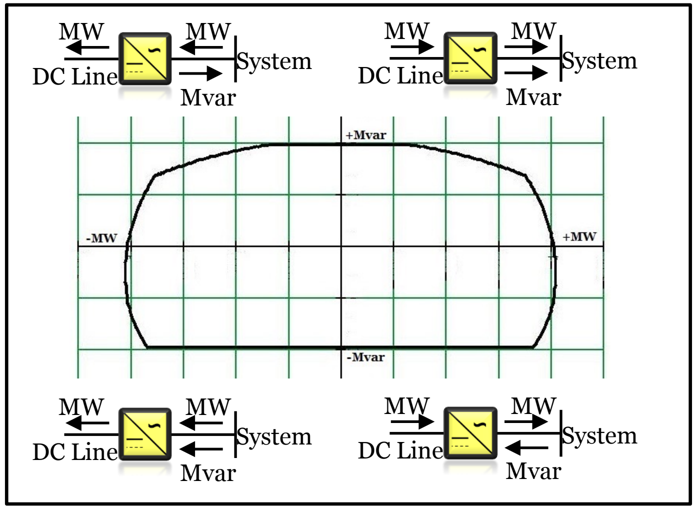
# Question 2a (1) – APT transmission solution – HVDC technology




Typical P-Q Curve for Fossil Fuel based Generators




Typical P-Q Curve for VSC Based HVDC Stations

- The practical length of a continuous high-voltage AC cable link is limited by the 60 Hz charging current:
  - ❖ The cable capacitance increases linearly with the length of the cable
  - ❖ HVDC cables only carry charging current during initial energization of the circuit
- Continued R&D over the past two decades have produced high-capacity polymer (XLPE) insulated DC cables that facilitate construction of very long and invisible high-capacity transmission lines.
  - ❖ New transmission lines onshore can be all underground or a hybrid of overhead and underground construction to mitigate siting issues and public concerns
- Voltage sourced converter ("VSC") based HVDC links can deliver renewable energy from remote wind, solar and hydroelectric resources and make such deliveries appear to the grid as supply from a local generator sited at the receiving end of the transmission corridor.
  - ❖ VSC based HVDC stations provide dynamic and continuous reactive power support.

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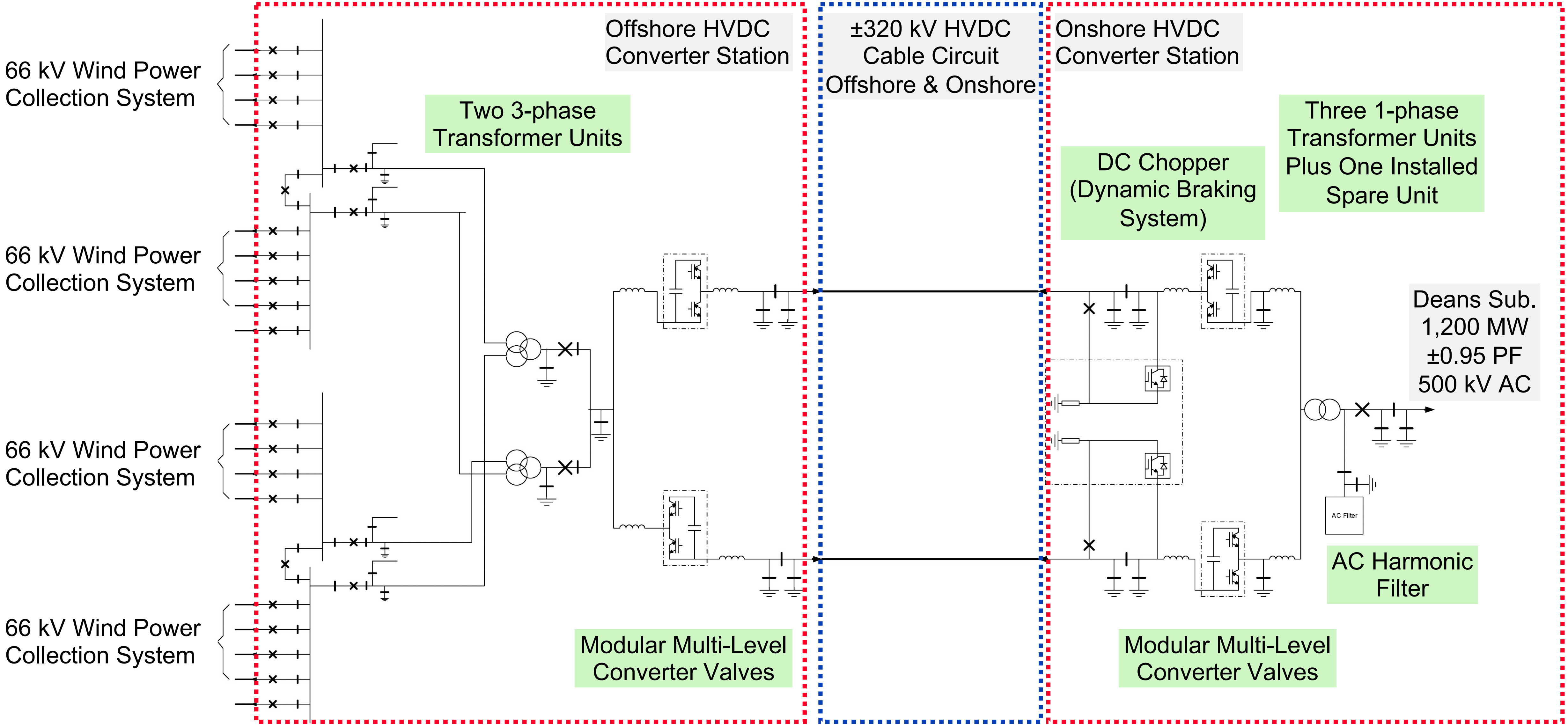
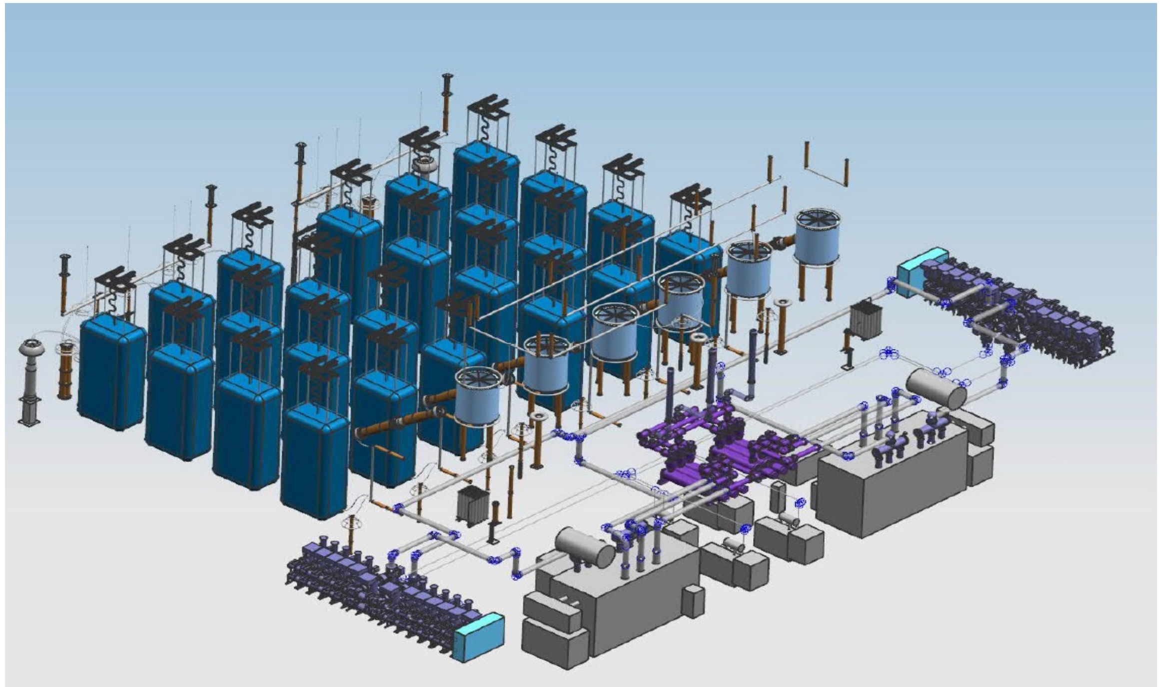
# Question 2a (2) – APT transmission solution – Major components – Single-Line Diagram



# Question 2a (3) – APT transmission solution – major components – offshore converter station

- 66 kV Gas Insulated Switchgear (GIS)
- 3-Phase Power Transformers (Each transformer unit can support a loading of up to 830 MW)
- 400 kV GIS
- Converter Reactors
- Modular Multi-Level Converter Valves

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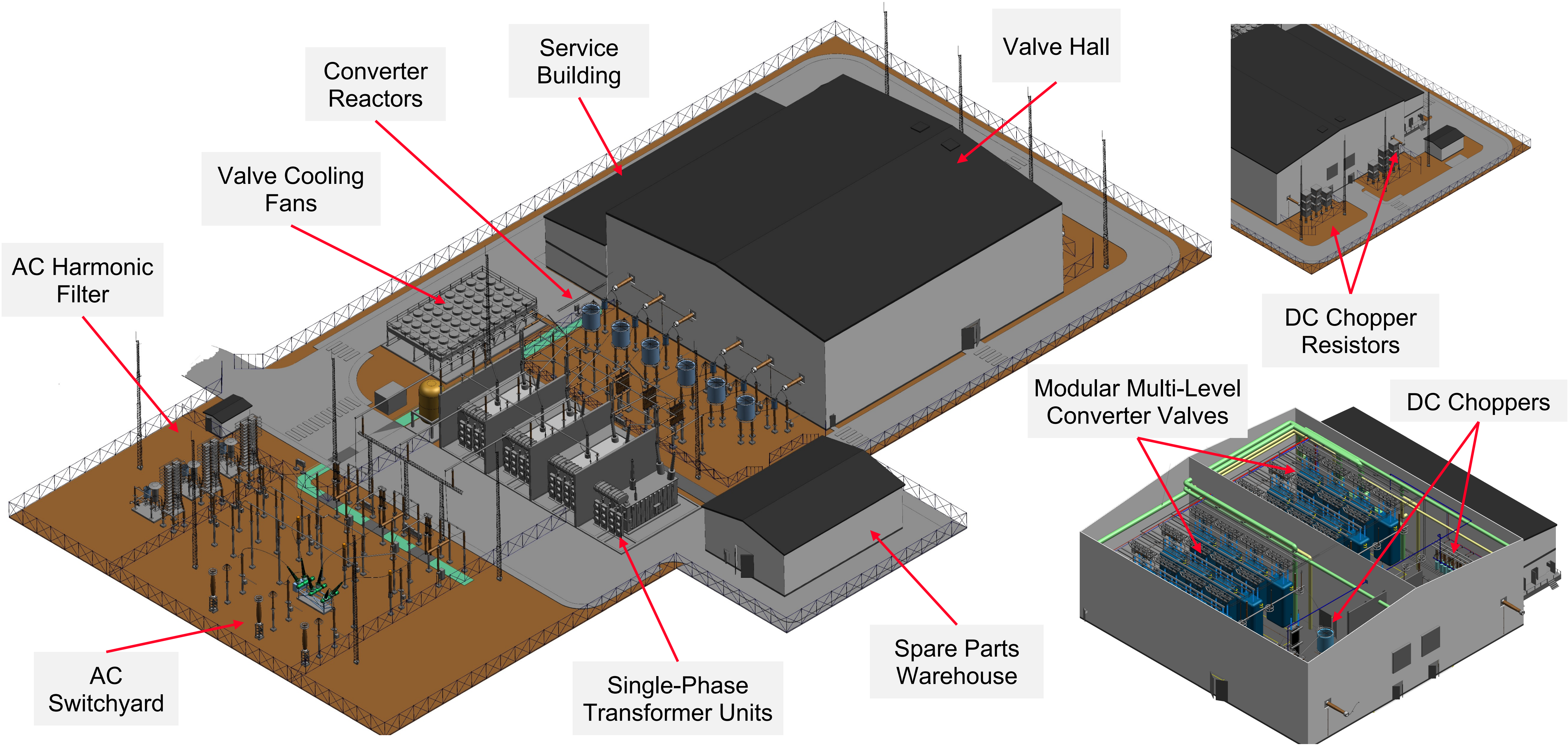
# Question 2a (4) – APT transmission solution – major components – onshore converter station

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# Question 2a (5) – APT transmission solution – major components – offshore converter platform

## Standardized execution experience and capabilities – reducing overall risk for multiple deliveries



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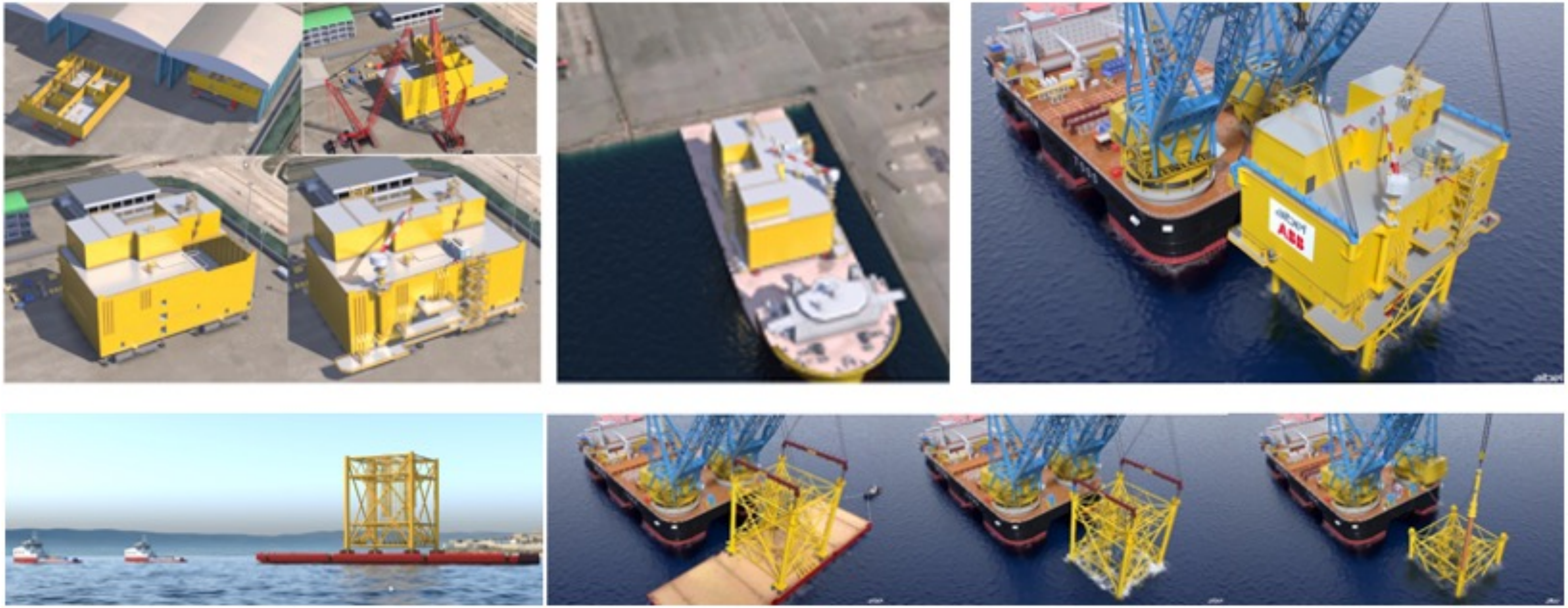
# Question 2a (6) – APT transmission solution – major components – offshore converter platform

| Engineering | Procurement | Fabrication | Installation | Transport | Commissioning |
| --- | --- | --- | --- | --- | --- |



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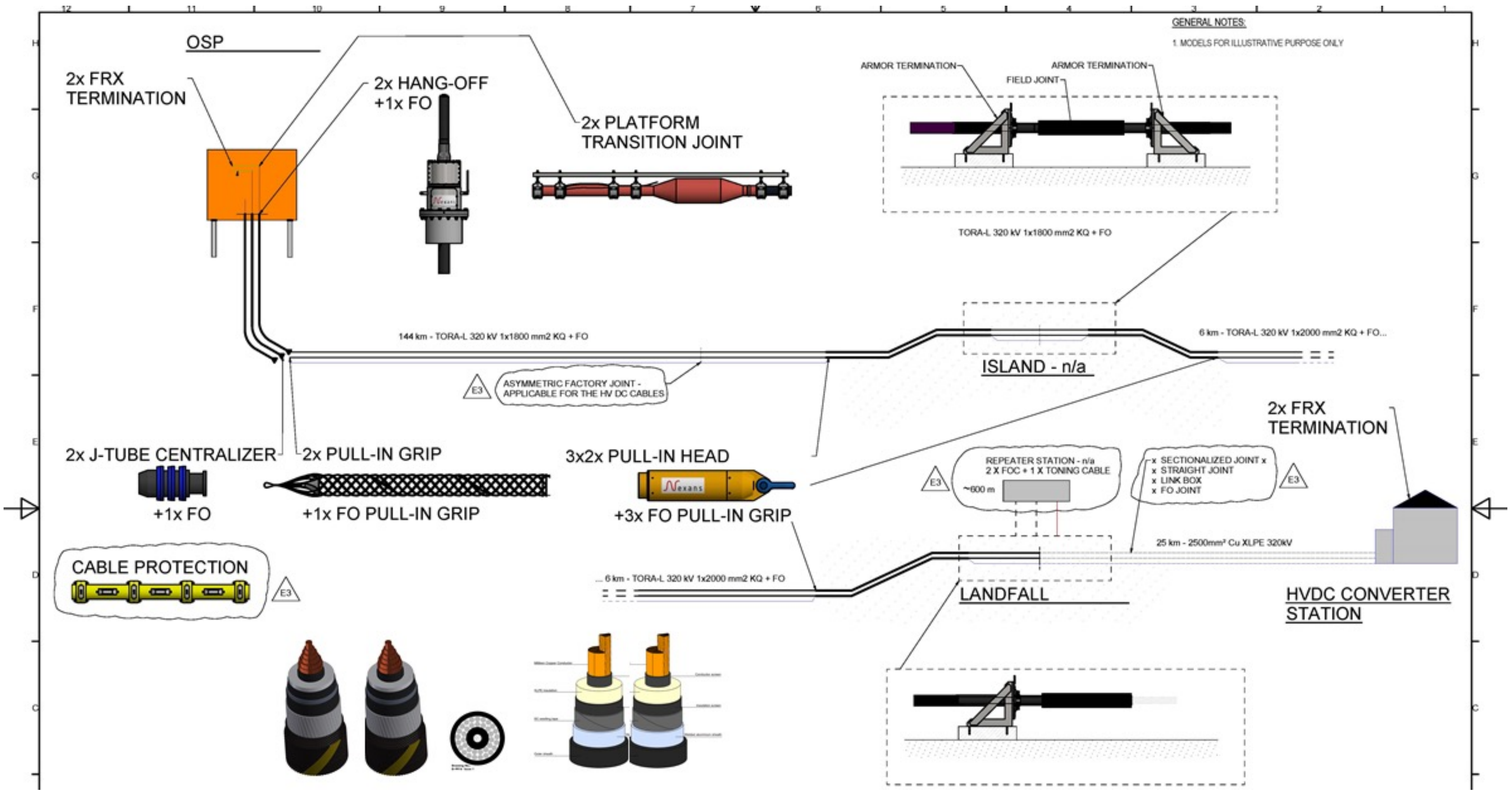
# Question 2a (7) – APT transmission solution – major components – export cable

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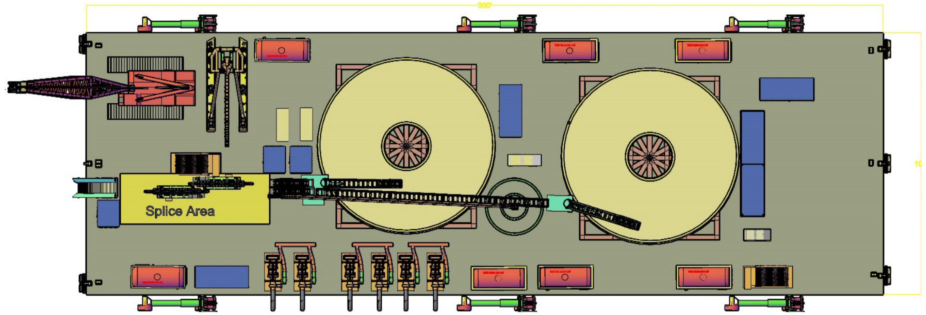
# Question 2a (8) – APT transmission solution – major components – offshore installation

## Near shore, 6 km

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## Offshore, 144 km



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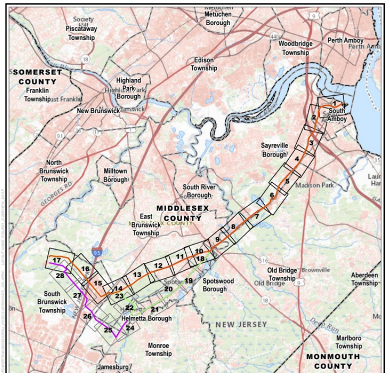
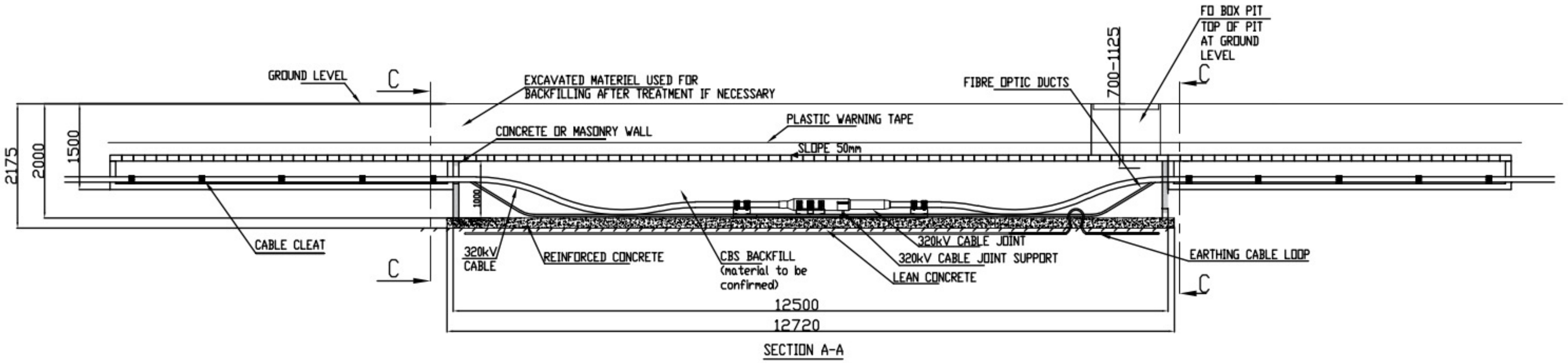
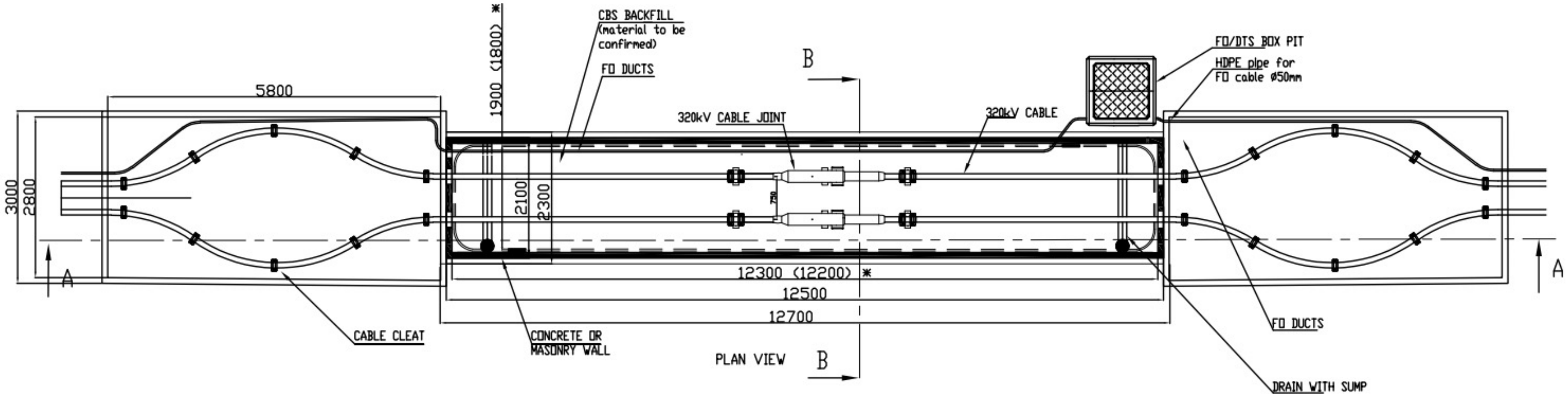
# Question 2a (9) – APT transmission solution – major components – onshore installation



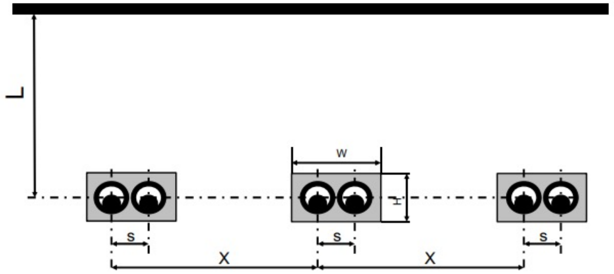

## Joint bay – general arrangement




**Laying arrangement**

| | | |
|---|---|---|
| Axial separation between two adjacent cables ( s ) | 270 | mm |
| Axial separation between two adjacent circuits ( X ) | 1500 | mm |
| Depth of burial ( L ) | 1030 | mm |
| Width of the ducts bank ( W ) | 650 | mm |
| Height of the duct bank ( H ) | 380 | mm |
| PE duct diameter ( inner / outer ) | 202 / 220 | mm |



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# Question 2b (1) – HVDC technology following variable generation assets

- The onshore HVDC station controls the DC voltage at the onshore termination of the DC cable circuit and supports the AC voltage at the grid interconnection point onshore (Deans 500 kV substation). On the AC side, the onshore station can be operated either in AC voltage, reactive power or power factor control.
- After the offshore HVDC station is energized via the DC cable circuit from the onshore station, it begins generating a constant power frequency and AC voltage and becomes the grid-forming facility for the offshore wind power collection system.
- As the grid-forming facility, the offshore HVDC station will appear to the offshore wind-turbine generators ("WTGs") as a very large synchronous motor load.
- The energy output from the WTGs will flow into the offshore HVDC converter station and charge the capacitance on the DC side. This will increase the DC voltage and cause the DC current to flow to the onshore HVDC station, which keeps the DC voltage constant at the receiving end of the HVDC link.
- This operation of the HVDC system will cause it to inherently follow the varying power output from the WTGs.

# Question 2b (2) – Variation limits / curtailments

- The HVDC link follows the power output from the WTGs and any curtailments of the output from the WTGs must be implemented via the wind farm control.

- The power frequency generated by the offshore converter station can be designed to follow the onshore power frequency in order to activate automatic power reduction of the WTGs’ output in connection with over-frequency conditions in the onshore grid.

# Question 2b (3) System studies

- APT's submission includes detailed PSS/E models of the proposed HVDC systems.
- APT's submission also includes conceptual analyses and preliminary feasibility studies to evaluate the impacts on the PJM system in New Jersey from injecting up to 3,600 MW of offshore wind power via the proposed APT HVDC links to the existing Deans 500 kV substation.
  - ❖ The results of the system simulations show that there is minimum impact to the PJM power system by moving 1,058 MW of offshore wind generation injection from the Larrabee substation to the Deans substation.
  - ❖ The study report includes Generation Deliverability Analysis (GD) and Long-Term Deliverability Analysis (LTD) on Summer and Winter system conditions using the PJM provided data package.
  - ❖ The analyses were first performed with the default POIs provided by PJM and then compared to the configuration with 1,058 MW moved from Larrabee to Deans.
- Possibility to interconnect two offshore platforms for redundant path to shore.

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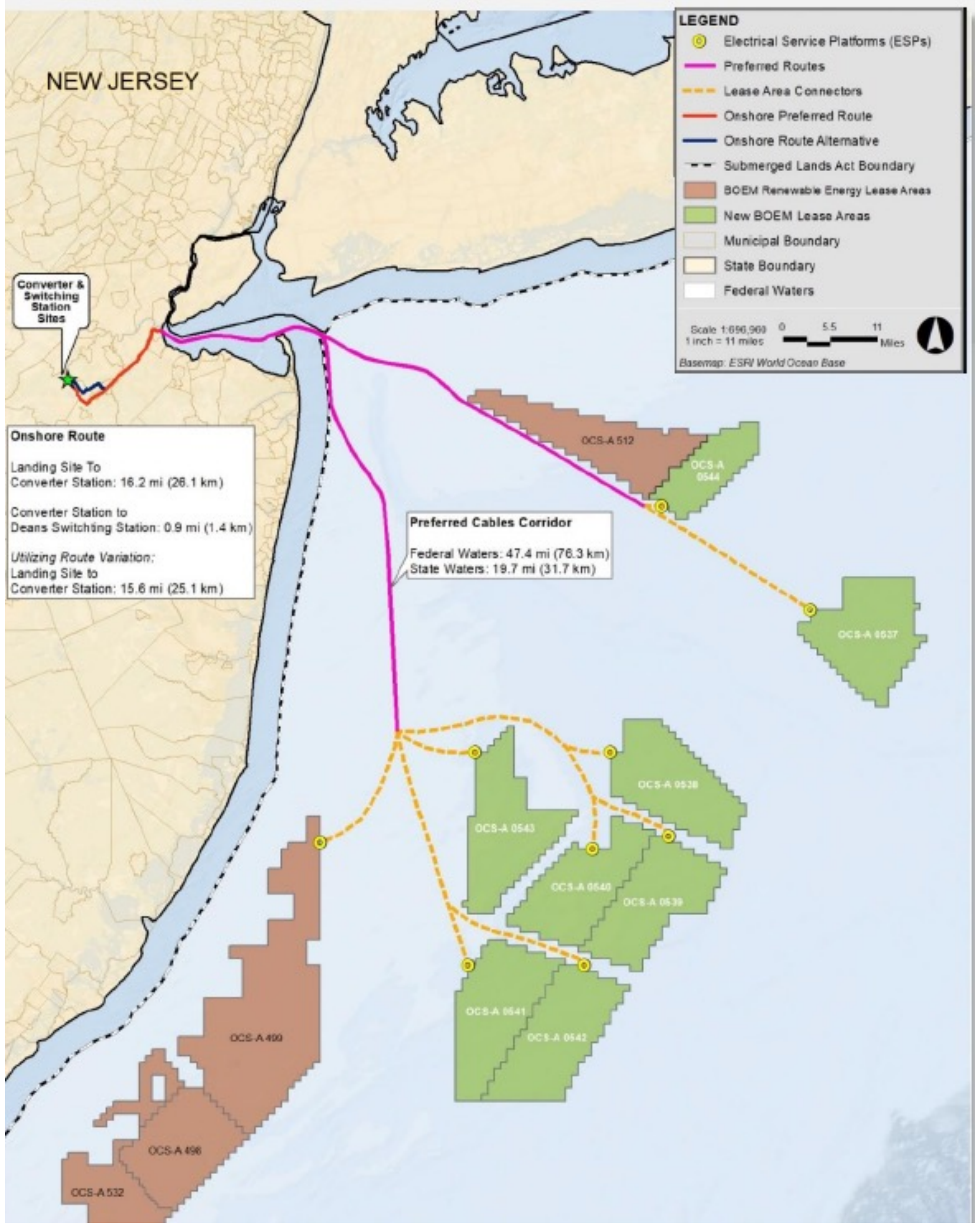
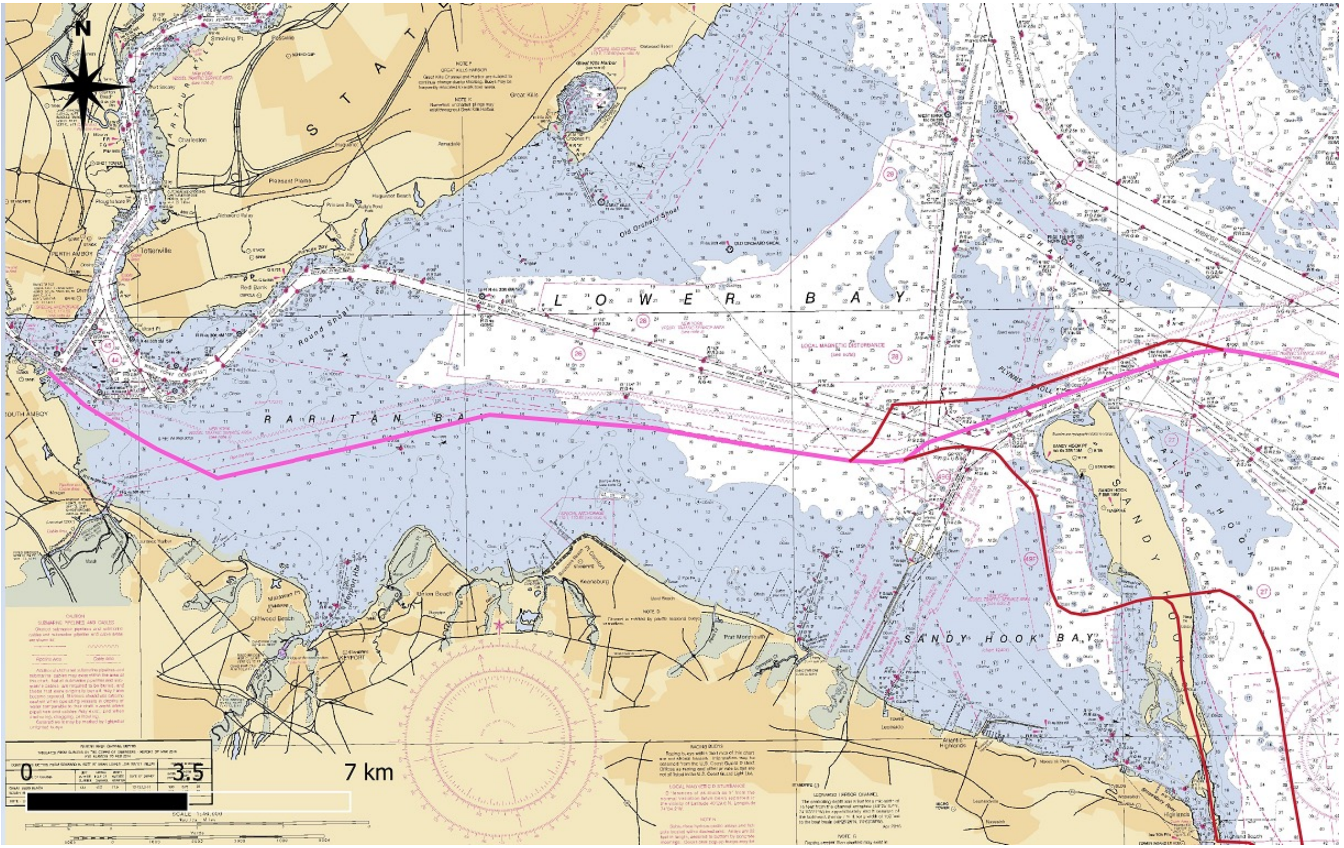
# Question 3 (1) – APT transmission solution – Offshore subsea cable routing




First PJM review of APT's 2021 SAA Proposals



# Question 3 (2) – APT transmission solution – Industrial landing in South Amboy





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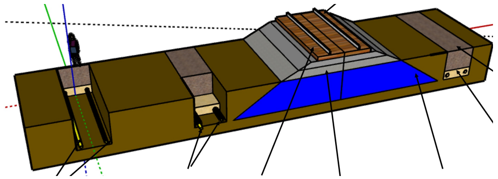
# Question 3 (3) – APT transmission solution – Underground clean energy corridor


16 Miles along Rail Corridor



Shared underground cable corridor in railroad easement

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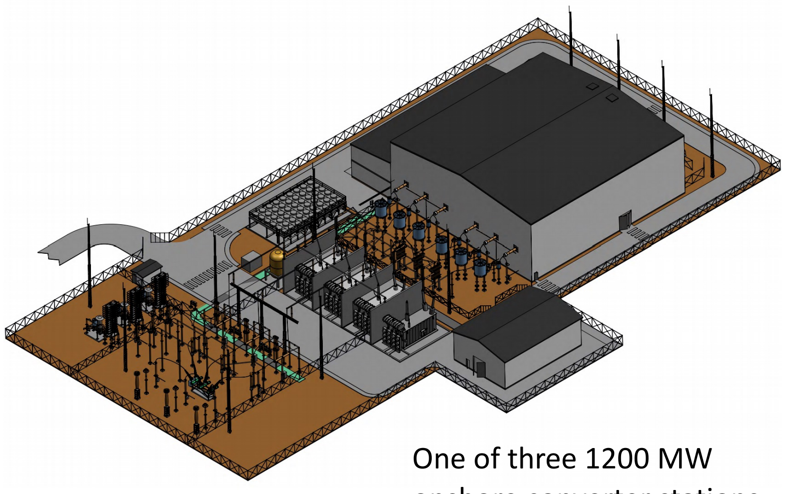
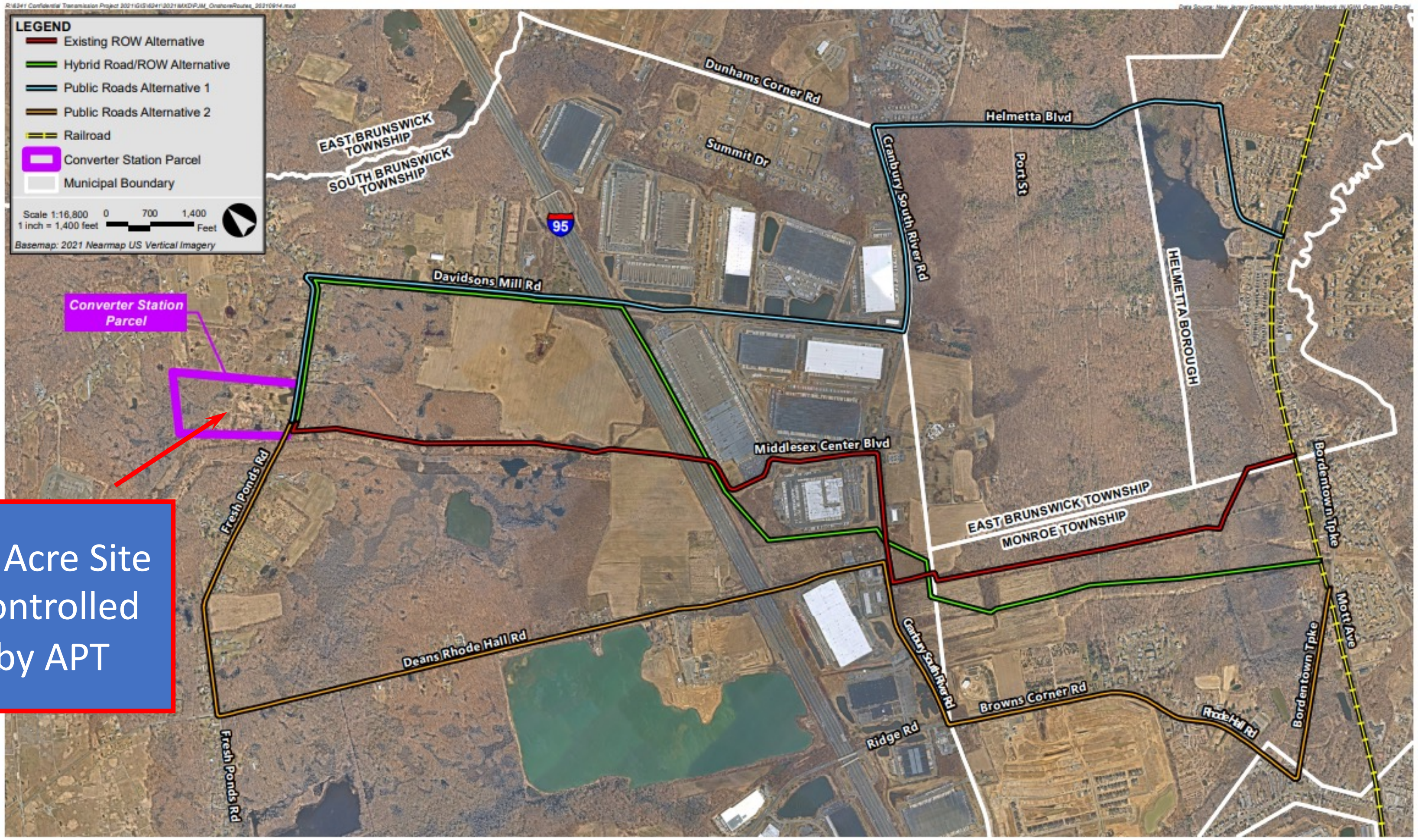
# Question 3 (4) – APT transmission solution – Underground route to converter station site



One of three 1200 MW onshore converter stations

First PJM review of APT's 2021 SAA Proposals




40 Acre Site Controlled by APT

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# Question 3 (5) – Permitting and RoW status / community support

- Overview:
- Seabed Cable Permitting - Mature and Well-established Process, both at state and federal level.
- APT has advanced plans for ROW from Deans to Offshore Platform: Extensive desktop routing exercise has been conducted. Terrestrial route surveyed for critical issues. Offshore infrastructure (platform) permit process is well established.
- State process – DEP permitting: tidelands conveyance, wetlands, waterfront development – All mature and well-established processes. Covers terrestrial and undersea portion (out to 3-mile state waters limit)
- Federal program – Subsumed under BOEM:

# Question 3 (6) – Permitting and RoW status / community support

[redacted]

ER
LLC

A Blackstone Infrastructure Partners Portfolio Company

# Question 3 (7) – Permitting and RoW status / community support

Any of the eight or more lease areas can be served by APT's three proposed transmission facilities. There are two options to align APT's transmission facilities to the selected lease areas:

1) Limit the SAA permitting scope to a strategic break off point that could serve multiple lease blocks (This is the approach APT presented in bid – but APT remains flexible on this). Remaining route and platform will be permitted in collaboration with the generation developer.

2) Permit full route and platform based on the emergence of clear priority projects

Summary:
Strong Experienced Team, APT has partnered with experienced permitting and implementation partners including Epsilon Associates, who served as lead consultant on successful Vineyard Wind permitting campaign. Overall, while a lengthy, permitting risk for the transmission facilities, as proposed, is considered low.

# Question 3 (8) – Permitting and RoW status / community support

## Community Support (onshore)

Letters of support have been obtained from all municipalities along proposed route from South Amboy (cable landing) to South Brunswick (Dean's Substation – Cable Termination)

| Local Government | Status |
|---|---|
| South Amboy (Cable landing) | Letter of Support from the Mayor |
| South Brunswick (cable landing and converter station) | Letter of Support |
| Sayreville Borough | Letter of Support |
| Old Bridge Township | Unanimous council vote in support |
| Spotswood Borough | Letter of Support |
| East Brunswick Township | Letter of Support |
| Helmetta Borough | Unanimous council vote in support; Letter from Mayor |
| Monroe Township | Letter of Support from the Mayor |
| Middlesex County | Letter of Support |

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# Question 4 (1) – Project Level 1 schedule

[redacted]

# Question 4(2) – Alignment with BPU OSW solicitation plan

*APT - 2021-10-10 REV7*

**NJ Offshore Transmission - Project and bidding phases**

| APT Transmisison phase | NJBPU OSW Solicitation* | Award Timing* | OSW Developer | MW* | COD* | Remarks |
|---|---|---|---|---|---|---|
| | 1 | Q2 2019 | Orsted | 1100 | 2025 | Transmission in developer scope |
| | 2 | Q2 2021 | Orsted | 1148 | 2027/28 | Transmission in developer scope, however, BPU and developer may mutually agree to make SAA transmission available |
| | | | Atlantic Shores | 1509.6 | 2028/29 | |
| Phase 1 Deans | 3 | Q2 2023 | | 1200 | 2030 | up to 3.8 GW require SAA transmission |
| | 4 | Q1 2025 | | 1200 | 2031 | |
| | 5 | Q1 2027 | | 1342 | 2033 | |
| Phase 2 | 6 | Q1 2029 | | TBD | 2035 | additional OSW expected to meet NJ clean energy targets |
| | Offshore Wind projects | | | | | |

* as outlined in the PJM / BPU OSW solicitation schedule



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# Questions provided by PJM

1. Describe entity providing the proposal (as appropriate given past participation in the PJM competitive process) and any relevant OSW project experience

2. Describe proposal(s)
   a. Include overview of all major components
   b. If controllable elements are included in the transmission path, describe their intended method(s) of operation

3. Describe any siting and permitting concerns

4. Outline any specifics of the project schedule which may be relevant to the BPU solicitation schedule

5. Outline any specifics that may be relevant to any of the OSW projects that have already been selected by NJBPU

6. Outline proposal interactions with other proposals submitted (as appropriate)

7. Provide an overview of the cost containment or cost control features of your proposal

8. Confirm contact information for questions following meeting

# Question 5 (1) – Specifics regarding existing solicitation #1 and #2 projects

*APT - 2021-10-10 REV7*

**NJ Offshore Transmission - Project and bidding phases**

| APT Transmisison phase | NJBPU OSW Solicitation* | Award Timing* | OSW Developer | MW* | COD* | Remarks |
|---|---|---|---|---|---|---|
| | 1 | Q2 2019 | Orsted | 1100 | 2025 | Transmission in developer scope |
| | 2 | Q2 2021 | Orsted | 1148 | 2027/28 | Transmission in developer scope, however, BPU and developer may mutually agree to make SAA transmission available |
| | | | Atlantic Shores | 1509.6 | 2028/29 | |
| Phase 1 Deans | 3 | Q2 2023 | | 1200 | 2030 | up to 3.8 GW require SAA transmission |
| | 4 | Q1 2025 | | 1200 | 2031 | |
| | 5 | Q1 2027 | | 1342 | 2033 | |
| Phase 2 | 6 | Q1 2029 | | TBD | 2035 | additional OSW expected to meet NJ clean energy targets |
| | | | | | | |
| | Offshore Wind projects | | | | | |

* as outlined in the PJM / BPU OSW solicitation schedule



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# Question 7 (1) – Cost containment / cost control - principles

APT's proposals provide unprecedented cost certainty to PJM & New Jersey. Our approach has been driven by:

- Advanced development work prior to proposal submission
- Comprehensive project execution planning (Project Safety concept, schedule, risk management, scope & interface planning between Alliance Partners, logistics concept)
- Project procurement plan securing execution capacity and globally scarce components
- Significant EPC project experience of the APT team & Blackstone in the development, financing, construction, and operations of large scale infrastructure assets (offshore wind, transmission, power generation, and general linear infrastructure)
- Goal to be responsive to the priorities of PJM and New Jersey around cost containment and intergenerational equity of cost recovery

# Question 7 (2) – Cost containment / cost control - financial

- APT's proposal utilizes the pre-determined annual revenue requirement ("Fixed ATRR") approach proposed by the NJBPU as opposed to the traditional cost of service model

- Fixed ATRR approach provides comprehensive risk mitigation to New Jersey's ratepayers in the form of fixed annual revenue payments to include all direct and indirect costs incurred. APT protects ratepayers by assuming all risks of the cost of:

  - Development
  - Permitting
  - Critical component & logistic procurement
  - Construction
  - Start-up and commissioning
  - Operations and maintenance
  - Tax rate
  - Debt financing

- Ratepayer impact delayed until project is operational

# Questions provided by PJM

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# Question 8 – Contact information

*For further information, please contact:*

Atlantic Power Transmission, LLC
A Blackstone Infrastructure Partners Portfolio Company
103 Carnegie Center Boulevard, Suite 300
Princeton, New Jersey 08540

Steve Boyle, Director, RTO and Government Affairs
Mobile – 215-287-4075
Email – stephen.boyle@AtlanticPowerTransmission.com

Andy Geissbuehler, CEO
Phone – 804-405-5156
Email – andy.geissbuehler@AtlanticPowerTransmission.com

# Concluding Remarks

- Proven 3 x 1200 MW OSW HVDC solution
  (same design as 3 x 1200 MW Dogger Bank project in the UK)
- Fully undergrounded cables, industrial landing and shared corridor minimize disruption and optimize economies of scale
- Voltage sourced converter ("VSC") based HVDC make wind energy deliveries appear to the grid as supply from a local generator sited at the receiving end of the transmission corridor.
- Right of Way support letters provided by all communities
- 40-year cost certainty
- Capacity reservations and long-term commitment of APT and Alliance Partners



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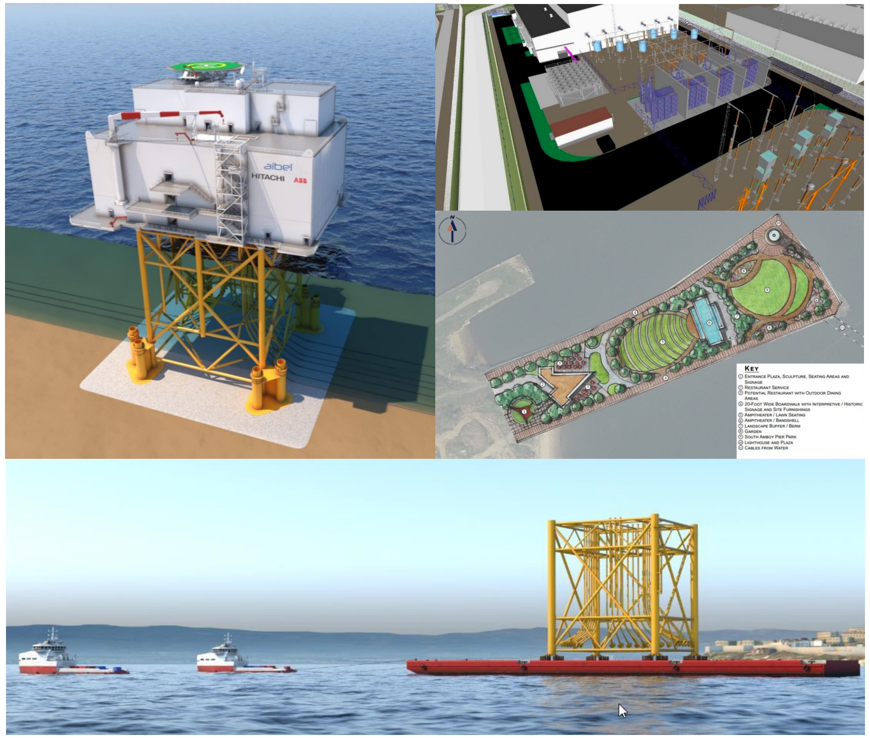
# New Jersey's nation leading 2021 Offshore Wind Transmission Solicitation

# Back - Up





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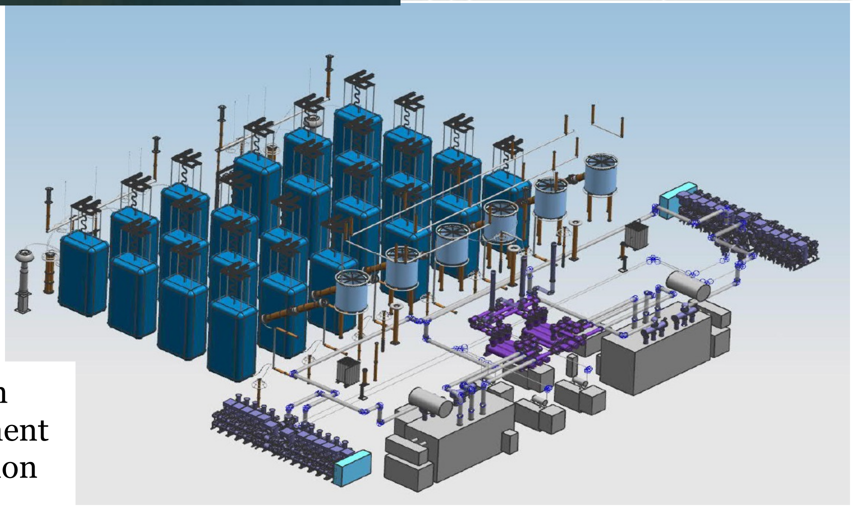
# Hitachi Energy Offshore Wind Project Examples

| Project Examples | | |
|---|---|---|
| | **Dolwin 1** | **Dolwin 2** |
| **Commissioning Year:** | **2015** | **2017** |
| **Power Capacity Rating:** | **800 MW** | **916 MW** |
| **No. of Poles:** | **1 (Symmetric Monopole)** | **1 (Symmetric Monopole)** |
| **AC Voltage:** | **155 kV (Off-Shore)**<br>**380 kV (On-Shore)** | **155 kV (Off-Shore)**<br>**380 kV (On-Shore)** |
| **DC Voltage:** | **±320 kV** | **±320 kV** |
| **Type of DC System:** | **Cable Link \| VSC Stations** | **Cable Link \| VSC Stations** |
| **Route Length:** | **47 miles Submarine Cable**<br>**56 miles Underground Cable** | **28 miles Submarine Cable**<br>**56 miles Underground Cable** |

Example of main circuit arrangement for offshore station (walls and floors removed)

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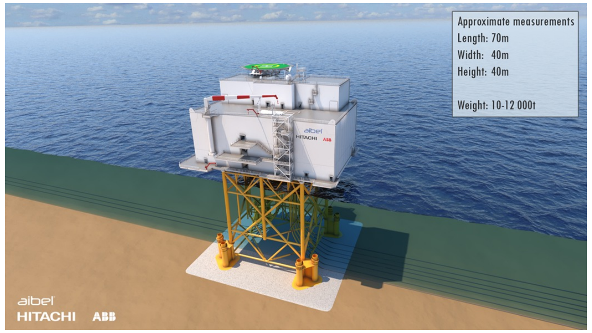
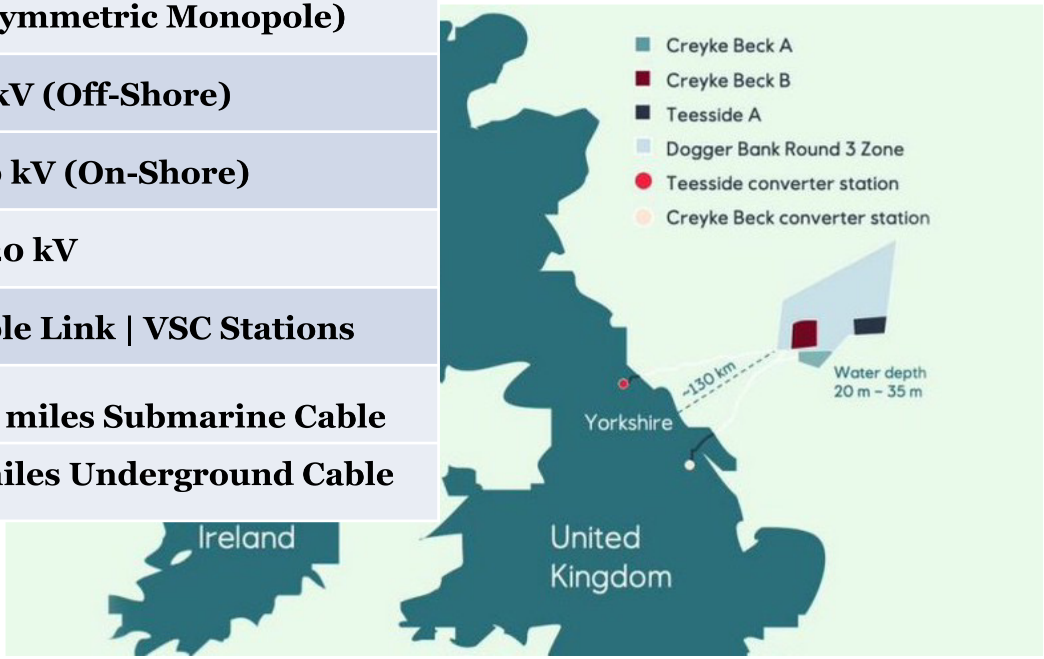
# Hitachi Energy Offshore Wind Project Examples

| Project Examples | | | |
|---|---|---|---|
| | Creyke Beck A | Creyke Beck B | Creyke Beck C |
| In-Service Year: | 2023 | 2024 | 2025 |
| Capacity Rating: | 1200 MW | 1200 MW | 1200 MW |
| No. of Poles: | 1 (Symmetric Monopole) | 1 (Symmetric Monopole) | 1 (Symmetric Monopole) |
| AC Voltage: | 66 kV (Off-Shore) | 66 kV (Off-Shore) | 66 kV (Off-Shore) |
| | 420 kV (On-Shore) | 420 kV (On-Shore) | 420 kV (On-Shore) |
| DC Voltage: | ±320 kV | ±320 kV | ±320 kV |
| Type of DC System: | Cable Link \| VSC Stations | Cable Link \| VSC Stations | Cable Link \| VSC Stations |
| Route Length: | 80 miles Submarine Cable | 80 miles Submarine Cable | 125 miles Submarine Cable |
| | 20 miles Underground Cable | 20 miles Underground Cable | 4 miles Underground Cable |

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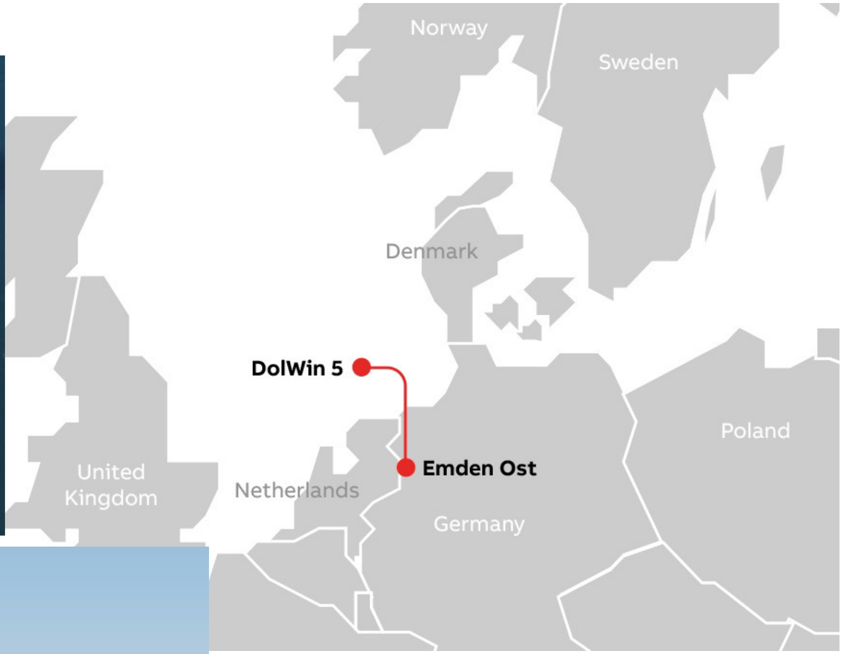
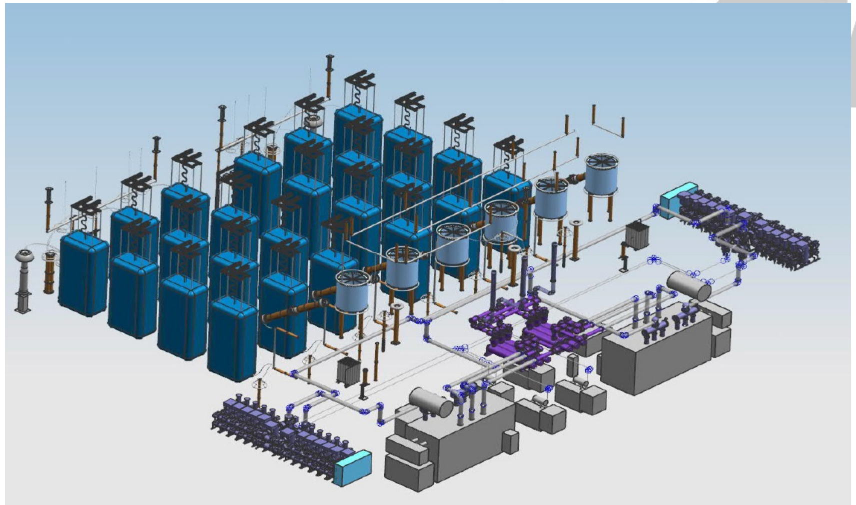
# Hitachi Energy Offshore Wind Project Examples

| DolWin 5 | |
|---|---|
| In-Service Year: | 2024 |
| Power Capacity Rating: | 900 MW |
| No. of Poles: | 1 (Symmetric Monopole) |
| AC Voltage: | 66 kV (Off-Shore) |
| | 380 kV (On-Shore) |
| DC Voltage: | ±320 kV |
| Type of DC System: | Cable Link \| VSC Stations |
| Route Length: | 62 miles Submarine Cable |
| | 19 miles Underground Cable |





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# Hitachi & Aibel Energy Offshore Wind Project Examples


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# Track record – Interconnectors (subsea and land)

Ongoing projects

**Kriegers Flak** (2015)
420 kV AC, 54 km

**Norned** (2008)
450 kV DC, 2x158 km

**Scotland Ireland** (2001)
250 kV DC, 2x65 km

**Amprion Raesfeld** (2013)
420 kV AC, 21 km

**Maritime Link** (2017)
500 kV DC, 340 km

**Vancouver Pole 1** (1969)
300 kV DC, 3x33 km

**Grand Bend WF** (2015)
300 kV AC, 105 km

**Cross Channel** (1985)
270 kV DC, 4x47 km

**Elia Stevin** (2015)
420 kV AC, 64 km

**DolWin6** (2022)
320 kV DC, 90 km

**Spain Mallorca** (2011)
250 kV DC, 242 km

**Cometa** (2011)
250 kV DC, 240 km, 1500 m depth

**Spain Morocco** (2005)
400 kV AC/DC, 2x27 km

**Bewag Berlin** (1999)
420kV AC, 17km

**Valhall** (2010)
150kV DC IRC, 300 km

**NSL** (2021)
525kV DC, 500 km

**Malta-Sicily** (2014)
245 kV AC, longest in the world

**Mon.Ita** (2015)
500 kV DC, 415 km

**Inner Oslofjord** (2018)
420 kV AC

**NordLink** (2020)
525 kV DC, 2x350 km

**Kahramaa Qatar** (2007)
420kV AC, 90km

**Gulf of Aqaba** (1997)
400kV AC/DC, 4x13km

**Fenno Skan 2** (2011)
500 kV DC, 200 km

**Estlink 2** (2013)
450 kV DC IRC, 150 km

**Skagerrak 1&2** (1976)
250 kV DC, 2x127 km

**Skagerrak 3** (1993)
350 kV DC, 127 km

**Skagerrak 4** (2014)
525 kV DC, 150 km

**Korea Cheju** (1993)
180 kV DC, 102 km

**Hong Yang** (2014)
550 kV AC, 46 km

**Shibo** (2007)
550 kV AC, 48 km

**Bejing Haidan** (2013)
550 kV AC, 20 km

**Hainan Guangdong** (2009)
525 kV AC/DC, 3x30 km

**Dubai Mamzar** (2010)
550 kV AC, 59 km

**Abu Dhabi (NASR)** (2017)
145 or 170 kV AC, 120 km

**Cook Strait** (1991)
350 kV DC, 3x40 km

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# Track record – Offshore Wind - Europe

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Ongoing projects


Nexans

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# APT Alliance Partner Hitachi Energy

## Company Overview

- 4 Business Units: Grid Integration, Grid Automation, HV Products and Transformers
- Business volume ~10 B USD
- 36,000 employees
- Majority ownership with Hitachi following Hitachi-ABB JV launch in summer of 2020

## Industrial Footprint

- Present in 90 countries | 115 factories globally
- World's largest installed HVDC base
- US headquarters in Raleigh NC with ~450 people
- US manufacturing examples: Virginia and Pennsylvania

## Anticipated scope for NJ OSW Transmission Facility

- Electrical design for complete solution and manufacturing of electrical components for HVDC converter stations
- Proven interfaces and clearly defined deliverables thanks to a 20-year collaboration with Aibel.

## Reference projects | renewable energy integration

- HVDC VSC technology (HVDC Light®) for offshore and onshore stations for the Dogger Bank A, B and C projects in the United Kingdom (3 × 1,200 MW, ±320 kV)
- Onshore and offshore HVDC Light® converter stations for DolWin 1, 2 and 5 projects in Germany (800 MW, 916 MW, 900 MW, ±320 KV)
- Onshore HVDC Light® converter stations for NordLink and North Sea Link projects between Norway and Germany and Between Norway and the UK (1,400 MW, ±525 kV)

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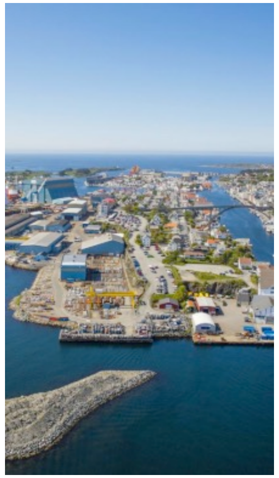
# APT Alliance Partner Aibel

## Company Overview

- EPC turnkey provider of offshore production platforms to the upstream Oil & Gas and Offshore Wind industry
- Annual turnover ~ 1.2 – 1.4 B USD
- 4,000 employees
- Privately owned, majority owner is FERD, a Norwegian investment company

## Industrial Footprint

- Yards in Norway and Thailand
- ~20 offshore O&M operations



## Anticipated scope for NJ OSW Transmission Facility

- Design, manufacturing, delivery and installation of HVDC platform and substructure (jacket)
- Proven interfaces and clearly defined deliverables thanks to a 20 year collaboration with Hitachi ABB on HVDC

## Selected reference projects

Project track record in oil & gas, oil & gas electrification (HVDC), offshore wind HVDC and floating wind. Examples:

- EPC contracts to supply the HVDC platforms for Dogger Bank A,B & C. (3x 1,200 MW, 320 KV)
- EPCIC contract to supply HVDC platform and onshore converter station for DolWin5 (900-1,200 MW, 320 KV)


DolWin 5 HVDC Platform – Aibel Patented GBS Technology

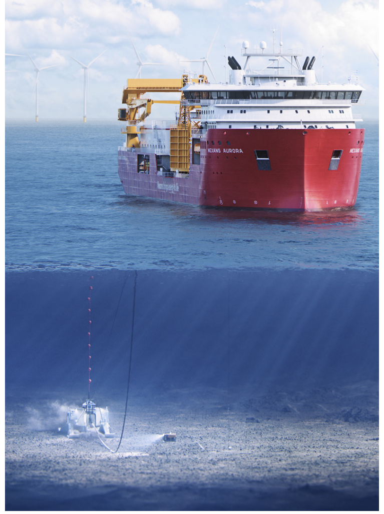
# APT Alliance Partner Nexans

## Company Overview

- Nexans global sales ~ 7 B USD; 25,000 employees
- Nexans Subsea & Land Systems (SLS) - End-to-end solution provider of high voltage projects
- 2,000 employees (SLS)
- Publicly traded, Quinenco is largest shareholder

## Industrial Footprint

- 6 plants and two cable laying vessels
- >500MEuro investments
- Charleston SC is only subsea HV cable plant in the US.



## Anticipated scope for NJ OSW Transmission Facility

- Design, manufacturing and installation of all cables, including beach crossings
- US facility and local team
- Proven collaboration with Aibel and Hitachi ABB

## Selected reference projects

25 GW of OWF enabled by Nexans, > 1500 submarine projects, > 10,000 Km of cables manufactured and installed. Examples:

- Frame agreement with Orsted for export cables (US)
- Preferred supplier to Equinor for two NY projects
- Nordlink (DC, 2x350km) and North Sea Link (DC, 500km)
- Contractor on >30% of all OWF project in Europe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