Ministry of Business, Income and Employment - Hikina Whakatutuki

MODELLING ASSUMPTIONS FOR FOSSIL-FUELLED PEAKER GENERATION

SUPPLEMENTARY TO NZ BATTERY OTHER TECHNOLOGIES FEASIBILITY STUDY

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MODELLING ASSUMPTIONS FOR FOSSIL PEAKER GENERATION

SUPPLEMENTARY TO NZ BATTERY OTHER TECHNOLOGIES FEASIBILITY STUDY

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1	21-Apr-2023	First Draft Issue
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	NAME	DATE	SIGNATURE
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Reviewed by:	NTM / RTJ	21-Apr-2023	

1 BACKGROUND

WSP has previously provided a high-level investigation of the possibility of installing Green Peaker generation plant to provide generation with a low utilisation and using imported biodiesel.

Building upon the Green Peaker work, WSP has been asked to carry out a high-level exercise to determine indicative costs of operating a peaker plant with imported LNG (a Fossil Peaker). In both cases (Green Peaker and LNG), the sourcing and costing of imported fuel has been undertaken by parties contracted separately to MBIE. WSP's role has been to investigate capex and non-fuel opex costs, and provide related information for these options.

LNG is commonly carried in purpose-designed ships at cryogenic temperatures. Unloading is commonly to a floating storage unit, which in turn supplies the LNG to a gasifier. Gas is then compressed as necessary for supply to either gas turbines or into a pressurised gas line.

WSP has obtained, at agreed level of accuracy, capex and related data for typical floating LNG storage and gasification units, and for pier construction if required. This data has been incorporated with capex data for OCGT installations that was assembled in the course of the Green Peaker analysis.

2 BASIS OF FOSSIL PEAKER CONCEPT

2.1 KEY REQUIREMENTS

WSP was provided with some high-level requirements from MBIE as part of the brief, including:

- Plant Purpose: As peaker plant in dry, calm, cloudy periods, coinciding with high electricity demand, i.e. relatively infrequent use during some evenings and mornings, typically concentrated in winter months.
- LNG Fuel delivery time frame: 6-8 weeks once ordered
- LNG Fuel ship capacity: ~4-5 PJ
- Generation Plant fuel demand: Min: 0 PJ/annum, Typical: 4-6 PJ/annum (260 TJ/d), Max: 20 PJ/annum *(In a high-use year, this level of daily use might be maintained for several weeks)*

Therefore, a solution should comprise LNG importation infrastructure plus a storage facility which combined can provide:

- The typical 4-6 PJ/annum requirement (~4~6% Utilization of plant rated for 260 TJ/d)
- Up to 20 PJ of volume per annum (~20-25% Utilization of plant rated for 260 TJ/d)

2.2 KEY ASSUMPTIONS

Key assumptions include:

- Considerations and costs relating to the supply and delivery of the LNG fuel to the port are being covered separately by MBIE's 3rd party.
- Assessments of feasibility of port options have been made at a very high level. These would require careful investigation and are dependent on the plans of existing owners.
- Potential underground gas storage exists at the Ahuroa storage facility, with a storage capacity of ~10 PJ (from MBIE). WSP have no specific knowledge on available capacity, integrity, or leak rate, etc. at this facility.
- We have not assessed the possible regulatory barriers to transporting imported natural gas via New Zealand's gas pipe and storage systems. We have also not considered the commercial issues related to such transport and storage.
- While indicative cost data has been obtained for LNG storage, we have not assessed availability of plant. Most floating storage and regasification units (FSRU) are leased rather than purchased outright. We have used capex costs identified for purchase of FSRUs. Should a decision (based on expediency) be to lease, it is expected the NPV of the lease to equate (within cost estimate accuracy limits) to the purchase price.

2.3 KEY PARAMETERS

The alignment of the assumed plant(s) to the high level requirements are summarised as follows:

- The peak load (gas) was indicated as 260 TJ/d. This is equivalent to a generation capacity of about 1200 MW by 2065. The generation plant assumed is identical in type and size increments to the plant proposed for the green peakers.
- With Ahuroa storage facility accommodating approximately 10 PJ of gas and LNG fuel ship capacity of about 5 PJ each, we have assumed that two FSRU's, each approximately equivalent to a 5 PJ shipment would be installed. This offers a combined maximum storage capacity of 20 PJ when combined with Ahuroa underground storage facility. Two FRSUs also offer the most practicable solution when considering the logistics of receiving incoming LNG shipments i.e. when a ship docks, it needs to be able to discharge completely in the shortest time or large demurrage charges result (hence the importance of having an FSRU that is empty and capable of receiving the complete cargo).
- An alternative, lower cost option based on a nominal 15 PJ maximum gas storage solution, would be to have only one FRSU at Taranaki. An alternative costing for this option has been provided in the costing table.
- Investigations indicate that strategically located OCGT sites in suitable North island port nodes other than Port Taranaki could be modified to provide the unloading and LNG storage and gasification capacity required. Each option would incur different issues however it appears that total capex and opex are similar, therefore WSP has not assumed a choice between these sites given the level of information available at this stage.

3 ASSESSMENT

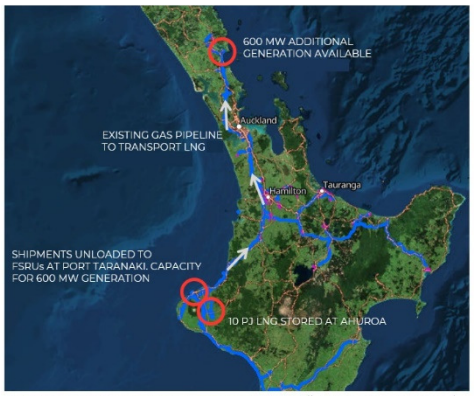
3.1 OPERATIONAL MODE

An operational mode has been assumed for the purposes of this assessment. While significant details have not been able to be confirmed in the course of this analysis, the operational mode is considered to be sufficiently reasonable to allow major cost components to be identified and to allow an early-stage evaluation of the option by the client. The proposed approach is as follows:

- **LNG Off-loading** Use modified port Taranaki facilities for off-loading, requiring two new (leased) FSRU including gasification units. LNG vessels would dock alongside either FRSU while unloading.
- **OCGTs** Locate half of OCGT's in the vicinity of the Port of Taranaki, and the other half strategically located in suitable North island Northern or Central nodes.

Taranaki OCGT Node Gasification at Taranaki is used to operate 'normal' peaker usage directly from 2 off FSRU gasifiers, with additional boil-off plus the amount to cover expected annual usage piped and compressed to Ahuroa. Peaker plant operated directly from the gasification unit minimises the flow demand via the pipeline to Ahuroa.

Northern / Central North Island OCGT Nodes Locate half of OCGT capacity close to one or both of these locations. These draw from Ahuroa, when required. These OCGT's come into action when Taranaki OCGT's are at full load. We note the existence of OCGT and CCGT plant already Centrally located, and that pipeline capacity also allows this peaker plant capacity to be serviced.



Background image sourced from Firstgas open data, https://data-firstgas.hub.arcgis.com/

3.2 COST INFORMATION

The basis of cost estimates for generation plants are based on comparisons to similar projects globally (equivalent to a Class 5 P50) and referring to the previous green peaker work for OCGT plant costs. The specific cost items for the LNG option (as provided in the cost table) include:

- Port costs include breakwater, receiving terminal and other facilities modification at Port Taranaki
- Floating reception/storage vessels and integral regasification units (FRSU). Based on high level capex costs identified for purchase of FSRUs.
- Pipeline to shore
- Compressors for connections to national gas system at Taranaki
- Development and owners costs are included in the Capital costs – Plant costs for the OCGTs
- As per the NZ Battery Project Feasibility Study AACE guidelines approach, we have added an appropriate contingency to the base estimate to arrive at the P50.

OFF GE LMS-100 OCGTs (1,200 MW installed 2065)	*$ = NZD 2023*
Approximate ramp rate / type of duty	8 min. cold start time, 50 MW/min. ramp rate, emergency ramp speeds of up to 500 MW/min.
Efficient scale of generation (MW)	100 MW units
Capital costs	
Plant costs	OCGT $2,600m (total for 12 x 100 MW GT's)
Off sites / receiving terminal, transport etc	Port $350m Each FSRU $650m [2 x FRSU 20 PJ option = $1,300m] [1 x FRSU 15 PJ option = $650m] Compressor $90m Ahuroa gas storage & transition: No additional capital provided. TOTAL $1,740m [2 x FRSU 20 PJ option] TOTAL $1,090m [1 x FRSU 15 PJ option]
Grid connection costs	$50m
Asset life	30 years
Variable costs	
Specific fuel consumption / conversion efficiency	42.6% net efficiency (LHV) LNG fuel costs ($ / MWh) delivered to port as determined by the MBIE's external 3rd party.
O&M	Variable O&M Cost $13.8 / MWh Annual OCGT O&M $70m Annual LNG infrastructure O&M $90m (includes 26m berth and port O&M + 64m FSRU O&M) Total Annual O&M cost $160m / year
Risks	
Overall risk parameters, as pertains to technology readiness and commercial procurement	The GE LMS-100 is a commonly installed OCGT Availability and leakage rate of Ahuroa storage