GCDF – Frequency control for PPMs

Review of current Grid Code requirements

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Scope of the Proposal

Review current requirement for frequency control of Power Park Modules (CC.6.3.7(a) and ECC.6.3.7.3.1(a)) to ensure it is fit for purpose for the offshore wind industry

- Outline of this presentation
  - Definitions, control design and Grid Code requirements
  - Current requirement vs. alternative solution (proposal)
  - Benefits of proposal
  - Propose change to Grid Code legal text

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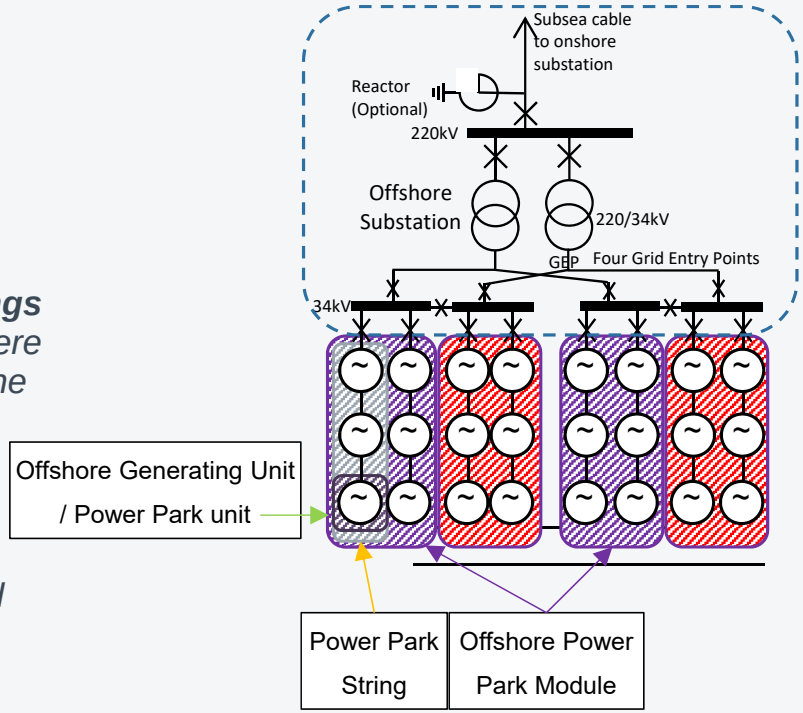
Grid Code Key Definitions

- Key definitions from the Grid Code (see diagram here)
  - Offshore Generator Unit / Power Park Unit
  - Power Park String
  - Offshore Power Park Module (PPM)

    *"A collection of one or more **Offshore Power Park Strings** (registered as a **Power Park Module** under the **PC**). There is no limit to the number of **Power Park Strings** within the **Power Park Module**, so long as they either:*

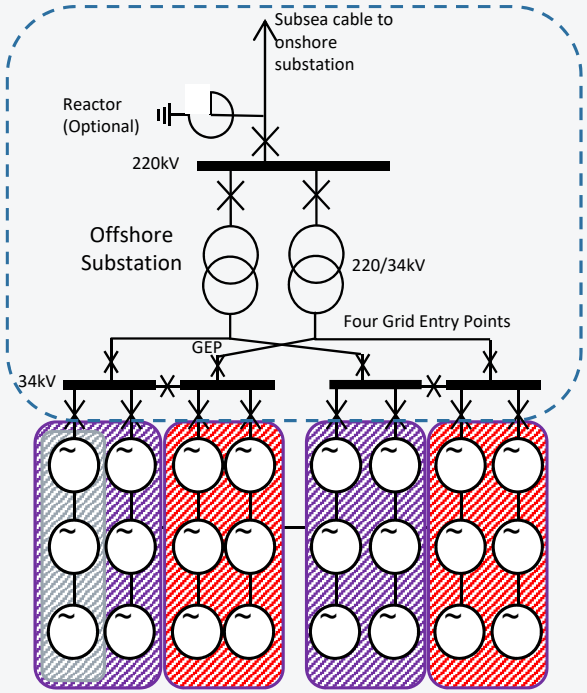
    (a) connect to the same busbar which cannot be electrically split; or

    *(b) connect to a collection of directly electrically connected busbars of the same nominal voltage and are configured in accordance with the operating arrangements set out in the relevant **Bilateral Agreement** ".*



Offshore Wind Farm Control Design Solutions

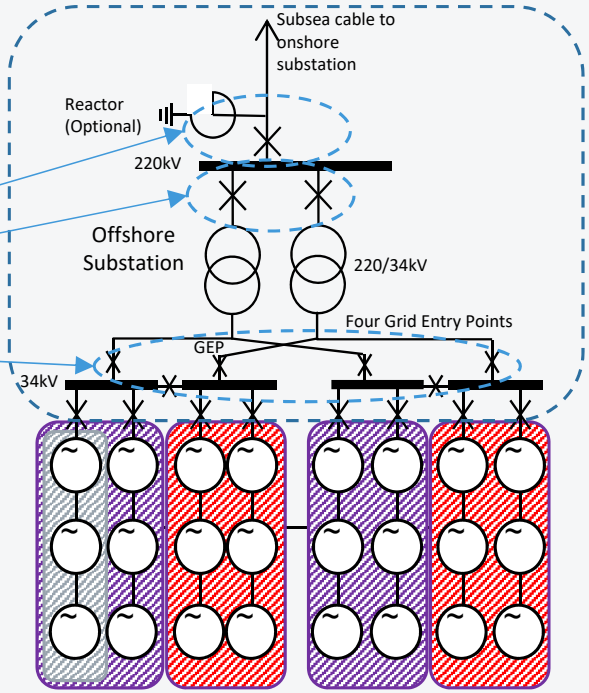
– Current control arrangements for Offshore wind farms



Offshore Wind Farm Control Design Solutions

– Current control arrangements for Offshore wind farms
  – Frequency control

Frequency control
- Respond to frequency variations to support the entire system



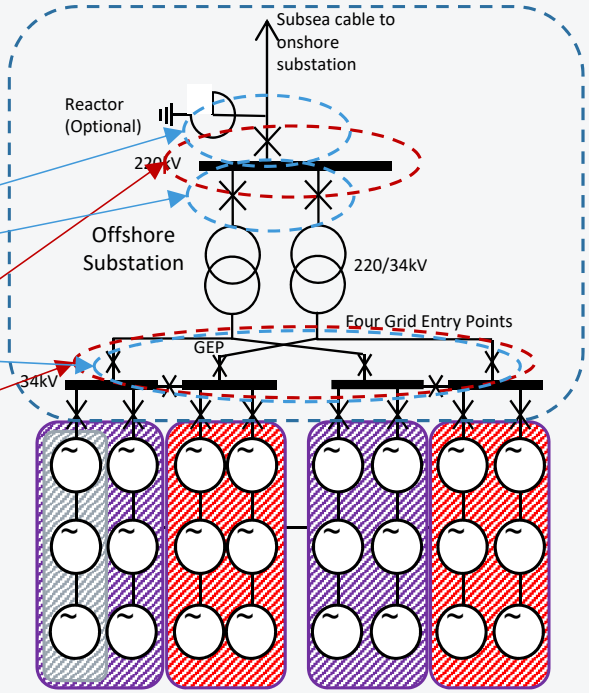
Offshore Wind Farm Control Design Solutions

- Current control arrangements for Offshore wind farms
  - Frequency control
  - Reactive power/Voltage control at offshore platform

Frequency control
- Respond to frequency variations to support the entire system

Reactive Power
- Maintain unity power factor at GEP
- Provide support to OFTO asset reactive power requirements

Voltage control
- Maintain constant voltage at OSS



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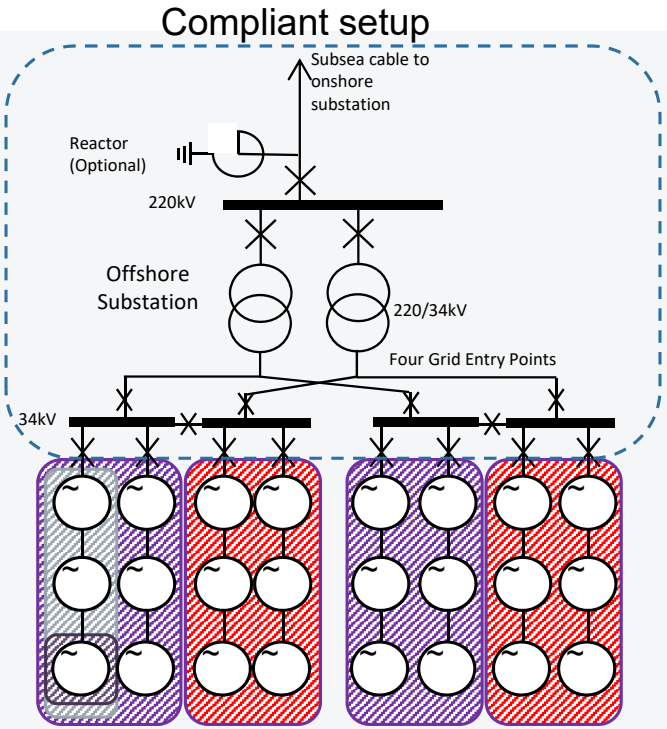
Frequency Control Requirement

– CC.6.3.7 (a)

*"Each **Generating Unit**, **DC Converter** or **Power Park Module** […] must be fitted with a fast acting proportional **Frequency** control device (or turbine speed governor) and unit load controller or equivalent control device to provide **Frequency** response under normal operational conditions in accordance with **Balancing Code 3** (BC3). In the case of a **Power Park Module** the Frequency or speed control device(s) may be on the **Power Park Module** or on each individual **Power Park Unit** or be a combination of both […]"*

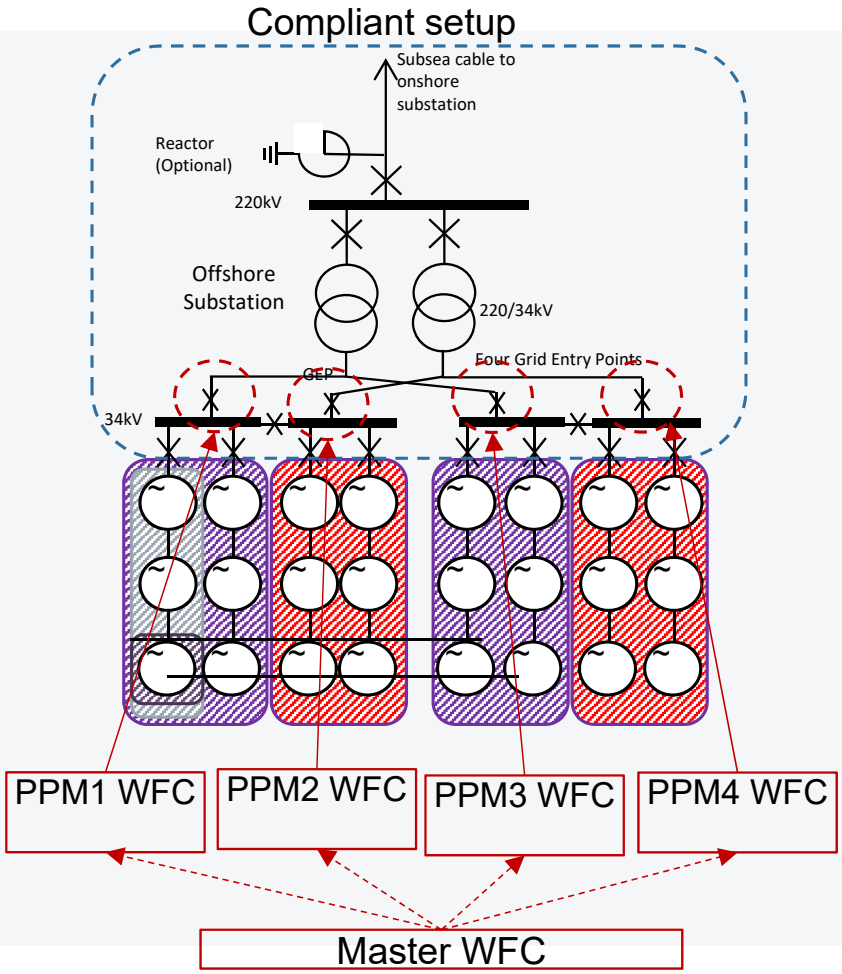
– ECC.6.3.7.3.1 (a)

*"In addition to the requirements of ECC.6.3.7.1 and ECC.6.3.7.2 each **Type C Power Generating Module** and **Type D Power Generating Module** (including **DC Connected Power Park Modules**) or **HVDC Systems** must be fitted with a fast acting proportional **Frequency** control device (or turbine speed governor) and unit load controller or equivalent control device to provide **Frequency** response under normal operational conditions in accordance with **Balancing Code 3** (BC3). In the case of a **Power Park Module** including a **DC Connected Power Park Module**, the **Frequency** or speed control device(s) may be on the **Power Park Module** (including a **DC Connected Power Park Module**) or on each individual **Power Park Unit** (including a **Power Park Unit** within a **DC Connected Power Park Module**) or be a combination of both. […]"*



Implication of Current Frequency Control Requirement and Proposed Solution

- The current requirement implies that
  - At least four Wind Farm Controllers (WFC) are required to meet the existing Grid Code requirement, one for each PPM.
  - A Master Wind Farm Controller (Master WFC) may be required to coordinate the four individual WFCs.
  - Depending on the way the reactive power / voltage is controlled and the location of the measuring point, additional control systems including additional measurement points may be required
  - Multiple BM Units could be required for this solution



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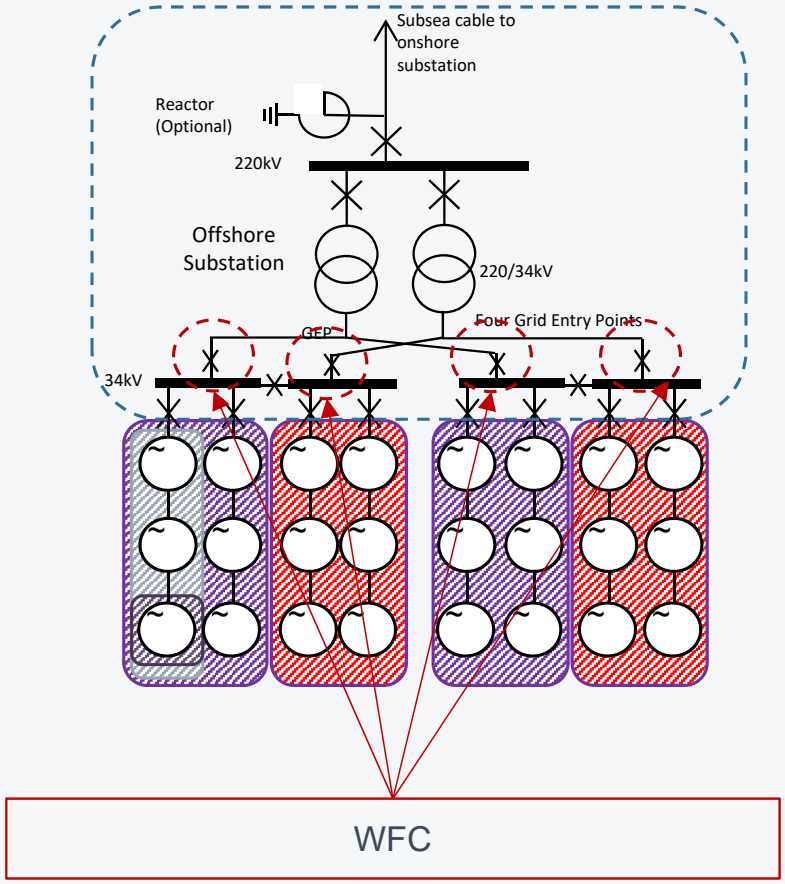
- A solution with a single WFC would offer a less complex solution and meet the same objective of the Grid Code requirement
  - Frequency could still be controlled providing the same compliant response
  - Less control systems would be required (4+1 vs. 1)
  - A Combined BM Unit could be defined here, simplifying both operation and control of the wind farm for both User and NG

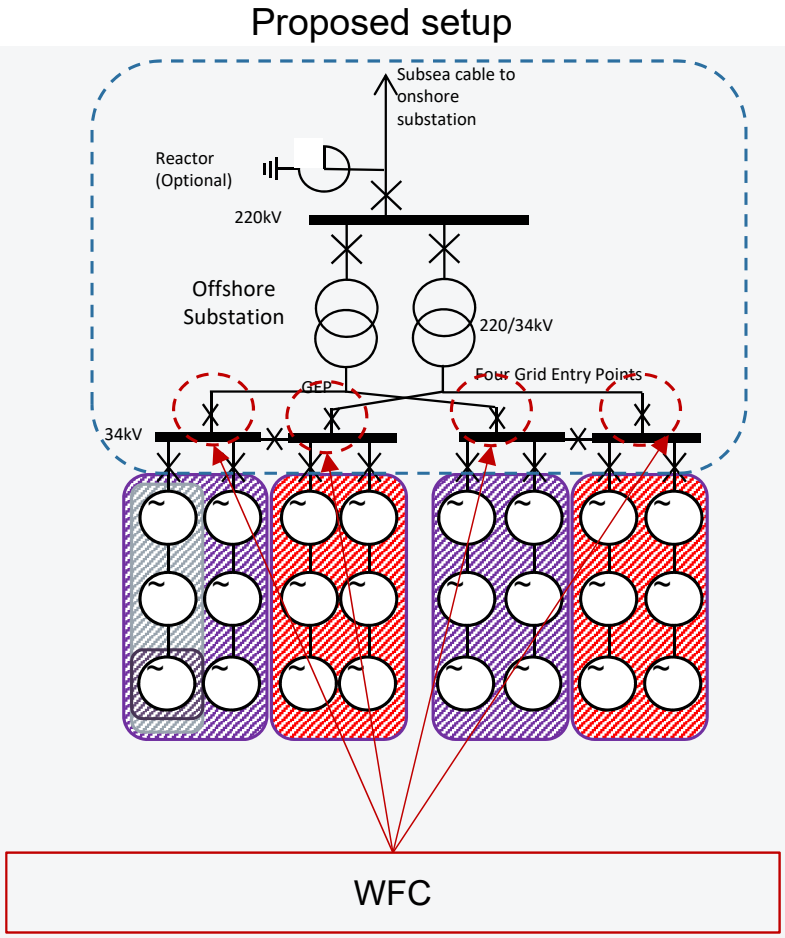
Proposed setup



Benefits of the Proposed Solution

Advantages of a solution with one WFC

– CAPEX reduction between £320-400k per offshore platform

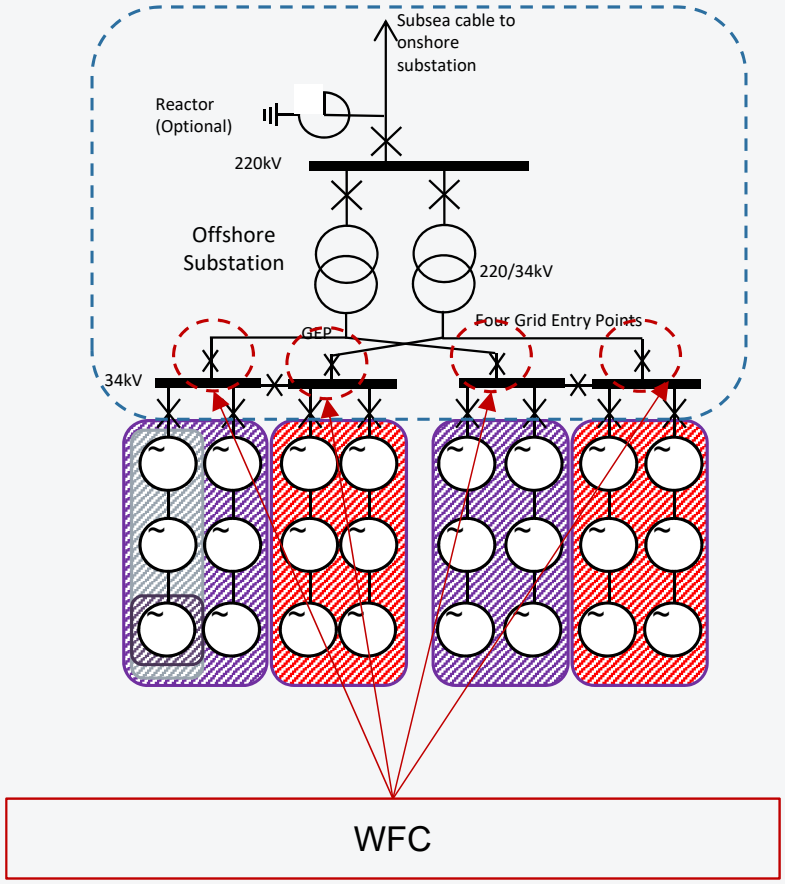


Benefits of the Proposed Solution

Advantages of a solution with one WFC

- CAPEX reduction between £320-400k per offshore platform
- Use of a Combined BM Unit for the entire Offshore platform
  - Better optimisation of the power output from the individual wind turbines on a second by second basis, under both normal operation and when there are outages
  - Higher energy capture during curtailment scenarios

Proposed setup



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- The reactive power / voltage control performed with a single WFC will eliminate the risk of instability due to multiple WFCs controlling the same point and reduce the risk of limiting the support that can be provided to the OFTO

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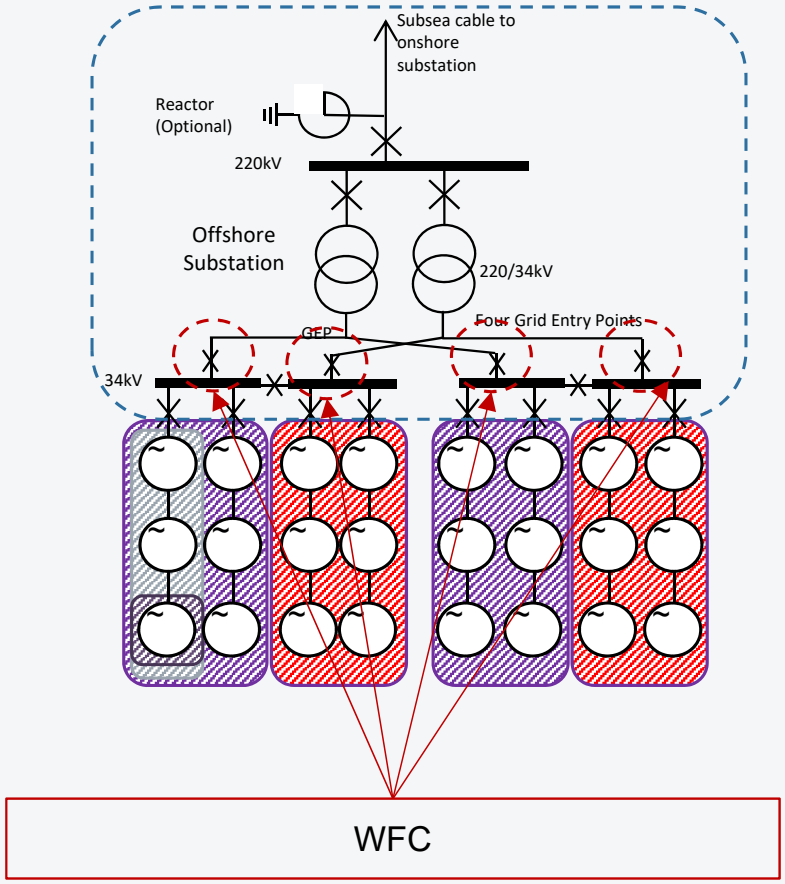

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- Simpler and less error-prone system

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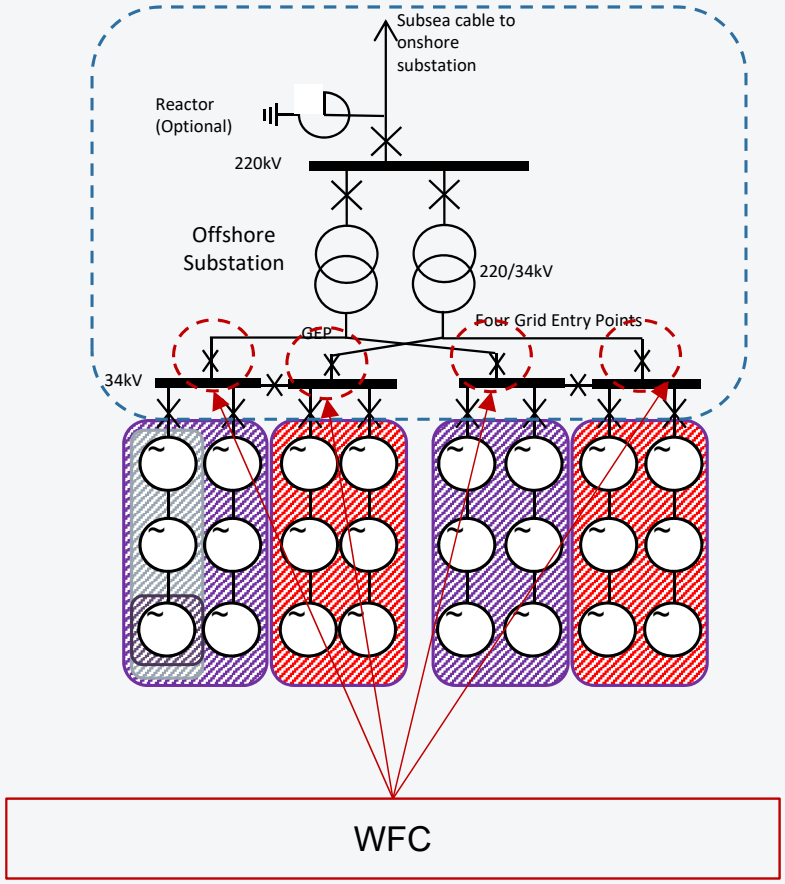

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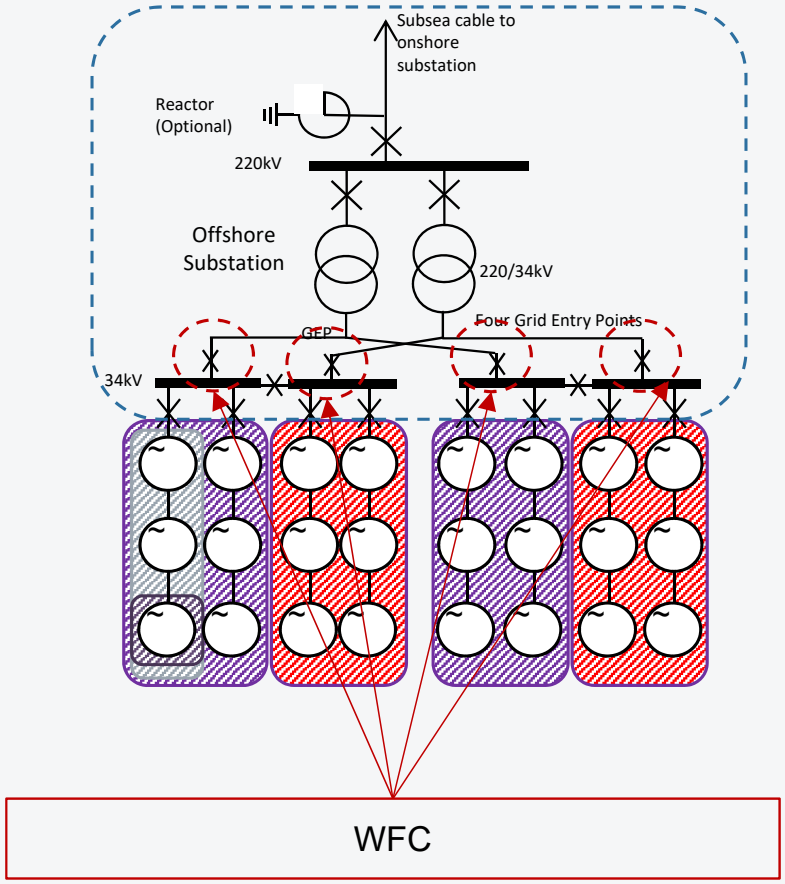
  - Higher energy capture during curtailment scenarios
- The reactive power / voltage control performed with a single WFC will eliminate the risk of instability due to multiple WFCs controlling the same point and reduce the risk of limiting the support that can be provided to the OFTO
- Simpler and less error-prone system
- Ørsted experience is that there is no visible benefit in having multiple WFCs for an offshore wind farm, mainly due the way the frequency control system is designed.

Proposed setup



Proposed Legal Text Change for CC.6.3.7

Proposal: modify the Grid Code requirement in CC.6.3.7 to allow wind farm developers to choose either solution for the control of frequency in the system

*"Each **Generating Unit**, **DC Converter** or **Power Park Module** […] In the case of a **Power Park Module** the Frequency or speed control device(s) may be*

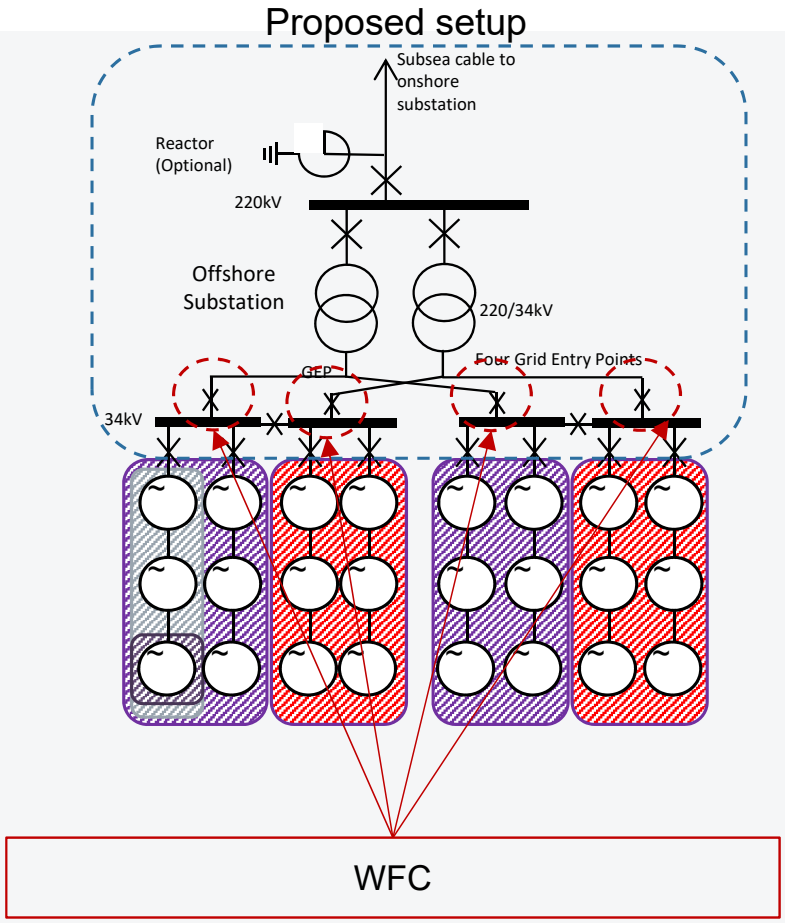
*i) on the **Power Park Module;** or*

*ii) on an aggregation of **Power Park Modules** which are registered under the same **BM Unit**; or*

*iii) on each individual **Power Park Unit**; or*

iv) a combination of i) and iii) or a combination of ii) and iii).

[…]"



Proposed Legal Text Change for ECC.6.3.7.3.1(a)

Proposal: modify the Grid Code requirement in ECC.6.3.7.3.1 (a) to allow wind farm developers to choose either solution for the control of frequency in the system

"*In addition to the requirements of ECC.6.3.7.1 and ECC.6.3.7.2 […] In the case of a* ***Power Park Module*** *including a* ***DC Connected Power Park Module****, the* ***Frequency*** *or speed control device(s) may be*

- *i) on the* ***Power Park Module*** *(including a* ***DC Connected Power Park Module****);* *or*
- *ii) on an aggregation of* ***Power Park Modules*** *(including a* ***DC Connected Power Park Module)*** *which are registered under the same* ***BM Unit****; or*
- *iii) on each individual* ***Power Park Unit Unit*** *(including a* ***Power Park Unit*** *within a* ***DC Connected Power Park Module****) ; or*
- *iv) a combination of i) and iii) or a combination of ii) and iii).*

[…]"