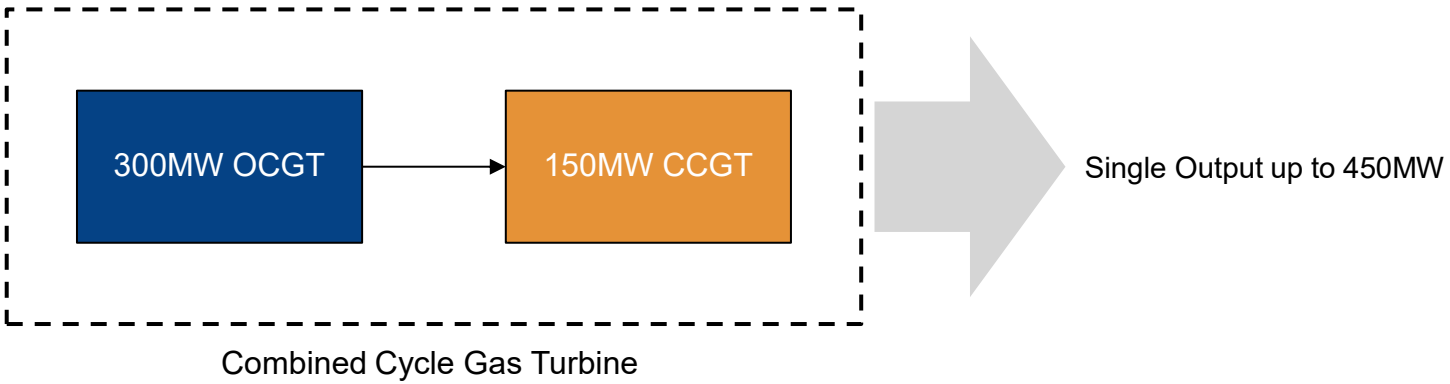
EP UK Investments

A member of the EPH Group

CMC Modification – Introduction of Modular Generator Unit Types and De-Rating Methodology
Capacity Workshop 45

Background – CCGTs

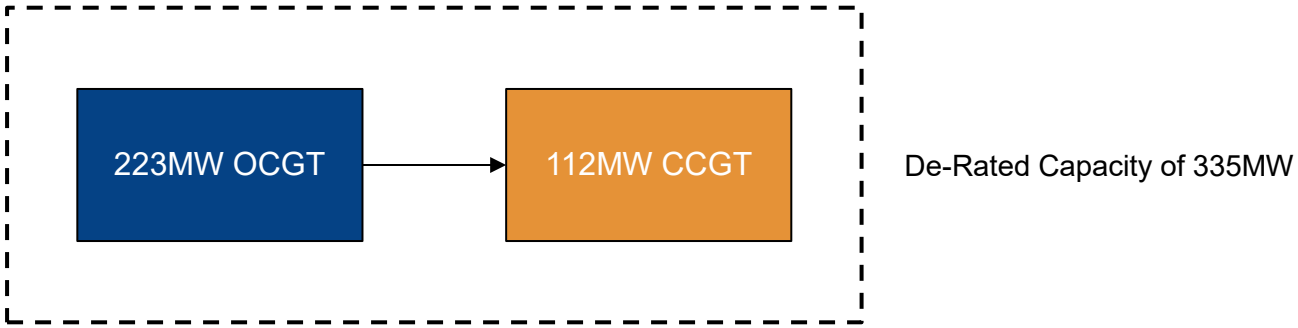
- Combined Cycle Gas Turbines typically consist of a single gas turbine which feeds a separate closed component to increase efficiency of operation and reduce emissions.
- Some Combined Cycle Gas Turbines (**CCGTs**) are capable of operating in combined mode only. Such an arrangement is outlined in the diagram below. This is usually when both turbines are mounted on a single shaft and/or lack of a by-pass stack to enable exhaust gasses from the OCGT to avoid the CCGT.
- This means that the combined modules of the CCGT are not capable of separate outputs.



Background – De-Rating Treatment of CCGTs

- These types of CCGTs are de-rated based on the de-rating curve and the combined capacity value of the CCGT components. This is because the unavailability of one component would mean the entire unit is unavailable.

- Using the T-4 2029/2030 de-rating factors, this would result in a 450MW CCGT being de-rated by 0.744, giving a de-rated value of 335MW.

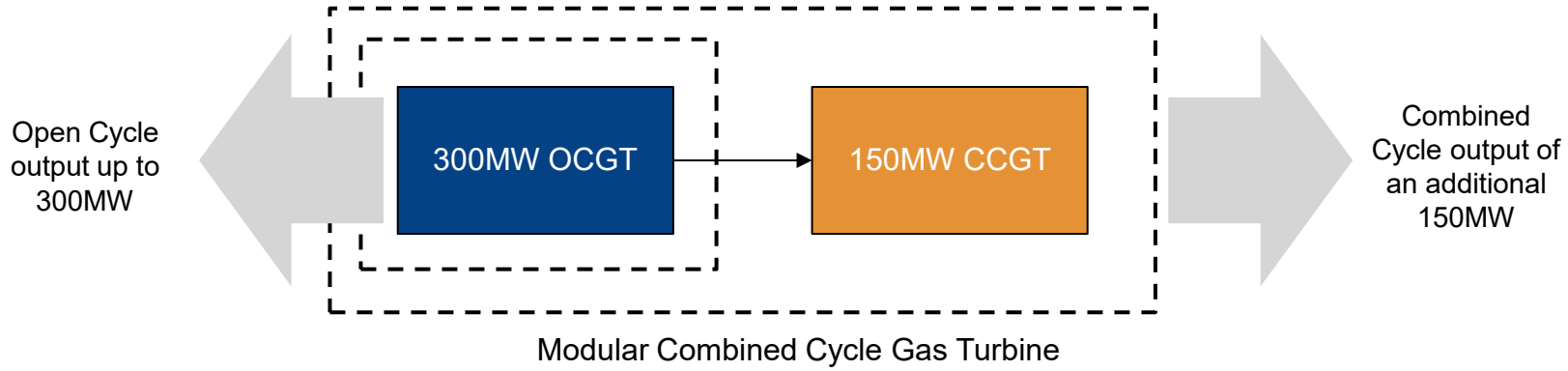


Combined Cycle Gas Turbine – De-Rated Capacity

Background – Modular CCGTs

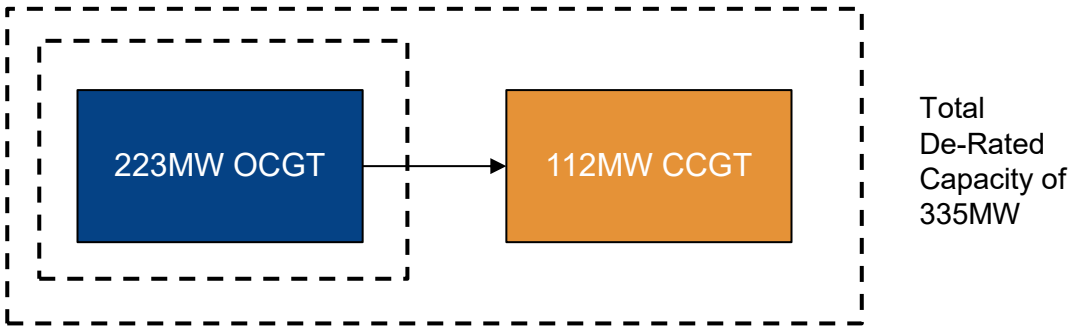
- This modification relates to a proposed new unit type; a Modular CCGT. This unit would be a CCGT which is capable of operating and exporting both on open mode only, and in combined mode.

- This arrangement offers greater flexibility to the Grid allowing the unit faster start times (operating in gas mode only), while being capable of higher efficiency and higher overall capacity. Additionally, these units have increased availability due to the fact that the gas turbine can still be dispatched if the closed component is unavailable.



Background – De-Rating Treatment of Modular CCGTs

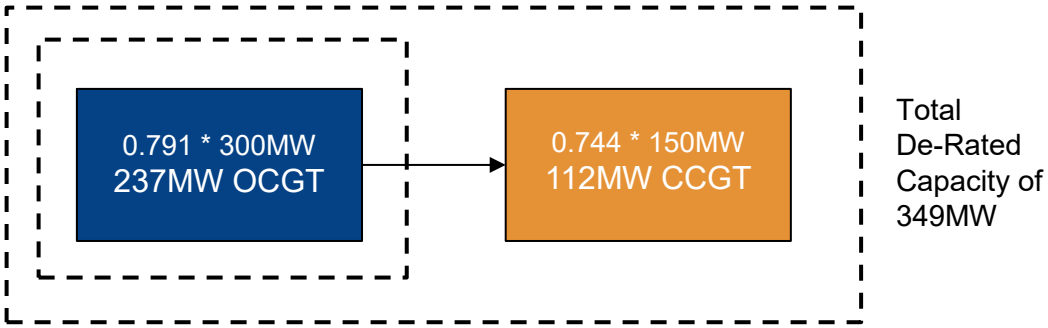
- Under the current arrangements, a modular CCGT unit is de-rated based on its combined capacity. This approach means that the reliability of the OCGT component of the combined unit is disproportionately low.



Modular Combined Cycle Gas Turbine De-Rated Capacity

Proposed Modification

- This modification proposes a new unit type introduced to the Capacity Market Code to reflect Modular Unit Types which consist of separate components combined with a single generator unit.
- This unit type would be relevant only with respect to Section E.8 of the CMC, where de-rated capacity of units is calculated.
- This modification proposes that each of the components consisting of a single Modular Unit is de-rated individually and then summed. This is consistent with the existing treatment of Aggregated Generator Units in the CMC.
- The proposed change primarily affects the open cycle element of the modular unit. In the below example the closed component is de-rated using the 450MW de-rating factor.

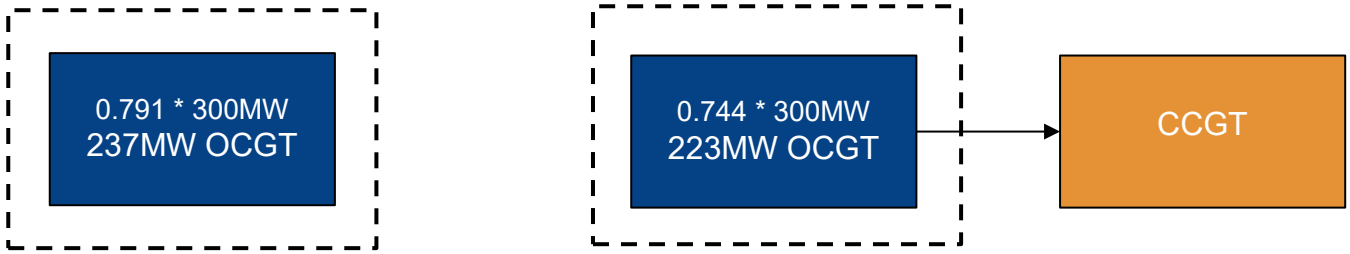


Modular Combined Cycle Gas Turbine Proposed De-Rated Capacity

Rationale

- Under the current arrangements, a standalone OCGT would have a higher de-rated capacity than an identical OCGT which feeds a closed component of a CCGT but is capable of independent dispatch. This is not rational as the feed-in to the closed component is an output to the OCGT generating and thus should not affect reliability of the unit.

- The use of the combined volume for determining the de-rating factor of the closed component reflects its reliance on the open cycle generator.



An identical OCGT would “lose” 14MW de-rated capacity when its output is used to feed a separate CCGT component

Rationale

- The proposed modification would de-rate each component of a modular unit separately. This would result in a higher total de-rated capacity for modular units and a more accurate de-rated capacity for the open-cycle component.

- More accurate de-rated capacity would support investment in modular CCGTs. These units provide benefits to the system through their flexibility. The open-cycle portion of a modular CCGT can start rapidly to provide support generation alongside wind and solar, while the closed-cycle component allows more efficient and less carbon intensive generation.

- The current arrangements penalise the OCGT portion of a modular CCGT for increased efficiency, which does not affect the reliability of the unit.

Example

Current Arrangements

Open Cycle Capacity (MW)	300
Closed Cycle additional Capacity (MW)	150
Combined Capacity (MW)	450
Gas Turbine DRF at 450MW	0.744
Open Cycle De-Rated Capacity: 300 MW * 0.744 (MW)	223.2
Closed Cycle De-Rated Capacity: 150 MW * 0.744 (MW)	111.6
Total De-Rated Capacity: 450MW * 0.744 (MW)	**334.8**

Proposed Arrangements

Open Cycle Capacity (MW)	300
Closed Cycle Capacity (MW)	150
Combined Capacity (MW)	450
Gas Turbine DRF at 300MW	0.791
Gas Turbine DRF at 450MW	0.744
Open Cycle De-Rated Capacity: 300 MW * 0.791 (MW)	237.3
Closed Cycle De-Rated Capacity: 150 MW * 0.744(MW)	111.6
Total De-Rated Capacity: (MW)	**348.9**

Drafting

- The modification introduces the following definitions to the Code:

  Modular Generator Unit: A configuration consisting of at least one Generator Unit and at least one Incremental Generator Unit.

  Incremental Generator Unit: Means a power plant or any similar apparatus that generates electricity (including all related equipment) with capabilities for delivering energy to the Transmission System or Distribution System and which is part of a Modular Generator Unit or Connected to the Transmission System or Distribution System, which is not capable of functioning as a single entity.

- The definition of Modular Generator Unit is employed for the purpose of Section E.8.1 and E.8.2 only.

- The definition of Incremental Generator Unit is intended to reflect the closed component of a modular generator. This definition is drafted to mirror the existing definition for generator, with the key difference that an incremental generator is not capable of "*functioning as a single entity".*

- Thus for a modular CCGT, the OCGT component would fit the existing definition of a Generator, and the closed component (which requires an in-feed from the OCGT thus not functioning as single entity), would be an Incremental Generator Unit. Together these units would form a Modular Generator Unit.

Drafting

- A Modular Generator Unit would be de-rated using the following formula:

$$GDRCN = Max\left[0, \sum_{i \neq VU} Min[DRFT_i \times ICT_i \times (1 + INCTOL_i), Max[DRFT_i \times ICT_i \times (1 - DECTOL_i), NDRVE_i + NDRVN_i\right] \times ADRFT + \sum_{i=VU} Min[DRFT_i \times ICT_i \times (1 + INCTOL_i), NDRVE_i + NDRVN_i] - GDRCE \times ADRFT$$

- This formula calculates a separate de-rated capacity for each Generator Unit or Incremental Generator Unit comprising a singular Modular Generator Unit, and sums the total to calculate the de-rated capacity of the Unit. This is similar to the existing treatment of Aggregated Generator Units.

- The Annual Run Hour Limit de-rating factor has been taking outside the summation. This is because individual components of the Modular Generator Unit do not have individual run-hour limits.

- The definition of DRFT is the de-rating factor of the relevant Technology Class at the volume of the Generator Unit or Incremental Generator Unit combined with the volume of any other Generator Unit. This means that the DRF for the Generator Unit will consider the capacity of the Generator Unit only, while the closed component will consider the combined volume of the Modular Unit.