Determination of Critical Contingency Price
in respect of the critical contingency of 23rd May 2017

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Introduction

1. This report sets out my determination of a Critical Contingency Price as required by the Gas Governance (Critical Contingency Management) Regulations 2008 ('the Regulations'). The Critical Contingency Price is required in respect of the critical contingency of 23rd May 2017.

2. Under the Regulations a critical contingency is triggered when the operating pressure reaches a low threshold which defines the pressure required to "maintain the supply of gas across the relevant part or parts of the transmission system and to avoid disruption of distribution systems connected to the transmission system" (Regulation 25(1)(a)(iv)).

3. The Critical Contingency Price is defined and applied retrospectively to contingency imbalances with the aim of ensuring efficient allocation of gas during the critical contingency.

4. This report and price determination is updated from an initial report (dated 27th June) and price estimate discussed at a workshop with interested parties on 3rd July 2017, followed by written submissions.

5. My final determination is that the critical contingency price for 23rd May 2017 is $10.62/GJ. The explanation is given below.

The Event

6. A Critical Contingency was declared on Tuesday 23rd May when the gas pressure threshold at the Kapuni Gas Treatment Plant (KGTP) (3 hours to 37.5 bar g) was breached.[1]

7. The cause was falling linepack in the Maui pipeline because of:
   - downstream delivery points taking significantly more gas than was scheduled to be injected into the Maui pipeline, and
   - a planned outage at the Pohokura Production Station (PPS) between 6.30 and 11am.

8. PPS injected additional gas before the start of the outage, but this was insufficient to avoid the demand-supply imbalance. Breaching of the Critical Contingency

[1] Critical Contingency Operator (2017) Critical Contingency Incident Report. System Imbalance 23 May 2017. Prepared in accordance with the Gas Governance (Critical Contingency Management) Regulations 2008

threshold at KGTP was noted at 10.33 am, the Critical Contingency was determined by the CCO at 10.50am and a Declaration Notice was issued at 11.14am.

9. Following the outage, PPS had started flows of 0.4TJ/hr by 10.35am, reached a flow rate of 5.4TJ/hr by 12.55pm, 7.6 TJ/hr by 1.55pm, 7.8TJ/hr at 2.55pm and 8.7TJ/hr at 3.55pm. Linepack in the Maui pipeline fell from 267TJ at 7am to a low of 231TJ at 12.55pm before stabilising and starting to rise. Linepack had risen slightly to 234TJ by 5.55pm and the system was regarded as stable at that point, with no increased demand expected.

10. The Critical Contingency was ended at 6.15pm, a total duration of 7 hours and 25 minutes.

11. Neither curtailment nor increased production was required during the Critical Contingency.

Concepts Relevant to Setting a Critical Contingency Price

12. The purpose of the critical contingency price and guidance on setting price is provided under Sections 67 and 71 of the Regulations (Box 1).[2]

13. Section 71 describes how to set the critical contingency price, but this needs to be interpreted in the light of the overall purpose of the price (Section 67). The price needs to:
    - encourage available supply;
    - signal scarcity; and
    - provide incentives to retailers to make arrangements to minimise the financial consequences of a critical contingency if one was to occur.

14. The implications of this are that the price should be relatively high, and certainly higher than market price expectations in the absence of a critical contingency. In addition, and importantly, because the price is determined and applied retrospectively, it can only achieve its objectives if it is (broadly) predictable by market participants. Given this, an important consideration for the process of determination is that the methodology used is both consistent with the regulations and builds on historical precedent, such that participants might reasonably estimate the final determined price.

15. In the critical contingency of 23rd May 2017 there was no curtailment as defined under the Regulations. This means that the relevant Sub-Sections of Section 71 which must be taken into account are 1, 2 and 3(b)(i) 3(b)(iii) only, ie the price must:
    - be in $/GJ;
    - be set to reflect a price that would allocate gas efficiently during the contingency; and

[2] Sections 68 to 70 address the appointment of the industry expert

- be set taking into account prices in the wholesale electricity market and any other matters relevant to allocating gas efficiently during the critical contingency.

Box 1 Regulatory Sections relating to Critical Contingency Price

67. **Purpose of applying critical contingency price to contingency imbalances**

The purpose of regulations 68 to 71 is to determine a critical contingency price to be applied to the contingency imbalances sustained by interconnected parties and shippers during a critical contingency to—

(a) avoid shippers instructing their suppliers of gas to reduce supply during a critical contingency when those shippers' consumers have been curtailed; and

(b) signal to suppliers and consumers of gas that it is a scarce and valuable product during a critical contingency; and

(c) provide incentives before a critical contingency, particularly for retailers who supply gas to consumers who are unlikely to be curtailed, to make alternative arrangements to minimise the financial consequences of a critical contingency.

71. Determining critical contingency price

(1) The industry expert must determine the critical contingency price in dollars per gigajoule of gas.

(2) The industry expert must seek to set the critical contingency price at a level that reflects the price that would be established by an efficient short-term market that allocated scarce gas resources to the highest value uses during the critical contingency.

(3) If—

(a) only consumers in curtailment bands 0 and 1a, or 0, 1a, and 1b, were curtailed during the critical contingency, the industry expert must base his or her determination on the prices in the wholesale market for electricity during the critical contingency except where that would be contrary to subclause (2); and

(b) any other circumstances apply, the industry expert must take into account the following matters:

(i) the prices in the wholesale market for electricity during the critical contingency; and

(ii) the economic cost of the loss of gas supply to those consumers who had their gas supply curtailed; and

(iii) any other matters that the industry expert considers relevant to achieving subclause (2).

Source: Gas Governance (Critical Contingency Management) Regulations 2008

Approach Used to Define the Critical Contingency Price

Previous Critical Contingencies

16. There have been three previous analyses of a critical contingency price as summarised in Table 1 and discussed in turn below. This is relevant to the latest incident because of the importance of precedence, as discussed above (paragraph 14).

Table 1 Estimates of Critical Contingency Price for previous events

Date	13 July 2010	20 April 2012	24 May 2016
Duration	3 hours	11 hours	4 hours 30 minutes
Curtailment	None	Curtailment of bands 0, 1a and 1b	None
Measurement approach	Price paid in balancing gas market	Netback of gas price that would curtail Southdown but not CCGTs	Netback of gas price for e3P
Critical contingency price	$15/GJ	$11.10/GJ	$6.66/GJ

13th July 2010

17. In 2010 there was a critical contingency lasting approximately 3 hours. There was no curtailment and a price of $15/GJ was set based on prices paid for balancing gas on the day.[3]

18. The industry expert (Dr John Small) considered electricity generators as possible providers of gas to the wholesale gas market, such that the wholesale electricity price could be used to estimate the opportunity cost of gas supply. However, he suggested that the wholesale electricity price is not necessarily the price that would emerge from an efficient spot market for gas if it was operating during the critical contingency. Dr Small noted that, if gas use by electricity generators was curtailed, electricity prices would increase such that the price based on willingness to pay (WTP) would be an under-estimate of price in a hypothetical spot market.

19. He calculated that the e3p (Huntly unit 5) Combined Cycle Gas Turbine (CCGT) generating plant would have a WTP of up to $12.85/GJ for gas. However, a price of $15/GJ was paid for gas in the balancing gas exchange market. He suggested that this was a better approximation to the critical contingency price because it was actually paid for gas in an attempt to restore pressure.

3rd March 2012

20. In 2012 there was a critical contingency lasting close to 11 hours, resulting in curtailment of bands 0, 1a and 1b (gas storage, electricity generators and other large consumers) (see Table 2).

Table 2 Curtailment required during 3rd March 2012 critical contingency

Curtailed partially	Curtailed completely
• Huntly Power Station (Units 5 & 6): 1,700GJ/h • Ngatimaru Rd (Methanex): 1,700GJ/h • Otahuhu B Power Station: 1,700GJ/h • Southdown Power Station: 62 GJ/h • Te Rapa Cogeneration Plant: 300GJ/h	• Ahuroa Storage Facility • Huntly Power Station (Rankine Units 1-4) • New Plymouth Power Station • Bertrand Rd (Methanex) • Ballance Ammonia-Urea (Fuel & Process) • Taranaki Combined Cycle (TCC) • Stratford Power Station Peakers

Source: OATIS CCO - 13:20 03/03/12 - Direction to Curtail Demand

[3] John Small (2010) Critical Contingency Price: 13 July 2010 Final Report, 6 September2010

21. The critical contingency price was estimated as a gas price at which the CCGTs would continue to operate but that Southdown would not. Using a netback calculation of the WTP for gas by these plants, the critical contingency price was set at $11.10/GJ.[4]

22. The wholesale price of electricity during the critical contingency reflected a situation in which some gas plants were not generating such that the electricity price reflected the gas scarcity at the time.

24th May 2016

23. In 2016 a critical contingency lasted for 4 hours 30 minutes but did not require curtailment.

24. Netback prices for gas for the highest cost electricity generation plants operating during the critical contingency (McKee and Stratford peakers) yielded a low willingness to pay for gas. With TCC not generating, the critical contingency price was estimated as the average willingness to pay for gas at e3P over the critical contingency period ($6.66/GJ).[5] This price is higher than the highest market price of gas that day of $5.85/GJ.

Lessons for the Current Critical Contingency

25. The previous examples differ in the circumstances of the critical contingency (curtailment or not) and the approach used to estimate price. However, the following lessons can be drawn:

    - Two sources of data are used to estimate price: (1) prices of gas in the balancing market; and (2) netback prices for gas based on prices in the wholesale electricity market.

    - There has been only one event in which curtailment occurred. The curtailment provided more information on which to base the price estimate; the Critical Contingency Price was estimated as that which would reproduce the outcomes of the curtailment directions. Where there is no curtailment, it is less clear how to use the market information. In 2010 a high price was paid in the balancing market and this was used as the basis for the Critical Contingency price. In 2016, market prices of gas were lower than the netback price of gas from wholesale electricity prices, and this was used as the basis.

26. From the limited history, the following appears to be the emerging rules used:

[4] Tim Denne (2012) Determination of Critical Contingency Price in respect of the critical contingency of 3rd March 2012

[5] Tim Denne (2016) Determination of Critical Contingency Price in respect of the critical contingency of 24th May 2016

- Where there is curtailment, the price is defined as that which would result in the same allocation as was achieved by curtailment;

- Where there is no curtailment, the higher of prices paid in the balancing market and a netback price based on the wholesale electricity price and the operating costs and performance of high value gas generators.

May 2017 Critical Contingency

27. The May 23rd 2017, incident involved no curtailment. We thus consider two sources of information to estimate price: (1) market prices of gas and (2) a netback price based on information from the wholesale electricity market.

Market Prices of Gas

28. Data from EMS suggests that prices in the physical market on 23rd May 2017 averaged $5.60/GJ.[6] This average price was used, with a 10% upwards adjustment,[7] to produce a marginal buy price (mbp) for balancing gas of $6.16/GJ.[8] There were no trades of balancing gas on the 23rd May.

29. These market prices appear to be representative of normal market conditions, rather than being elevated prices relevant to a critical contingency. They would represent a floor for the critical contingency price.

Electricity Market Information

Methodology for Estimating a Netback Price

30. The netback price is an estimate of the maximum willingness to pay (WTP) for gas by electricity generators. It can be estimated from the wholesale price of electricity and the variable costs of running the plant. Each generating plant is assumed to be willing to generate when the total cost of generating one more MWh of electricity (including the costs for gas) is no higher than the revenue received for that one additional MWh. Where all other costs are known, the maximum WTP for gas can be estimated using the following equation.

$$WTP = \frac{(WP - VC)}{HR} - GTC - CC$$

Where:	WTP	= willingness to pay for gas (in $/GJ)
	WP	= wholesale price of electricity ($/MWh)
	VC	= variable cost of generation ($/MWh)
	HR	= heat rate in (GJ/MWh)[9]
	GTC	= gas transmission cost ($/GJ)
	CC	= carbon cost ($/GJ)

[6] http://www.emstradepoint.co.nz/market-results/
[7] The uplift factor changed from 3% to 10% on 23rd May 2017.
[8] https://www.bgix.co.nz/prices
[9] Note the heat rates in Table 3 in GJ/GWh

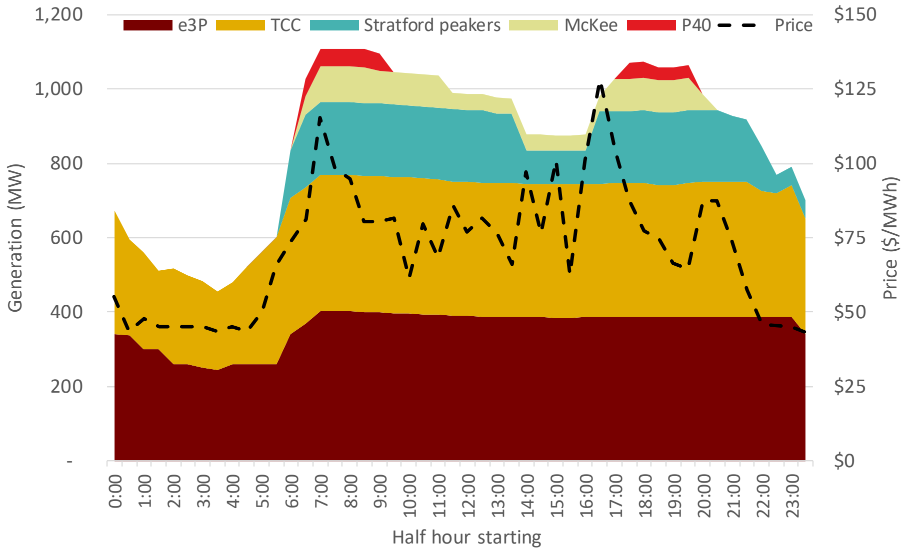
We bring the relevant data together below.

Data to Estimate a Netback Price

Generation and Market Prices

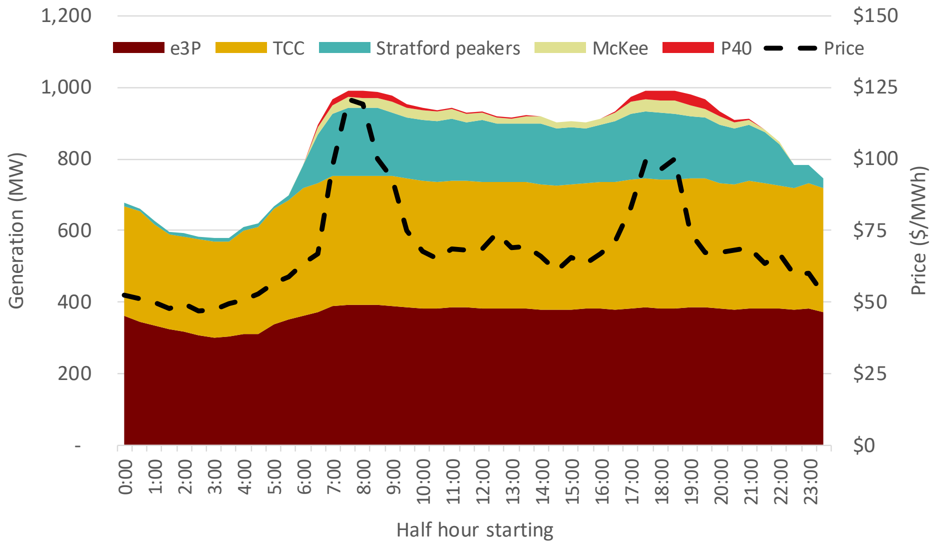
31. Figure 1 shows the generation from gas-fired plants on 23rd May and the average price across two relevant nodes (HLY2201 and SFD2201).[10] Figure 2 shows the same data for an average across the 14 weekdays of the period from the start of the week before to the end of the week after the critical contingency (excluding the 23rd May).

Figure 1 Gas-fired electricity generation and electricity price 23rd May 2017



Source: data from Electricity Authority[11]

Figure 2 Gas-fired electricity generation and electricity price 15 May -2 June 2017 (excl 23rd)



Source: data from Electricity Authority

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[10] No prices were reported for MKE1101 for much of May 2017

[11] Load_Generation_Price series from: www.emi.ea.govt.nz/Datasets/Wholesale/Final_pricing/Load_Generation_Price/2017

32. During the critical contingency (11:00 to 18:30) electricity was generated by e3P, Taranaki Combined Cycle (TCC) and the McKee and Stratford peakers; Huntly P40 only generated from 17:30. Generation levels were greater in total on the 23rd than on the average weekday for the rest of the month and prices were higher. Total electricity generation in New Zealand on the 23rd May was the 2nd highest day of the month, with the highest generation the previous day (the 22nd). On both days, generation was 6% higher than for the average weekday in May.

33. The Stratford peakers reduced generation between approximately 14:00 and 16:00 on the 23rd, but this does not appear to be a response to electricity price. We bring together data below relating to e3P, TCC, and the peakers.

Heat rates and Operating Costs

34. Plant-specific information on heat rates and costs is provided in Table 3.

Table 3 Gas plant information and assumptions

	Huntly unit 5 (E3P)	TCC	McKee Peaker	Stratford Peakers
Heat rate (GJ/GWh)	7,300	7,700	10,500	10,600
Variable cost ($/MWh)	$4.40	$4.41	$8.20	$6.50
Gas transmission cost ($/GJ)	$0.50	$0.14	$0.00	$0.14
CO2 Emissions Factor (kg/GJ)	53.89	53.89	53.89	53.89
CO2 price ($/tonne)	$17.00	$17.00	$17.00	$17.00
CO2 cost $/GJ (@ 67%)1	$0.61	$0.61	$0.61	$0.61
Total variable cost ($/MWh) absent gas price	$12.63	$10.21	$14.65	$14.49

[1] From 1 January 2017 the requirement to surrender emission units is 67% of a unit per tonne of CO_2.
Source: MBIE Electricity Demand and Generation Scenarios: Generation Cost Assumptions; Personal communications from Contact and Todd Energy; MBIE Energy Greenhouse Gas Emissions; OMF Carbon Daily Report 23 May 2017

Netback Price

35. We use the data in Table 3 to estimate a WTP for gas given the wholesale electricity price at the nearest pricing node for each plant. The results over the critical contingency period are shown in Table 4.

36. Although the peakers might ramp up and down over a relatively short period, the CCGTs would not. For this reason, we examine the average WTP over the critical contingency as a whole. The lowest values are the WTP values for McKee ($5.77/GJ) and Stratford ($6.34/GJ); values for e3P and TCC are $10.62/GJ and $9.29/GJ respectively.

37. The WTP values for the peakers are close to the market prices for gas and thus do not provide useful information for setting the Critical Contingency Price. In addition, historical precedent has been to use the CCGTs as high value users of gas, consistent with Regulation 71(2).

Table 4 Wholesale electricity price per node and resulting willingness to pay for gas

	Pricing node			Plant			
Period starting	**HLY2201**	**SFD2201**	**MKE1101**	**e3P**	**TCC**	**Stratford Peaker**	**McKee Peaker**
	Wholesale price $/MWh			**Willingness to Pay for Gas ($/GJ)**			
11:00	$71.72	$64.57	$57.02	$8.09	$7.06	$4.72	$4.04
11:30	$90.01	$81.38	$76.21	$10.60	$9.24	$6.31	$5.86
12:00	$80.68	$72.92	$68.29	$9.32	$8.14	$5.51	$5.11
12:30	$85.40	$77.20	$72.30	$9.97	$8.70	$5.92	$5.49
13:00	$79.97	$72.81	$68.18	$9.22	$8.13	$5.50	$5.10
13:30	$68.97	$63.37	$59.34	$7.72	$6.90	$4.61	$4.26
14:00	$100.78	$92.98	$87.07	$12.08	$10.75	$7.40	$6.90
14:30	$79.56	$73.41	$68.75	$9.17	$8.21	$5.56	$5.15
15:00	$105.01	$96.90	$90.74	$12.65	$11.26	$7.77	$7.25
15:30	$65.01	$59.60	$55.82	$7.18	$6.41	$4.26	$3.92
16:00	$105.01	$96.43	$90.30	$12.65	$11.20	$7.73	$7.21
16:30	$134.50	$121.63	$113.90	$16.69	$14.47	$10.11	$9.45
17:00	$111.40	$97.11	$85.75	$13.53	$11.29	$7.79	$6.77
17:30	$92.94	$82.42	$72.73	$11.00	$9.38	$6.41	$5.53
18:00	$81.46	$72.96	$62.61	$9.43	$8.15	$5.52	$4.57
Average				$10.62	$9.29	$6.34	$5.77

Source: prices from Electricity Authority datasets Wholesale

Critical Contingency Price

38. In determining a critical contingency price, I am steered by Section 71 of the Regulations (Sub-Sections 2 and 3(i)) to take account of prices in the wholesale electricity market in deciding a price that would allocate gas efficiently during the contingency. I am also steered by precedent towards examining prices of gas in the balancing market, where these are higher. Because they are not higher, I have limited my considerations to prices based on a netback from wholesale electricity prices.

39. The estimated WTP for gas by the peakers is little different from market gas prices. That for CCGTs is higher than market prices on 23rd May 2017 and is equivalent to the value of gas in its highest value use within the wholesale electricity market. This was the assumption used in defining the critical contingency price, both in April 2012 (when there was curtailment) and in May 2016 (when there was no curtailment, TCC was not operating and e3P was regarded as a high value use).

40. The choice of whether to use the WTP for TCC or e3P comes down to other considerations, particularly the need to signal scarcity and the need for consistency in approach.

    - Both plants might be defined as high value uses of gas and the WTP of both is higher than market prices.

- A price set based on the WTP for either plant might be expected to lead to the sale of additional gas from the peaking plants, although this is not certain.
- The WTP for e3P is the highest value based on wholesale price information, but is still lower than the Critical Contingency price determined on two of three previous occasions. It has been used previously to set price.

41. A critical contingency price based on the WTP of e3P ($10.62/GJ) would:
    - Signal scarcity (67(b));
    - Make use of prices in the wholesale electricity market (71(3)(i));
    - Allocate gas to the highest value use within the wholesale market, and on the evidence of market prices, allocate it to higher value uses than other gas users that day also (71(2)); and
    - Make use of other matters considered relevant to achieving efficient allocation (71(2)), such as consistency with the methodology used previously and thus establishing some predictability to price setting.

42. My determination is that the critical contingency price for the 23rd May 2017 should be $10.62/GJ.