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PAPER NO.	:	**EMC/RCP/33/2007/CP15**
SUBJECT	:	**EQUITY BETWEEN GENERATORS AND INTERRUPTIBLE LOADS IN RESERVE PROVISION**
FOR	:	**DECISION**
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Executive Summary

This paper examines the equity between Generation Registered Facilities (GRFs) and Load Registered Facilities (LRFs) in Reserve provision.

A Market Participant has expressed concern that payments to GRFs and LRFs were inequitable given that LRFs have been activated for Reserve considerably less often than GRFs have.

The paper noted that as GRFs and LRFs are different types of facilities, their responses differ in several aspects and different operational requirements also apply to each. Thus, Reserve provision by these two types of facility is not directly comparable.

Nonetheless, this paper explores and evaluates 3 options to address the issue: (1) consider Reserve from GRFs and LRFs as different services, (2) alter the Reserve payment methodology and, (3) adjust the Primary and Secondary Reserve activation frequencies of LRFs to bring about more balanced response between GRFs and LRFs in Reserve provision.

Overall, we assess option 3 to be the most appropriate one to be considered. Consequently, we recommend that the Panel requests the PSO to review whether the current Primary and Secondary Reserve activation frequencies for LRFs can be raised to give LRFs an increased expectation of being activated during contingencies.

After a lengthy discussion, the Panel decided to maintain the status quo unless strong justification can be provided to make any changes.

1. Introduction

This paper assesses the equity between Generation Registered Facilities (GRFs) and Load Registered Facilities (LRFs) in Reserve provision.

2. Background

The Reserve market was designed to accommodate GRFs and LRFs as Reserve Providers and to consider Reserve from both as equivalent. Hence, while the Market Rules defined Reserve as "generation capacity **or** load reduction capacity", it specified a common treatment of the Reserve offered by GRFs and LRFs in the market clearing formulation, and a common settlement methodology for determining payments to GRFs and LRFs for Reserve.

When the wholesale electricity market commenced operations on 1 January 2003, only GRFs were allowed to provide Reserve. A year later, on 1 January 2004, LRFs joined GRFs in being eligible to offer Reserve.

As part of the preparations for LRF participation, proposed market clearing formulation changes for implementing security limits on Reserve from LRFs were referred to the Technical Working Group (TWG) for consideration. In reporting back to the RCP, the TWG also highlighted its concern that Reserve provided by GRFs and LRFs appeared to be different services since GRFs and LRFs would be subject to different technical and operational requirements as Reserve Providers. At the time, EMC believed that it was premature to vary the design of the market[1].

More recently, a Market Participant submitted its view that payments to GRFs and LRFs for Reserve were inequitable. This was said to be because GRFs are only paid at a fraction of the Reserve price even though they have been responding to contingencies, but LRFs are paid at the full Reserve price even though they have not been responding to contingencies. (To dispel one false notion of inequity suggested in this statement, we note here that actually **all** Reserve Providers are paid at some fraction of the Reserve price which varies with their expected Reserve provision capability[2]. This is described more fully later in this paper.) To address the said inequity, the Market Participant suggested pegging reserve payments for LRFs to their activation settings, and having these set to levels that would bring about a given likelihood of activation.

Although this issue was couched in terms of dissatisfaction with the Reserve payment methodology, we believe it is worth examining the Reserve provision framework more generally since concern over the differences between GRFs and LRFs in Reserve provision had been previously expressed and since it is clear from the Market Participant's suggestion to peg payment to activation that its perceived inequity springs from some of these differences.

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1 See RCP Paper No.: EMC/RCP/09/2003/216 – Provision of Reserve from Load Facility.

2 LRFs are currently paid at 0.95 times the Reserve price (but this is subject to PSO's review of their reserve effectiveness), while GRFs are paid between 0.55 and 0.95 times the Reserve price based on their historical responses to contingency event.

The remainder of the paper is structured as follows. Section 3 outlines key aspects of the existing Reserve provision framework. Section 4 considers the equity of GRFs and LRFs within the existing Reserve provision framework and evaluates several alternatives to the current arrangements, including the suggestion to peg payment to activation settings. Section 5 concludes. Feedback from industry consultation and our recommendations are given in Sections 6 and 7.

3. Reserve provision

3.1. Reserve Classes

A Reserve Provider (either GRF or LRF) may register to provide Reserve of any or all of the three Reserve Classes. Reserve Classes are differentiated by their purpose and required performance standards, as summarised in Table 1.

Table 1: Reserve Classes

Reserve Class	Purpose	Response mode	Response time	Response duration
Primary	Arresting a fall in system frequency resulting from the forced outage of a generator	Automatic	Within 8s of being triggered by a contingency event	At least 30s
Secondary	Restoring and maintaining system frequency at an acceptable limit	Automatic	Within 30s of being triggered by a contingency event	At least 10 min
Contingency	Replacing lost Energy or Reserve resulting from the forced outage of a generator	Manual/ automatic	Within 10 min of being instructed by the PSO	At least 30 min

3.2. Reserve Provider Groups

For each Reserve Class a Reserve Provider is registered to provide, it is assigned to a Reserve Provider Group by the PSO. The PSO reviews these assignments at least annually. Except for newly-registered LRFs (which are assigned to Reserve Provider Group ‘A’), the assignment (or re-assignment) of a Reserve Provider is determined by its “Reserve Effectiveness” as shown in Table 2.

Table 2: Reserve Effectiveness and scaling factors of Reserve Provider Groups

Reserve Provider Group	Reserve Effectiveness (RE)	Scaling factor
A	RE ≥ 0.9	0.95
B	0.8 ≤ RE < 0.9	0.85
C	0.7 ≤ RE < 0.8	0.75
D	0.6 ≤ RE < 0.7	0.65
E	0.5 ≤ RE < 0.6	0.55

Reserve Effectiveness is the average actual Reserve provided for a unit of Reserve requested from the Reserve Provider. It is estimated through linear regression[3] of the Reserve Provider's "actual response" on its "expected response". Table 3 outlines how observations for Reserve Providers' actual and expected responses are obtained for this estimation.

Table 3: Actual and expected responses for determining Reserve Effectiveness

Status	Reserve Class	GRFs	LRFs
Newly registered	Primary; Secondary	Actual response: Measured during verification test Expected response: Obtained by computer simulation based on validated unit model[4]	N.A. – All are assigned to Reserve Provider Group 'A'
	Contingency	Actual response: Measured during verification test Expected response: Declared expected output at 10 min after event	
Existing	Primary; Secondary	Actual response: Measured during actual disturbance event Expected response: Obtained by computer simulation based on validated unit model[4]	Actual response: Measured during actual disturbance event Expected response: Scheduled reserve
	Contingency	Actual response: Measured during actual disturbance event Expected response: Output based on declared ramp rate	Actual response: Measured during actual disturbance event Expected response: Scheduled reserve

3.3. Payment for Reserve

Reserve Providers receive payment for being **scheduled** to provide Reserve. When scheduled to provide Reserve, a Reserve Provider will receive payment even if it is not activated, and it will not receive any extra payment for being activated[5].

For each Reserve Class, the Market Clearing Engine (MCE) uses the scaling factors shown in Table 2 to discount the offered quantities of Reserve from each Reserve Provider Group. This is to account for the likelihood that the Reserve Providers will provide less than the quantity of Reserve requested from them. The price that a Reserve Provider assigned to a given Reserve Provider Group gets paid at is correspondingly discounted. Hence, for any Reserve Class:

Reserve payment	[(Scaling factor of assigned Reserve Provider Group) × (Reserve

[3] The fitted regression equation has no constant term: (Actual response) = (Reserve effectiveness) × (Expected response). This is estimated by Ordinary Least Squares.

[4] This is a computer model of the GRF. The GRF's Primary and Secondary Reserve release capabilities under various frequency excursions are established through computer simulation based on this model.

[5] There is no payment for activation, but increased output by a GRF when it is activated will entitle it to additional credits paid at its nodal Energy price, and reduced consumption by an LRF when it is activated will lower the charges it must pay in the Energy market.

=	price)] × (Scheduled Reserve quantity)

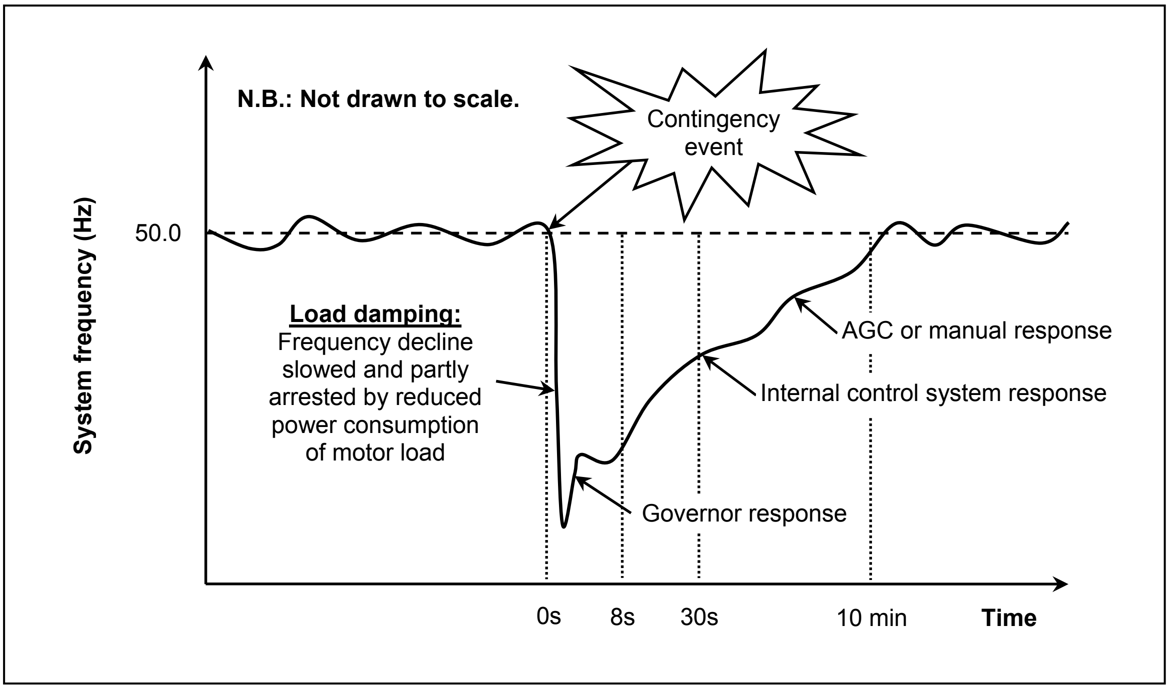
3.4. Activation of Reserve

The following describes how GRFs and LRFs are activated to provide Reserve.

GRFs

A GRF naturally increases output by governor action whenever system frequency falls by more than its governor deadband (required to be at most 0.05 Hz by the Transmission Code). The magnitude of this response depends on the frequency change, and which other generators are on-line, their relative loading levels, their governor settings and their unit conditions. The governor action of all on-line generators rapidly halts the decline in system frequency and brings system frequency back up slightly. System frequency is usually only restored to the nominal value of 50 Hz as generators further increase output in response to their internal control systems and in response to Automatic Generation Control (AGC) signals from the PSO's Energy Management System. Figure 1 illustrates the typical frequency response following a contingency event such as the forced outage of a generator.
If a GRF is not on AGC, its dispatch coordinator is instructed to activate Contingency Reserve from the facility through verbal or written communication from the PSO. Upon receipt of such an instruction from the PSO, the dispatch coordinator must manually ramp the generator up to the instructed output level within 10 minutes and maintain that output level for a further 30 minutes.

Figure 1: Frequency response following a contingency event

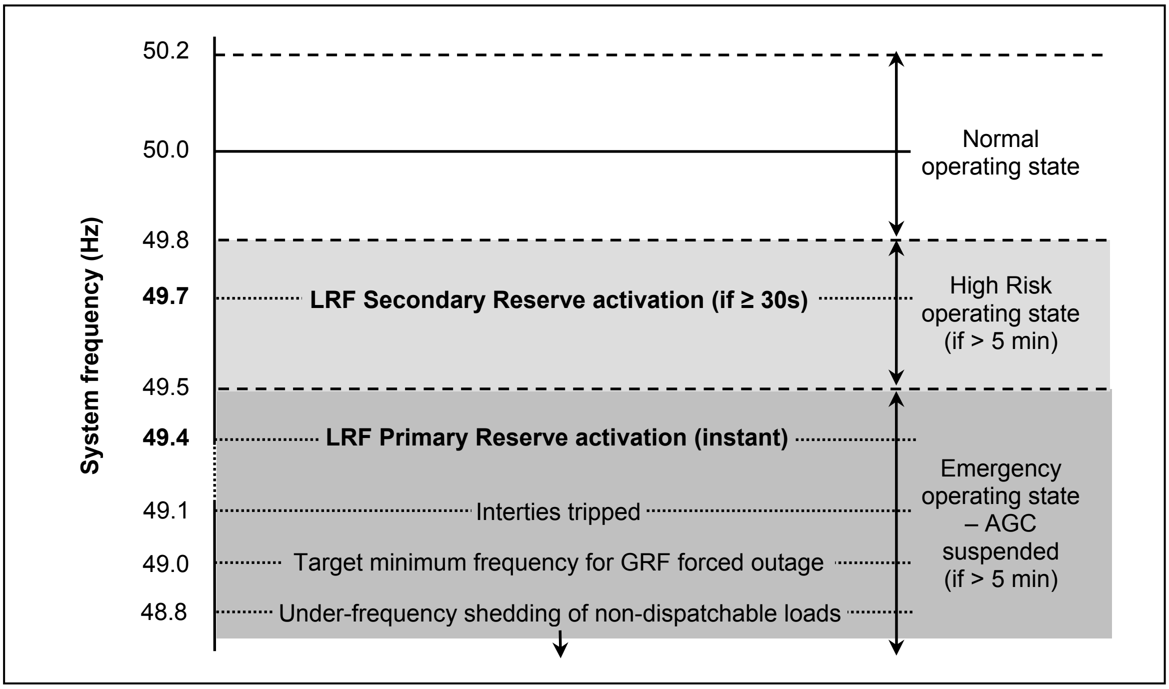


LRFs

Each LRF registered to provide Primary or Secondary Reserve must be fitted with an under frequency relay (UFR) and Monitoring-Recording-Activation (MRA) device with contact output. The UFR/MRA device trips the LRF, instantly reducing its power consumption to zero, whenever system frequency falls to and remains at or below the pre-set level for the specified period of time.

Figure 2 shows the required frequency and timer settings for UFR/MRA devices.

Figure 2: LRF Primary and Secondary Reserve activation levels



The dispatch coordinator of an LRF is instructed to activate Contingency Reserve via alphanumeric message paging from the PSO. The dispatch coordinator must first confirm that the same message is reflected in an advisory notice posted on EMC's trading website before manually reducing the LRF's power consumption by its scheduled quantity of Contingency Reserve within 10 minutes of the advisory notice's issuance.

The dispatch coordinator may only restore power for the LRF when cleared to do so by the PSO. The System Operation Manual states that this will typically be within 30 minutes of the reduction in power consumption.

4. Analysis

A Market Participant had pointed out, back in February 2006, that LRFs have not been responding to contingencies since 1 July 2004. LRFs were first activated on 11 May 2006 and only for Contingency Reserve. The number LRF activations are as shown in Table 4. EMC was also alluded to the fact that the other 3 LRF activations were due to the tripping of 2 GRFs i.e. a double contingency event.

Table 4: Number of LRF activations

Period	Primary	Secondary	Contingency	Remarks
Jul – Dec 2004	0	0	0	-

Jan – Dec 2005	0	0	0	-
Jan –Jun 2006	0	0	1	-
Jul – Dec 2006	1	1	1	Activated due to a double contingency event
Jan – Mar 2007	0	0	0	-

Based on Table 4, it is observed that LRFs rarely get activated in view that, on average, about 10 generator forced outages (i.e., contingencies) occurred each month for period January 2003 to December 2006. For Primary and Secondary Reserve, this is explained by GRFs and LRFs having different activation mechanisms. This may give the impression that LRFs are rarely activated, while only GRFs that are scheduled to provide Reserve are activated to provide Reserve. However, this may not be true because it would be inaccurate to assume that:

a) for every generator forced outage, LRFs should be expected to respond since there could be periods where a generator forced outage had occurred but where no LRFs have been successfully scheduled to provide Reserve and thus, the LRFs are expected not to respond;

b) generators scheduled to provide Reserve respond to every generator forced outage as there could be outages which are so small that generators scheduled to provide Reserve need not respond as responses from the intertie and generators scheduled to provide Regulation were already sufficient; and

c) only generators scheduled to provide Reserve respond to contingencies since inherently generators <u>not</u> scheduled to provide Reserve could also respond to such contingencies.

If considered useful by the RCP, and if the PSO is able to provide the information on each generation forced outage and the corresponding amount of Reserve provided by each GRF and the intertie, a study could be made to evaluate the extent of the above. This could point out that the extent of LRFs not responding to contingencies compared with GRFs which are scheduled to provide Reserve may not be as large as it seems.

Additionally, it is also simplistic and perhaps unfair to LRFs to focus solely on the occurrence of activations when there are also other ways in which Reserve provision differs for GRFs and LRFs.

Table 5 summarises the main similarities and differences.

Table 5: Comparison of GRFs and LRFs in Reserve provision

	GRFs	**LRFs**
Eligibility to provide	• Can register to provide any/all Reserve Classes.	• Can register to provide any/all Reserve Classes.
Payment	• Based on scheduled quantity and assigned Reserve Provider Group. Scaling factor of 0.95 usually applies at registration, revised if performance deteriorates. • Received payment even if standby capacity not provided in real-time (e.g., due to forced outage)[6], but is subject to compliance monitoring • No payment for activation, but entitled to additional Energy credits for increased output.	• Based on scheduled quantity and assigned Reserve Provider Group. Scaling factor of 0.95 automatically applies at registration, revised if performance deteriorates. • Received payment even if standby capacity not provided in real-time (e.g., due to low consumption level), but is subject to compliance monitoring • No payment for activation, but Energy debits are lowered due to reduced consumption.
Limits on scheduled quantity	• No externally-imposed limits – only physical capability limits and offer limits apply.	• For security, the total quantity that may be scheduled from LRFs in each Reserve Class and each (geographical) Reserve Provider Zone is capped.
Activation	• Frequent – intrinsically responds to very slight frequency dips, Contingency Reserve activated manually or automatically through AGC. • Will provide Primary and Secondary Reserve in a contingency even if not scheduled.	• Rare – Set to trip only when frequency falls to 49.4Hz or falls to or below 49.7Hz for 30s, Contingency Reserve only activated manually. But contributes to initial load damping in each contingency. • Once activated for a given Reserve Class, effectively provides all slower-acting Reserve Classes.
Immediacy of response	• More drawn out as some time (upwards of few seconds) is required to increase output.	• Consumption instantaneously falls to zero when tripped.
Response quantity	• Will typically not provide full scheduled quantity – response is graduated, varying with the frequency decline and the characteristics and operating conditions of all other online generators.	• Will typically provide full scheduled quantity in a single discrete block.
Response duration	• Closer to the required performance standard – Primary: at least 30s; Secondary: at least 10 min; Contingency: at least 30 min.	• Power restoration requires clearance from the PSO– typically within 30 min for all Reserve Classes, possibly longer.

6 In 2004 the RCP considered that the sum of all Reserve payments made to GRFs that trip was too insignificant to justify implementation of a settlement solution for retracting them (see RCP Paper No.: EMC/RCP/14/2004/01 – Reserve and regulation payments to non-complying units). The RCP continues to monitor the magnitude of such payments.

As GRFs and LRFs are different types of facilities, their responses differ in several respects and different kinds of technical and operational requirements must apply to each. Given that there are the many dimensions of response and that the requirements are not directly comparable, it is not obvious that the existing Reserve provision framework is inequitable. Nonetheless, the differences suggest that it may be appropriate or beneficial to:

1. consider Reserve from GRFs and LRFs as different services,
2. alter the Reserve payment methodology, or
3. adjust the Primary and Secondary Reserve activation frequencies of LRFs so responses from GRFs and LRFs are more balanced.

We consider each of these in turn.

4.1. Consider Reserve from GRFs and LRFs as different services

Since the responses of GRF and LRFs are different, it may be appropriate to consider Reserve provided by each as different services. However, the market was designed to allow LRF participation in the Reserve market principally because it was recognised that decreased consumption from LRFs has the **same** effect on the system frequency as increased output from GRFs. This means that Reserve from GRFs and LRFs are not fundamentally different and thus should not be considered as different services.

With suitable controls, LRFs can in principle provide responses that meet the required performance standards for the existing defined Reserve Classes. And since we have no reason to believe that the three existing Reserve Classes inadequately provide for system security, it does not seem necessary to consider Reserve from GRFs and LRFs as different classes of service either.

Further, if Reserve from GRFs and LRFs were to be considered different services or different classes of service, separate quantity requirements would have to be determined for Reserve from GRFs and from LRFs. But as there is no need for (or no basis to require) any particular quantity of Reserve to be procured specifically from GRFs or from LRFs (given that they would have the same effect on system frequency), separate requirements for Reserve from GRFs and LRFs cannot be determined.

Hence, we do not believe it is appropriate to consider Reserve from GRFs and LRFs as different services or different classes of service.

4.2. Alter the Reserve payment methodology

This section considers a proposal to peg Primary and Secondary Reserve payments to LRFs to their activation settings, which would be set to bring about a given likelihood of activation. This proposal has the effect of varying payment to LRFs based on their likelihood of response in a contingency

Essentially, the proposal involves a new Reserve Activation Group framework for LRFs. Reserve Activation Group represents the probabilities of being activated in a contingency for LRFs.

To give LRFs in different Reserve Activation Groups different probabilities of activation, LRFs in different Reserve Activation Groups would have different UFR/MRA device activation settings.

LRFs would be allowed to choose which Reserve Activation Group to be in according to their preferred probability of being activated in a contingency, and they would be paid at prices that are discounted by the relevant scaling factors for their chosen Reserve Activation Group (see Table 6).

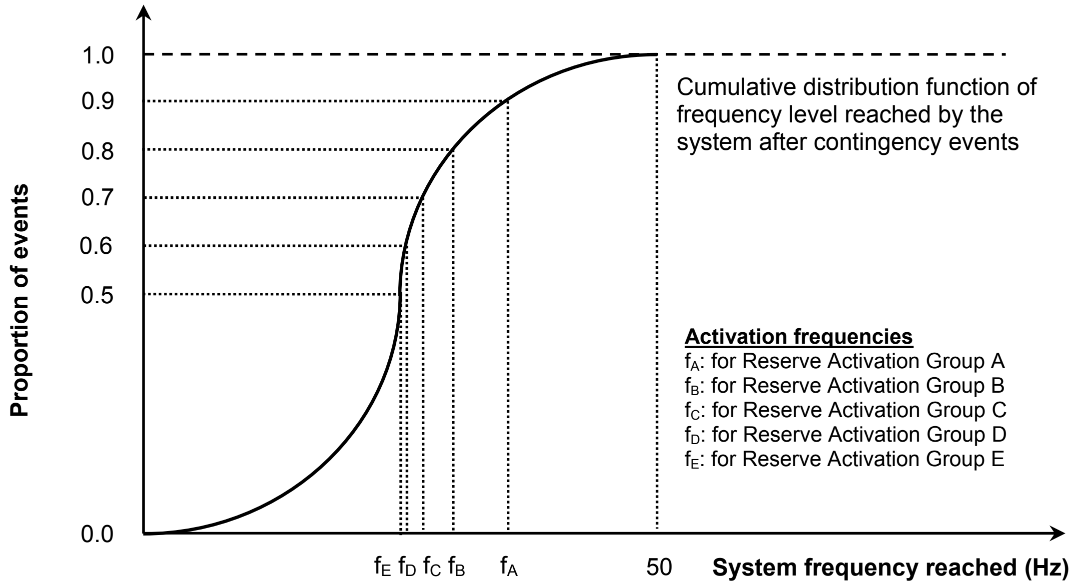
Table 6 Proportion of Events and scaling factors of Reserve Activation Groups

Reserve activation group	**Proportion of Events (PE)**	**Scaling factor**
A	PE ≥ 0.9	0.95
B	0.8 ≤ PE < 0.9	0.85
C	0.7 ≤ PE < 0.8	0.75
D	0.6 ≤ PE < 0.7	0.65
E	0.5 ≤ PE < 0.6	0.55

To provide Primary Reserve, the UFR/MRA device of an LRF would be set to trip it the moment[7] system frequency falls to the activation frequency for its chosen Reserve Activation Group. Activation frequencies for the five Reserve Activation Groups would be determined from the corresponding frequency levels reached by the system within 8 seconds (i.e., the required response time for Primary Reserve) of previous contingency events, for the various proportions of events shown in Figure 3. (These proportions are the same as the Reserve Effectiveness levels used to assign GRF to Reserve Provider Groups.)

7 This is the response time required currently. Although the required response time for Primary Reserve is within 8 seconds of being triggered by a contingency event, LRF activation must be instantaneous to contribute towards arresting a fall in system frequency.

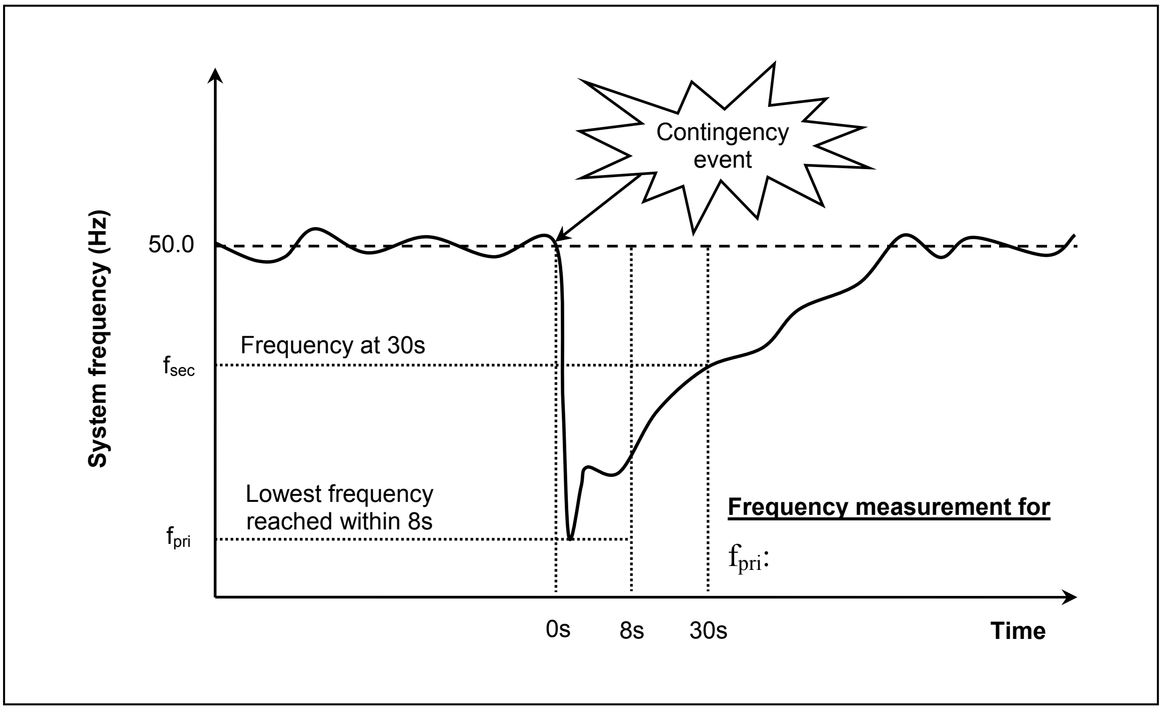
Figure 3: Activation frequencies for LRFs in each Reserve Activation Group



To provide Secondary Reserve, the UFR/MRA device of an LRF would be set to trip it when system frequency falls to and remains at or below the relevant activation frequency for 30 seconds[8]. Activation frequencies for the five Reserve Activation Groups would be determined in the same way as for Primary Reserve, but with frequency levels reached at 30 seconds after previous contingency events. Figure 4 illustrates how the frequency levels differ.

8 This is response time required currently. Since LRFs can provide reserve instantly, they can be activated at the very end of the required response timeframe for secondary reserve (i.e., 30 seconds).

Figure 4: Frequency measurements extracted for each contingency event



LRFs providing contingency reserve will not be assigned to any Reserve Activation Group since their activation would remain at the PSO's discretion. Effectively their scaling factor will be one, i.e., there would be no discounting.

The proposal seems simple, but is problematic on several fronts. We evaluate this proposal against conceptual and practical considerations and the practices in other jurisdictions.

4.2.1 Conceptual considerations

This proposal to pay LRFs discounted prices which reflect their chosen probabilities of being activated in a contingency rests on the argument that it is equitable to do so since the probability of being activated in a contingency is lesser for LRFs compared to GRFs. If this argument is accepted, then to maintain equity and fairness, it is also necessary to alter the payment methodology to take into account other dimensions in which Reserve provision differs between GRFs and LRFs in a contingency (see Table 5). Specifically, for immediacy of response, response quantity and response duration, it could be argued that payments to GRFs should be discounted to reflect that:

a. GRFs' responses are more drawn out (i.e., gradual increase in output) as GRFs need some time to increase their output while the responses of LRFs are immediate in that their consumption falls instantaneously to zero when tripped;
b. GRFs generally do not provide the full scheduled quantity of Reserve when activated, while LRFs would provide the full scheduled quantity of Reserve when activated; and
c. GRFs' response duration is shorter than the LRFs' in the case of Primary and Secondary Reserve since LRFs can only restore power upon obtaining clearance from the PSO.

Thus, it is inequitable to discount payments to LRFs without also discounting payments to GRFs taking into account how the 3 dimensions above differ between GRFs and LRFs for Reserve provision.

To alter the payment methodology to take into account the various dimensions in which Reserve provision differs between GRFs and LRFs would require a methodology that is able to distil these differing dimensions into a single parameter. However, in reality, determining such a methodology would be extremely difficult, if not impossible. Assuming even if it is possible to determine a payment methodology which accounts for each of these different dimensions, we would still need to assign weight to each of these dimensions to reflect their relative importance in order to derive that single parameter. Such assignment is likely to be arbitrary and indefensible.

4.2.2 Practical Considerations

Further, there are also a number of practical difficulties with the implementation of this proposal:

1. **Defining the scope of contingency events** (for which frequency measurements are extracted). As Reserve is principally procured to cover generator forced outages, it is clear that these should fall within the scope of contingency events. Forced outages of generators that running at 10 MW or lower should however be excluded. This would be consistent with the practice of exempting up to 10 MW of each generator's output from being allocated a share of Reserve costs as outages of that size are deemed not to require the activation of Reserve.

   Arguably, contingencies in Malaysia should also be included as these affect the frequency in Singapore due to the interconnection of both power systems. However, these can be indistinguishable from regular events such as switching on of large industrial loads as their effect on system frequency is the same and the PSO is not usually notified of either of such events.

2. **Extracting frequency measurements**. Besides the significant effort that extracting the required data is likely to entail, it not clear at this point whether the data required for determining Secondary Reserve activation frequencies can be obtained.

3. **Limits on determined activation frequency levels**. As the UFR/MRA devices of LRFs are currently only required to have sensitivity of 0.05 Hz, activation frequencies corresponding to the specified proportions of events may be too finely differentiated to be implemented. Maintaining this level of equipment sensitivity, determined activation frequencies would need to be rounded to the nearest 0.05 Hz. Consequently, the number of activation frequencies that can be determined may be fewer than five. Also, the determined activation frequencies should be at most 49.75 Hz – the smallest possible decrement from the lower bound of the normal operating state band, since it is usual for frequency levels to fluctuate within this band.

4. **Changing of LRF activation settings**. The proposal would let LRFs choose their preferred probability of activation and associated activation setting. Every time an LRF decides it prefers a different probability of activation, the PSO would have to test and verify the LRF's Reserve provision capability at the new activation setting and EMC would have to update dispatch-related data used by the MCE. In view of the time and effort involved, frequent changes in activation group should not be allowed.

It is not clear at this point if the proposal can be implemented because of these practical difficulties.

4.2.3 Practices in other Jurisdictions

Looking at other jurisdictions where interruptible loads are activated through UFRs to provide fast-acting Reserve (see Annex 1), we see that there are several other jurisdictions (i.e., Australia, New Zealand and Texas, USA) that also have a common reserve market for all providers, where a common payment methodology but different activation requirements apply to different types of providers. The practices in other jurisdictions do not point to the need to consider changing the current practice in Singapore.

4.2.4 Conclusion

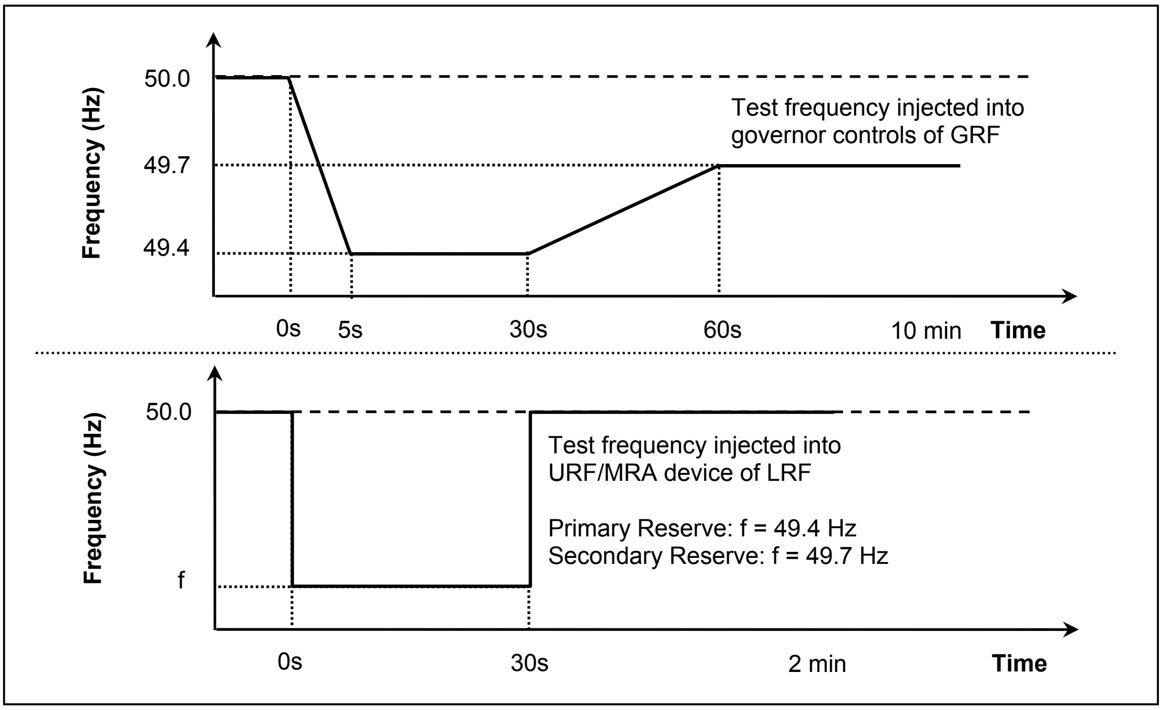
Overall, there does not seem to be a case for altering the existing Reserve payment methodology.

4.3. Adjust Primary and Secondary Reserve activation frequencies of LRFs

As the responses of GRFs and LRFs exhibit different features, it is difficult to alter the current Reserve provision arrangement to make it completely equitable. However the responses of LRFs are to an extent controllable, particularly the frequency levels at which they are activated. Thus, Primary and Secondary Reserve activation frequencies of LRFs can be adjusted to balance the responses of GRFs and LRFs. We consider whether this is appropriate.

According to the PSO, the existing Primary and Secondary Reserve activation frequencies for LRFs were set so as to parallel the frequency levels used to verify that GRFs' Primary and Secondary Reserve release capabilities (i.e., GRFs' MW output increments) meet the minimum requirements of the Transmission Code. Figure 5 shows the frequency profiles used to test the Reserve provision capabilities of GRFs and LRFs. (Note that the governor responses of GRFs are intrinsic reactions. And although it does not count as activation for Reserve, LRFs are also responding to a small degree to all contingencies through their contribution to load damping.)

Figure 5: Frequency profiles used to test Reserve provision capabilities of GRFs and LRFs



However, at the existing activation frequencies, LRFs have hardly been activated for Primary and Secondary Reserve. Excluding the major contingencies that the aggregate Reserve requirement was not meant to sufficiently cover, LRFs have not been activated at all for Primary and Secondary Reserve. The lack of previous activations gives LRFs close to **zero** expectation of future activation. This potentially distorts competition in Reserve markets because it effectively reduces LRFs' expected costs of providing Reserve, giving them an unfair advantage. A Reserve Provider's expected cost of providing Reserve includes the cost of providing capacity on standby and the expected cost in a contingency (which depends on the probability of activation and the costs incurred when activated). While LRFs can reasonably expect negligible costs in a contingency at the existing activation frequencies, GRFs cannot.

Since it is undesirable for the market to have a subset of Reserve Providers with close to zero expectation of activation, we believe that LRF activation frequencies for Primary and Secondary Reserve should be raised. This is to give LRFs some expectation of being activated during contingencies, not necessarily to give LRFs the same probability of activation as GRFs. LRFs may still be activated less frequently, but responses from GRFs and LRF over time (since LRFs have more immediate and fuller responses) could be more balanced.
As the PSO is vested with the responsibility of determining the performance requirements for ancillary services, we suggest the PSO be requested to review whether the current Primary and Secondary Reserve activation frequencies for LRFs can be raised to **give LRFs an increased expectation of being activated during contingencies.**

5. Conclusion

Historically, LRFs have been activated for Reserve considerably less often than GRFs have. This is because GRFs intrinsically respond to very slight frequency dips, but the activation settings of LRFs rarely trigger their activation. But there are other ways in which Reserve provision differs for GRFs and LRFs. In view of these, we have considered:

1. treating Reserve from GRFs and LRFs as different services,
2. altering the payment methodology, and
3. adjusting the Primary and Secondary Reserve activation frequencies of LRFs.

As discussed in the paper, both options 1 and 2 are not appropriate, but we believe the Primary and Secondary Reserve activation frequencies of LRFs should be adjusted so that LRFs have an increased expectation of being activated in contingencies. Consequently, we recommend that the PSO be requested to review whether the current Primary and Secondary Reserve activation frequencies for LRFs can be raised to give LRFs an increased expectation of being activated during contingencies.

6. Consultation

We have published this paper on the EMC website for comments. We received comments from the PSO, Tuas Power, Island Power, Air Product, Senoko Power and Diamond Energy. Their comments alongside EMC's responses to them are attached in Annex 2.

Below we highlight those comments which are referred to the PSO for consideration:

- It was raised that activation of LRFs at higher frequency setting may pose risk to system security and reliability. To enable the RCP to understand the risk involved, we request that the PSO provide the RCP with a study to illustrate the likelihood and severity of the problems involved with over-frequency should the activation frequency for LRFs be set at 49.75Hz and what level would not cause over-frequency concerns.(Please refer to item 4 in Annex 2);

- Tuas has suggested raising the activation frequency setting for LRFs so that there is 50% expectation of LRFs responding to contingency. Tuas's suggestion is for the PSO to consider. (Please refer to item 7 in Annex 2);

- It was raised that market participants have no knowledge on whether the correct amount of reserve is being dispatched. A possible reason why LRFs are not being called upon could be that the PSO is dispatching too much generation reserve. If this were the case, the system frequency would not fall to the levels that trigger LRFs. It was suggested that PSO provide information on actual system responses and reserve dispatched. (Please refer to item 19 in Annex 2); and

- It was raised that the load enabled for interruption by LRFs must be greater than or at a minimum equal to the scheduled reserve as measured and reported to the PSO through near real time reporting. Otherwise, breach of a dispatch instruction results. Therefore, it was questioned why the scaling factor for reserve effectiveness as defined for LRFs are less than 1.0. (Please refer to item 23 in Annex 2).

7. Recommendations

EMC recommends that the RCP:

a. **support** the maintenance of the existing Reserve payment methodology;

b. **request** the PSO to review whether the current Primary and Secondary Reserve activation frequencies for LRFs can be raised to give LRFs an increased expectation of being activated during contingencies.

c. **request** the PSO to respond those points highlighted in section 6 of this paper; and

d. **discuss** if the PSO is able to provide the information on each generation forced outage and the corresponding amount of Reserve provided by each generator and the intertie flow, if it is considered useful by the RCP that a study be performed to evaluate for all generator force outages, the extent to which intertie, GRFs **not** scheduled to provide Reserve, GRFs scheduled to provide Regulation, GRFs scheduled to provide Reserve and LRFs, respond to provide Reserve in contingencies.

8. Discussion and Decision of the RCP

The RCP had a lengthy discussion on this paper and the recommendations put up by the EMC. We highlight some key points of discussion by the RCP below:

- It was argued that the inequity in payments to GRFs and LRFs can be likened to a situation where an option to activate reserve from LRFs which will not be exercised fetches the same or even higher price than an option to activate reserve from GRFs which will most likely be exercised. This is simply illogical since an option which is very likely to be exercised should fetch a premium over one which is almost unlikely to be exercised.

- However, it was commented that the said inequity issue is not so straightforward and it should not be seen simply as LRFs having undue advantage over GRFs. It was argued that if LRFs indeed have an advantage over GRFs, then the market should see greater participation of LRFs for reserve provision. However, this is currently not the case. As it is, there is still a lack of participation of LRFs in reserve provision. Limits imposed by the PSO could not possibly be the reason for lack of participation since the market has not even seen such limits being hit yet. Thus, without a full understanding of the conditions that drive or confine how LRFs behave, it would appear too simplistic to assume that LRFs have undue advantage over GRFs in terms of reserve provision.

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- It has been highlighted that GRFs scheduled to provide reserve may not be the only one responding to contingencies while LRFs do not since 'free-reserve' providers also respond to contingencies. For instance, intertie could contribute to arresting frequency dip and online generators (not scheduled to provide reserve) could also be providing reserve due to their internal response to frequency dip. Thus, the extent of the said inequity between GRFs scheduled to provide reserve and LRFs scheduled to provide reserve may not be as large as it seems.

- It was said that to assess the true extent of the said inequity, a study would need to be conducted and the PSO would need to provide the information on each generation outage and correspondingly, the amount of reserve provided by each GRFs and intertie. In response, the PSO has informed the Panel that how GRFs respond to a contingency event is a complex issue and to gather the necessary data would require substantial efforts and impose a significant burden on the resources of the PSO.

- The PSO has maintained that current activation frequency settings for LRFs are optimal from system security considerations and the PSO does not support increasing the activation frequency settings for LRFs.

- Additionally, it was pointed out although activations for LRFs in Singapore are fewer than other countries, this could not be due to activation frequency since the activation frequency for LRFs in Singapore is already higher than those in other countries.

After much discussion, and given that the study to assess the true extent of the said inequity is not warranted since substantial efforts and burden would have to be imposed on the PSO to gather the necessary information, the RCP decided to maintain the status quo unless strong justification can be provided to make any changes.

Annex 1: Reserve provision in other jurisdictions where interruptible loads are UFR-activated

Table 6: Reserve response requirements and payment

Jurisdiction	Name of service	Service response standard	Payment	Historical number of activation
Ireland	Short Term Active Response (STAR, scheme for interruptible loads only)	At any time from 07:00 to midnight (the "service period"), automatically disconnect when frequency falls to specific level (frequency level reached after the loss of largest generator historically), reconnect when frequency recovers to near normal operating level (usually after 5 min).	Based on annual energy consumption (during service period) multiplied with a pre-determined price specified in the contract.	Historically, STAR was activated about 5 times per annum. (Note: Contract provides for 20 interruptions per annum. If providers are interrupted more than 20 times, they will be paid a lot more.)
National Electricity Market (Australia)	Fast Raise Service (6s)	Automatically initiate response when frequency changes below lower limit of Normal Operating Frequency Band (49.9 Hz). Proportional controller: Amount is monotonically increasing from 50 Hz for range between lower limit of Operational Frequency Tolerance Band (49.5 Hz) and Normal Operating Frequency Band. Switching controller: Amount is one or more step changes if frequency falls through Frequency Setting (49.55 to 49.75 Hz or 48.0 to 49.6 Hz for Tasmania, allocated by NEMMCO based on all providers' Response Capabilities – providers with higher Response Capabilities are allocated higher Frequency Settings).	Based on market price and quantity cleared.	NEM makes payment for the service on the basis of being able and ready to respond. There is no additional payment when the service is actually used or the load is switched off. Hence, NEMMCO does not record the number of times the service is actually used or load is switched off.
	Slow Raise Service (60s)	(Same as for Fast Raise Service.)		
	Delayed Raise Service (5 min)	Switching controller to automatically or manually initiate response if frequency falls through its Frequency Setting (same range and allocation procedure as for Fast Raise Service).		

Jurisdiction	Name of service	Service response standard	Payment	Historical number of activation
New Zealand	Fast Instantaneous Reserve (6s)	Partly Loaded Spinning Reserve and Tail Water Depressed Spinning Reserve: Provided 6s after Contingent Event, sustained for at least 60s. Interruptible Load: Disconnect within 1s of frequency falling to or below 49.2 Hz (frequency level 1s into the typical worst case under- frequency, so that interruptible loads contribute to slowing the frequency decline before the minimum level is reached at 6s), sustained for at least 60s (Normal Band: 49.8 to 50.2 Hz).	Based on market price and quantity cleared.	2001 - 8 times 2002 - 4 times 2003 - 2 times 2004 - 7 times 2005 - 9 times 2006 - 3 times 2007 (beginning of year to Apr 07) - 4 times
	Sustained Instantaneous Reserve (60s)	Partly Loaded Spinning Reserve and Tail Water Depressed Spinning Reserve: Provided during first 60s following Contingent Event, sustained for at least 15 min. Interruptible Load: Disconnect within 60s of frequency falling to or below 49.2 Hz, sustained until instructed by system operator.		
Texas, USA	Responsive Reserve Service (10 min)	Generation Resources: Immediately responsive to system frequency, ramp to required level within 10 min, maintain for period of service commitment. Interruptible Load: Interrupt within 10 min of verbal instruction by ERCOT or automatically when frequency reaches specific level (no lower than 59.7 Hz), maintain until restoration approved by ERCOT. DC Tie: Increase/decrease delivery to/from ERCOT at ERCOT frequency of 59.9 Hz within 4s, at rate of at least 30 MW/min, until ERCOT frequency recovers to 60.0 Hz. Hydro Unit: Initiated at no lower than 59.9 Hz, generating within 4s.	Based on market price and quantity cleared.	Information not available to date.

Source: Ireland – Short Term Active Response Information Document (January 2005, from EirGrid's website: http://www.eirgrid.com/), additional information by enquiry; National Electricity Market (Australia) – National Electricity Rules (Version 9), Market Ancillary Service Specification (Version 1.5, from NEMMCO's website: http://www.nemmco.com.au/); New Zealand – Electricity Governance Rules (31 August 2006), Reserve Management Tool Functional Specification (25/05/04, from the New Zealand Electricity Commission's website: http://www.electricitycommission.govt.nz/), other documents from the New Zealand Electricity Commission's website; Texas – ERCOT Protocols (October 1, 2006), ERCOT Operating Guides (October 1, 2006).

Annex 2: Industry Comments and EMC's Responses

Item No.	PSO's Comments	EMC's Responses
1	PSO noted that in EMC's earlier paper on Provision of Reserve from Interruptible Load Facility (EMC/RCP/09/2003/216), it was acknowledged that reserves provided by ILF is different from that provided by GRFs. They should not be considered in the same class due to the different nature in which they provide reserves. It is therefore regrettable how that view cannot withstand the test of time in the face of a feedback from a Market Participant. All of a sudden, EMC decides to forsake/disregard technical differences between both facilities and choose the easier way of increasing the activation frequency of IL facilities (ILF), which could compromise security of the power system. Beside the perceived payment inequity between GRFs and ILFs, PSO sees no basis to require all ILF to raise the UFR activation setting especially with higher risk to the power system.	The TWG brought up that there were differences in the way GRFs and LRFs provide reserve. The differences could suggest that reserves provided by LRFs and GRFs were different, i.e. they should not be considered in the same class. To address this, one possible solution was to create a separate class of reserve to be provided by LRFs only. But this solution was not pursued at that time. 1) We have considered this possible solution in our paper (under Option 1 but have found it to be inappropriate. The Reserve market was designed to allow both GRFs and LRFs to provide reserve to the 3 reserve classes. This is because it was recognised that decreased consumption from LRFs has the same effect on the system frequency as increased output from GRFs. Since there is no reason to believe that the existing three Reserve Classes inadequately provide for system security, it is thus not necessary to create a separate class of Reserve to be provided by LRFs only.
2	It was also stated in the summary in para 3.1 of EMC/RCP/09/2003/216, any form of inequity in terms of frequency of activations should be compensated by the conversion of that reserve into energy through the additional energy payments to the Generators. However, IL providers do not receive additional payment, as they are only paid reserves. As this is a payment issue, PSO would prefer to leave the pricing and settlement matters to the Market Operator instead.	The previous paper is wrong. Payments for energy generated by generators in response to providing Reserve is compensation for having agreed to generate energy for the amount of Reserve it is scheduled for at the market clearing price. It is not an activation payment. It is inequitable to discount payments to LRFs (for their low probability of being activated to provide reserve compared to GRFs) without also discounting payments to GRFs taking into account the following:

		a. GRFs' responses are more drawn out (i.e., gradual increase in output) as GRFs need some time to increase their output while the responses of LRFs are immediate in that their consumption falls instantaneously to zero when tripped; b. GRFs generally do not provide the full scheduled quantity of Reserve when activated, while LRFs would provide the full scheduled quantity of Reserve when activated; and c. GRFs' response duration is shorter than the LRFs' in the case of Primary and Secondary Reserve since LRFs can only restore power upon obtaining clearance from the PSO. To alter the payment methodology to take into account the above dimensions in which Reserve provision differs between GRFs and LRFs would require a methodology that is able to distil these differing dimensions into a single parameter. However, in reality, determining such a methodology would be extremely difficult, if not impossible. Assuming even if it is possible to determine a payment methodology which accounts for each of these different dimensions, we would still need to assign different weights to each of these dimensions to reflect their relative importance in order to derive at that single parameter. Such assignment is likely to be arbitrary and indefensible. Review of practices in other jurisdictions also does not point to the need to consider changing the current reserve payment methodology used in Singapore.
3	Determination of the UFR activation frequency of ILF is the responsibility of PSO and any attempt to change must be justify with technical/engineering considerations, not simply to address payment/charges issues. If we look at the international practices in setting the activation frequency of ILF, system size relative to the largest contingency is the prime consideration. Examples are the Electricity Supply Board, ESB of Ireland, which activates its IL at 49.3Hz and the New Zealand Electricity Market, which activates its IL at 49.25Hz. Hence, our IL activation frequency of 49.4Hz is comparable to the other international practices of similar power system size.	Comparison based on IL activation frequency alone may not be sufficient. Our review of New Zealand Electricity Market and ESB of Ireland also showed that historically, they have relatively higher number of IL activations (compared to Singapore): **New Zealand:** 2001 - 8 times 2002 - 4 times 2003 - 2 times 2004 - 7 times 2005 - 9 times 2006 - 3 times

		2007 (beginning of year to Apr 07) - 4 times **ESB of Ireland:** about 5 times per annum
4	The paper 'EMC/RCP/09/2003/216' incorrectly stated that activation frequency setting of ILFs was intentionally set lower simply to encourage IL participation in the reserves market. Determination of the current frequency setting of IL activation was in fact, carried out over the course of almost 1 year of exhaustive power system engineering study including co-ordination with the existing Under-Frequency Loadshed scheme for the non- dispatchable loads. Due consideration was also given to international practices of other jurisdictions, so as to ensure that IL activation in Singapore for Reserve provision will not compromise system security and reliability. Some of the considerations are as follows: • Recovery times of IL facility. For GRFs, when system frequency recovers after a forced outage, their output also recovers almost instantaneously (within a minute typically). Therefore, the GRFs can respond (arrest the fall in system frequency and restore & maintain system frequency at an acceptable limit) quickly should the next forced outage/tripping occur. But for ILFs, once they are activated, historically, it would take a much longer time (1 to 2 hours) for them to run back their plants, therefore exposing the system to risk of having less reserve in the meantime to respond in the next forced outage/ tripping. Potentially, it could lead to higher risk of load shed if the ILFs are always activated first. • Supply and demand fluctuations can occasionally cause the system frequency to drop below 49.8Hz. If IL frequency setting was set slightly lower than 49.8Hz as proposed by EMC, it could result in increased occurrences of unnecessary activations of IL due to causes other than forced outages. This will deprive the power system of the required reserves should a contingency happen before ILFs can be re-connected to the system. Therefore, it is important to set the activation frequency of ILFs at the current level, where it is most needed and should be activated during a significant forced outage rather than the minor fluctuations or forced outage events.	We note PSO's concerns that activation of LRFs at higher frequency setting may pose risk to system security and reliability. To enable the RCP to understand the risk involved, we request that the PSO provide the RCP with a study to illustrate the likelihood and severity of the problems involved with over-frequency should the activation frequency for LRFs be set at 49.75Hz (as earlier suggested by EMC, barring system security concerns) given that the current frequency activation setting for Secondary Reserve for LRFs is already set at 49.7Hz and also, the PSO has imposed limits on the amount of reserve that can be provided by LRFs for system security reason as follows: • Firstly, there is a system-wide limit placed on the amount of reserve that can be provide by LRFs set as a percentage of total reserve requirements for each reserve class. For primary reserve, secondary and contingency reserve the limit are 10%, 20% and 30% respectively • Secondly, to deal with the voltage stability issues which are more prominent on a regional basis, PSO requires dividing the island into various zones to be able to monitor this properly. Thus, a MW limit per class of reserve for each zone has been set in the SOM. In addition if setting the activation frequency for LRFs to be 49.75Hz will pose a problem of over-frequency, then what is the highest activation frequency setting for LRFs that will not pose such a problem? On the comment that once LRFs trip, they would take much longer time before they are capable of providing reserve again and hence, LRFs should be tripped latter than GRFs does not seem equitable since both GRFs and LRFs offer to provide reserve to the same class of reserve. On the concern that minor fluctuations or forced outage events may result in unnecessarily tripping of LRFs, this concern may not be significant if LRFs activation frequency setting was set slightly lower than 49.8Hz since it was pointed out in point 5 that even if the LRFs

	• The amount of generation reserves activated is dependent on the system frequency decay during forced outages. Unlike the ILF where the amount of IL reserve provided is solely dependent on the UFR setting. GRFs can vary their output, providing at times only a fraction of the reserves scheduled, according to the variations in system frequency but for ILF once activated, it provides the full amount of reserves scheduled. Therefore, under forced outage, if ILFs are activated at higher frequency, the gross reserves provided may exceed the required reserves and the power system could end up with over-frequency issues, which might lead to tripping of online generators. For example, in New Zealand on 6 August 2004, they experienced an under-frequency event but due to over-provision of IL reserves, the system frequency peaked at 50.32Hz after about 30 seconds. Considering that NZ IL frequency setting was already at the lower 49.25Hz, it is quite unimaginable what the system frequency will be like if they set their IL activation frequency higher as what EMC suggested.	frequency activation for Primary Reserve were to increase from 49.4Hz to 49.7Hz in 2006, there would only be an additional 6 LRF activations in 2006
5	So what if the IL frequency activation for Primary Reserve was to increase from 49.4Hz to 49.7Hz in 2006? Based on the historical forced outage records, it would only yield an additional 6 activations of ILF in 2006. Considering that there was a total of 151 generation forced outages in our interconnected power system in 2006, it would still not address the payment equity issue between the GRFs and ILFs in Reserve provision.	We noted this point in our evaluation of Option 3. As mentioned in the paper, since the responses of GRFs and LRFs exhibit different features, it is difficult to alter the current Reserve provision arrangement to make it completely equitable. Having said this, the responses of LRFs are to an extent controllable, particularly the frequency levels at which they are activated. Thus, Primary and Secondary Reserve activation frequencies of LRFs can be adjusted to bring about more balanced responses of GRFs and LRFs (if this does not pose a risk to system security). This is because it is undesirable for the market to have a subset of Reserve Providers with close to zero expectation of activation.

6	In conclusion, there are serious repercussions on the power system if the IL activation is set much higher than the current level. PSO see no basis in revising upward the ILF activation frequency as proposed by EMC (Option 3 in the concept paper). We urge EMC to seriously consider Option 1 giving due recognition to the fact that GRFs and ILF behave differently in the provision of reserve and address the payment issue, which is entirely within EMC's capability rather than threading into the unfamiliar ground of power system engineering. EMC may wish to consider the creation of new Ancillary Services Contracts for IL, similar to what other jurisdictions in ESB, New Zealand, California, etc, are doing. This option was not envisaged in the early days of opening up reserve provision to ILF in 2004 as the NEMS then just went live for less than a year and there was desire to minimize changes to the Market system. Now that the NEMS is fairly mature, it's probably time for EMC to explore the feasibility of this option. Alternately, if no change to the MCE is desired, PSO view that it is more appropriate for EMC to resolve this purely payment and settlement issue via Option 2, again well within EMC's capability.	We have given options 1 and 2 due consideration but have found them to be inappropriate. We believe there is a case to review whether Primary and Secondary Reserve activation frequencies of LRFs can be raised to give LRFs have an increased expectation of being activated in contingencies. Thus, we maintain our recommendation (i.e. Option 3) pending PSO's study on concerns of over frequency should the current activation frequency setting for LRFs be raised (refer to our comments on item 4).
	Tuas Power's Comments	**EMC's Responses**
7	Tuas Power is in support of option 3 (EMC's recommendation) that the current Primary and Secondary Reserve activation frequency for LRF be raised to bring about a more balanced response between GRF and LRF in Reserve provision and equity in reserve payments. It is of the opinion that a more equitable setting would be a 50% expectation of LRF responding to contingency events (e.g. tripping of a 250MW unit) given that LRF are paid 0.95 times the reserve price all the time while GRF can	Tuas's suggestion of raising the activation frequency settling for LRFs so that there is 50% expectation of LRFs responding to contingency is for the PSO to consider.

	be paid as low as 0.55 times the reserve price for responding almost all the time.	
8	Tuas Power is however of the opinion that EMC has adopted a biased position in setting out its position with regards to supporting the case for maintaining the current reserve payments to LRF vis-à-vis payments to GRF. The following comments on the paper support our views on EMC's position:	
	1) Background (section 2) paragraph 3 - The original statement --- "To dispel one false notion of inequity suggested in this statement, we note here that actually all Reserve Providers are paid at some fraction of the Reserve price which varies with their expected Reserve provision capability" --- gave the impression that LRFs are paid generally on an equal basis as GRFs. A more accurate representation would be all LRFs are paid at 0.95 times the prevailing Reserve price on the basis of their deemed response to contingency events, while GRFs are paid between 0.55 and 0.95 times the Reserve price based on their historical responses to contingency events.	We have added in a footnote to clarify the statement.
	2) Analysis (section 4) paragraph 1 - To consider rephrasing to: "The Market Participant had pointed out, back in Feb-06, that LRFs have not been responding to contingencies since 1 July 2004. The LRF activation was only first activated on 11 May 2006. The LRF activations are as shown in Table 4." As the original statement: "The Market Participant claimed that LRFs have not been responding to contingencies. We understand the number of LRF activations since the first LRF began offering Reserve on 1 July 2004 is as shown in Table 4……. Based on Table 4, it is not true LRFs have not been responding to contingencies." as worded gave readers the impression that the original statement was incorrect when it was in fact correct at the point it was made.	We have re-phrased the statement

	3) Analysis (section 4) table 5 - To consider rephrasing as: "Received even if standby capacity not provided in real-time (e.g., due to forced outage). There is no immediate penalty, but with the downward revision of reserve effectiveness in the next quarter due to non-performance, there would be penalties (delayed) for the unit." instead of the original statement: "Received even if standby capacity not provided in real-time (e.g., due to forced outage) – no penalties." as it seems to emphasize that there is no penalties when GRFs do not respond to contingency events given the context of the paragraph where comparison was drawn to LRFs being liable to penalties for non compliance	We note that it was incorrect in the Concept paper we have published to state that GRFs are not liable for penalty but LFRs are liable for penalty for non-compliance. Under the SOM, both GRFs and LRFs are liable for penalty for non-compliance for being unable to provide adequate reserve as scheduled or instructed. However, in terms of payment, GRFs can receive payment for standby capacity even though such capacity may not be available in real-time (e.g. due to forced outage). Likewise, for a LRF, it too can receive payment for standby capacity even though such capacity may not be provided in real-time (e.g. due to low consumption level),
	4) Conceptual considerations (section 4.2.1) paragraph 2 – The statement: "a) GRFs' responses are more drawn out (i.e., gradual increase in output) as GRFs need some time to increase their output while the responses of LRFs are immediate in that their consumption falls instantaneously to zero when tripped;" gave readers an impression that LRFs provide faster and better quality of responses than GRFs. However based on GRFs mandatory governor deadband settings and LRF UFR setting, GRFs will always technically provide more immediate response than LRFs and if the UFR setting is not reached, then there is no response at all from the LRFs. The market rules do not differentiate as to whether a drawn out or immediate response is better; only that the facility cleared to provide reserve is able to deliver that amount in the required timeframe.	We agree that GRFs respond to system disturbances is more immediate due to their governor response. This is why, under Option 2, discounting of payments to LRFs based on their (chosen) probability of being activated in a contingency) is considered, whereas we have not suggested the same for GRFs (i.e. discounting of payments to GRFs). We agree that the market rules currently do not make a distinction whether 'immediate' response is better than 'drawn-out' response. But is it not also true that the rules currently do not make a distinction between LRFs and GRFs in terms of number of activations in relation to reserve payment? We cannot choose to discount payments to LRFs based on one dimension and ignore other differing dimensions between GRFs and LRFs for Reserve provision.
	5) Conceptual considerations (section 4.2.1) paragraph 3 – The statement: "b) GRFs generally do not provide the full scheduled quantity of Reserve when activated, while LRFs would provide the full scheduled quantity of Reserve when activated;" give readers an incomplete picture. GRFs sometime provide more than the full scheduled quantity but are penalized subsequently if they failed to deliver the full scheduled quantity	What the statement means is that when activated for reserve, LRFs will provide full scheduled amount upon activation, whereas GRFs generally will not have to provide full scheduled amount (because tripping of generators is rarely the largest unit which reserve is procured for).

	(via reserve effectiveness classification). The implied statement that LRFs provided full scheduled quantity when activated is only on the basis of 2 activation events (and in which in one of the case, the LRFs did not provide primary and secondary reserve during the contingency event, but only contingency reserve when called upon by the PSO, i.e. a few minutes after the contingency event – immediacy of response relative to GRFs in that case?	We agree that GRFs may need to provide more than full scheduled quantity in rare situations (e.g. when there is a double contingency such that even the aggregate Reserve procured was not sufficient to cover that contingency).
	6) The paper did not emphasize that 3 out of the 4 activations of interruptible loads was due to a system double contingency event, i.e. under normal circumstances, there has only been only one activation of interruptible load.	We believe this to be true as we understand the activation of Reserve from LRFs occurred on 21 Dec 06 when there was tripping of two generating units (i.e. double contingency event) due to an unplanned disruption to the piped gas supply. We have amended the paper to reflect this comment.
	Air Product's Comments	**EMC's Responses**
9	We disagree with the conclusion that because LRFs were activated a less number of times than GRFs they should either receive a reduced payment or their under frequency set point should be raised to increase the probability of their activation. A MW of reserve provided by a LRF can substitute for a MW of reserve provided by GRF. As both are able to fulfill the requirement of the market they should have the same value. In fact, a LRF being able to be fully deployed faster than a GRF should even be priced higher.	We did not recommend altering payment methodology (see conclusion under Option 2). We agree with the first statement in that the Reserve market was designed to accommodate GRFs and LRFs as Reserve Providers and to consider Reserve from both as equivalent. However, we disagree with the last statement that Reserve by LRFs should be priced higher since LRFs are being able to be fully deployed faster than GRFs. It is inequitable to alter payment methodology based on just one dimension when there are also many other differing dimensions between GRFs and LRFs in the provision of Reserve.
10	The paper stated the low number of activation give the market a "close to zero expectation to activation" for a LRF. It was concerned that a "close to zero expectation to activation" would reduce LRFs' cost of providing reserve and thus giving them an unfair advantage. There is no evidence to support this argument. The current small number of LRFs in the market shows that incentive provided by the market is insufficient to encourage greater participation. To increase the probability of activating LRFs will	A Reserve Provider's expected cost of providing Reserve includes the cost of providing capacity on standby and the expected cost in a contingency (which depends on the probability of activation and the costs incurred when activated). Since the probability of activation for LRF is close to zero (based on historical evidence), hence LRFs' expected cost in a contingency would be close to zero. This reduces LRFs cost of providing reserves.

	further discourage participation. It is known in other markets that steps were taken to encourage load participation to help control power costs by avoiding the need to build and operate some amount of new generation to fulfill the reserve requirement.	
11	In our view, the strategy to determine which facilities to be activated should be based on the principles of; • First and more importantly, ensuring no threat to system security and • Secondly, promote the optimal utilization of GRFs & LRFs. After ensuring system security, the win-win scenario would be for generation facility to generate whenever opportunity arises and load facility to consume whenever circumstance allows. After all generation facilities are built to generate and load facilities are built to utilize the generation. Deviation from this will lead to sub-optimal resource utilization and waste. Therefore during a contingency, GRFs should be activated first unless doing so threaten system security. Furthermore, GRFs are not penalized for activation. Under the current market a GRF continue to get paid after activation, in the form of energy payment, while a LRF do not. Wholesale prices after activation are expected to be significant and GRFs is able to gain from such activation	We agree that the activation frequency setting for LRFs should always have regard for system security (this is why we have requested PSO to provide RCP with a study for the RCP to understand the risk associated with over-frequency should the current activation frequency setting for LRFs be raised (see our comments on item 4)). At the existing activation frequencies, LRFs have hardly been activated. Excluding double contingencies that the aggregate Reserve requirement was not meant to sufficiently cover, LRFs have not been activated at all for Primary and Secondary Reserve. Historically, the lack of previous activations gives LRFs close to zero expectation of future activation. This potentially distorts competition in Reserve markets because it effectively reduces LRFs' expected costs of providing Reserve, giving them an unfair advantage. The payment received by GRF for its generation after activation should not be seen as activation payment. It is entitled to additional energy credits for increased output. Similarly it can be argued that for a LRF, its energy debits are lowered due to zero consumption when activated.
12	.LRFs & GRFs cleared by the market have equal value and abilities to provide reserve, but that should not mean that the market have to adopt an activation strategy that is based on certain probability. Instead the market should adopt the strategy that optimizes resources and create a win-win outcome for the participants. In conclusion we do not support the recommendation of the paper.	Please refer to our comments above.

	Island Power’s Comments	EMC’s Responses
13	To assess changes in the Reserve market it is necessary to also consider impacts on the energy market. This is because the two markets are interrelated – reserve and energy are co-optimised every half-hour in the price discovery process. There is minimal consideration of impacts on the energy market in the paper which we believe needs further thought.	We note that an increase in activation frequency setting for LRFs which increases the probability of activation may reduce participation. However, we do not think that it will have considerable impacts on the energy market given that currently the volume of load participating in the Reserve market is very small in comparison to total market size.
14	The volume of load participating in the Reserve market is currently very small in comparison to both total market size and load participation in other countries. We understand the total volume of LRFs is only about 20MW. For comparison, in the New Zealand electricity market, a market of similar size of Singapore with virtually identical market rules, there is up to 400MW of LRFs. Some of this difference can be explained by the different load types in these countries, but that does not fully explain the large difference. Markets function well when there is participation from both the supply and demand side. It is a common feature of deregulated electricity markets that demand participation is low compared to other product markets. This is largely due to the low elasticity of demand. Given this current low level of demand side participation, it is important to not create barriers to further loads participating in the market. To put this in another way, the market should create an environment conducive to demand side participation. The market should be encouraging more loads to participate in the Reserve market and not creating barriers, provided they comply with the necessary technical requirements.	We agree markets function well when there is participation from both the supply and demand side. But it is also true that we need a level playing field and avoid giving either side undue advantage to promote fair and efficient competition. Our recommendation to consider raising the frequency activation setting for LRFs should be seen in this light, and not as a barrier to entry.
15	The paper discusses whether it is unfair for GRFs and LRFs to be called upon a disproportionate number of times. We raise some further points on this as follows. Generation and load have fundamentally different cost structures and drivers. Generation plant is synchronised to the national grid and responds automatically to system frequency --- it is in the business of providing electricity. Consumers typically need electricity as an input for producing their products and services. Load interruptions are	Our paper noted that while the Reserve market is designed to treat Reserve from both GRFs and LRFs as equivalent, GRFs and LRFs differ along several dimensions in Reserve provision. We also note that it is inequitable to alter payments to LRFs purely based on their relative low number of activations without also altering payments to GRFs taking into account other dimensions in which GRFs and LRFs differ for reserve provision.

	without notice and the corresponding value of lost load can be extremely large. Loads when armed in the Reserve market provide a key security feature, similar to an insurance product, whether called upon or not. For these reasons, we believe it is acceptable for GRFs and LRFs to be called upon a disproportionately number of times to provide reserve.	We further note that it is not possible for GRFs and LRFs to have the same number of activations. Having said this, the responses of LRFs are to an extent controllable, particularly the frequency levels at which they are activated. Thus, we believe there is a valid case to review whether Primary and Secondary Reserve activation frequencies of LRFs can be raised to bring about more balanced responses of GRFs and LRFs (if this does not pose a risk to system security).
16	The paper recommends "hence, we do not believe it is appropriate to consider Reserve from GRFs and LRFs as different services or different classes of service." We support this recommendation for two main reasons: • GRFs and LRFs provide the same outcome in managing frequency/ • the market is already very small and defining these as different services would make the market even smaller. This would have an adverse impact on market efficiency.	We support the recommendation based on the reason cited in bullet point 1, and not 2. The key consideration should be that the Reserve market was designed to accommodate GRFs and LRFs as Reserve Providers and to consider Reserve from both as equivalent. This is because it was recognised that decreased consumption from LRFs has the same effect on the system frequency as increased output from GRFs. Since there is no reason to believe that the existing three Reserve Classes inadequately provide for system security, it is not necessary to create a separate class of Reserve specifically to be provided by LRFs.
17	The paper recommends "overall, there does not seem to be a case for altering the existing Reserve payment.' We support this recommendation given that the conceptual and practical considerations and practices observed in other jurisdictions.	Noted.
18	The paper recommends "…we suggest the PSO be requested to review whether the current Primary and Secondary Reserve activation frequencies for LRFs can be raised to give LRFs an increased expectation of being activated during contingencies." This is an arbitrary request as no doubt the answer to this question is 'yes'. Further guidance and direction would be needed from the market to the PSO as to the level of 'increased expectation'. For the reasons described earlier regarding market size, efficiency, barriers to entry and the arbitrary request to the PSO, we do not support this approach.	We believe there is a valid case to review whether Primary and Secondary Reserve activation frequencies of LRFs can be raised so that LRFs have an increased expectation of being activated in contingencies. Thus, we maintain our recommendation (i.e. Option 3) pending PSO's study on concerns of over frequency should the current activation frequency setting for LRFs be raised.

19	An observation we make from the paper is that market participants have no knowledge on whether the correct amount of reserve is being dispatched. For example, there is no information on actual system response following contingencies. A possible reason why LRFs area not being called upon could be that the PSO is dispatching too much generation reserve. If this were the case, the system frequency would not fall to the levels that trigger LRFs. There is a balance to be struck between the volume of security products procured and cost, which ultimately borne by consumers. We recommend the PSO be requested to provide information on actual system responses and reserve dispatched.	PSO to consider this request.
	Senoko Power ‘s Comments	**EMC’s Response**
20	<u>One-size-fits-all regime for different service providers</u> Senoko, as a Generation Registered Facility (GRF), optimise our generation assets through bids to provide energy and reserves. We have to ensure that our plant are maintained properly to provide all the services when scheduled, including the exacting performance and responses to system requirements for the different classes of reserves. LRFs on the other hand do not need to actively manage its “portfolio” like GRFs. Neither is it exposed to the price risks in the reserve prices. The only risk it faces, it seems, is the possibility of having its facility’s loads reduced or tripped off in the unlikely instances where system frequency falls below 49.7 Hz. We note that over 33 months, LRFs are activated only once for Primary, once for Secondary and twice for Contingency. At the same time, it continues to receive the same payment as a GRF (or even more) at the maximum scaling factor of 0.95 for not providing any useful responses to moderate the system frequency deviations until the level of 49.7Hz. This preferential treatment to this class of reserve provider is an anomaly when there is no price differentiation. In contrast, while GRFs respond constantly to system frequency changes, the effective reserve price it receives is subject to reduction based on its	

	Reserve Effectiveness. In providing reserves, GRFs are expected to set aside capacity, and risk a shortfall of reserve capacity should units trip. This point to a key problem in the current Reserve regime. It is a "one size fits all" scheme that fails to take into account that the "service" GRFs and LRFs essentially differ in scale, scope and cost of provision, and creates, in EMC's words, an "unfair advantage" for LRFs. <u>Option 3 has real, practical limitations</u> EMC's proposals to address the differences are: • to consider Reserve from GRFs and LRFs as different service; that is, to re-classify LRFs as a separate reserve class, possibly in order to establish a separate payment scheme for LRFs; • to alter the Reserve payment methodology; EMC proposed a new concept called "Reserve Activation Group", where an LRF in a Group of its own choosing would be subject to varying probabilities of being called in for service, with corresponding price levels to reflect the different probabilities; or, • to adjust the Primary and Secondary Reserve activation frequencies of LRFs so responses from GRFs and LRFs are more balanced. Option 3 is EMC's recommendation. Option 3 certainly has its merits. It appears to be fair, raising the response frequencies of LRFs to be more "on par" as far as expectation of activation is concerned. However, if the objective of increasing LRF's response frequency is merely to ensure there's some equity in the probability of response, due to the dynamic nature of system frequency variations and reserve response, we anticipate that determining what the appropriate Primary and Secondary reserve response frequencies to be a near impossibility. This is due to the characteristics that there will be a "dead band" of non participation by the LRF above whatever value that the activation frequency is set below 50 Hz. For example, if the activation is raised to 49.8 Hz, there is no response of reserve participation by the LRF until the system frequency drops to 49.8 Hz. Hence the same problem exists where the activation frequency has been at 49.7 Hz.	As mentioned in the paper, since the responses of GRFs and LRFs exhibit different features, it will be difficult to alter the current Reserve provision arrangement to make it completely equitable. Having said this, the responses of LRFs are to an extent controllable, particularly the frequency levels at which they are activated. Thus, we suggest the PSO review whether the activation frequencies of Primary and Secondary Reserve for LRFs can be raised to bring about <u>more balanced</u> responses of GRFs and LRFs (if this does not pose a risk to system security).

	System frequency constantly varies, and GRFs are always responding to such variations differently, based on system and plant characteristics at the time. We do not think it is possible to attempt to model such system characteristics and interaction in order to predict a suitable LRF activation frequency that would raise the probability of activation to be more on par with that of GRFs. The PSO would be in the best position to advise on this point.	
21	<u>Option 2 deserves more consideration</u> We think that the EMC has dismissed Options 2 (and 1; in our opinion, both are related) too readily. While the EMC claims that LRFs should not be considered to provide a separate class of service from GRFs, the fact remains that GRFs and LRFs respond to frequency variation differently. That both facilities have the same "effect" on system frequency is over-simplistic. One only needs to compare the frequency of response by GRFs (which is impossible to compute) with that by LRFs. In short, due to the dynamic responses by GRFs to system frequency variations, there is little need for LRFs to be activated. It is thus puzzling that LRFs continue to receive payment when it is the GRFs that are responding to system frequency changes. We hope that the Rule Change Panel will agree with us that GRFs and LRFs do provide different services, and thus there is a need to examine how LRFs are to be rewarded for the services they provide. As the paper is still at the conceptual stage, we hope the RCP will be convinced that a separate payment structure is necessary, and request the EMC to provide a more comprehensive and in-depth examination of payment schemes that may be adopted by the Singapore market.	The paper noted that GRFs and LRFs differ along several dimensions in Reserve provision. This is why, for Option 2, we consider it necessary to take into account all differing dimensions if we were to alter the payment methodology to maintain equity for both GRFs and LRFs. To alter the payment methodology to take into account the above dimensions in which Reserve provision differs between GRFs and LRFs would require a methodology that is able to distil these differing dimensions into a single parameter. However, in reality, determining such a methodology would be extremely difficult, if not impossible. Assuming even if it is possible to determine a payment methodology which accounts for each of these different dimensions, we would still need to assign different weights to each of these dimensions to reflect their relative importance in order to derive at that single parameter. Such assignment is likely to be arbitrary and indefensible. The Reserve market was designed to accommodate GRFs and LRFs as Reserve Providers and to consider Reserve from both as equivalent. This is because it was recognised that decreased consumption from LRFs has the same effect on the system frequency as increased output from GRFs. Since there is no reason to believe that the existing three Reserve Classes inadequately provide for system security, it is not necessary to create a separate class of Reserve specifically to be provided by LRFs.

	Diamond Energy's Comments	**Responses from EMC**
22	EMC has referenced in the Concept Paper feedback from industry consultation. We would to clarify this statement as Diamond Energy has not been consulted. In future, per the minutes of the 9th RCP our expectation is that reasonable consultation with GRFs, LRFs, and other industry stakeholders will take place prior to the release of a concept paper. This is to ensure that the content of a concept paper is unbiased, and non-discriminatory. The intent of the recommendation in the Concept Paper appears to pacify the claims made by the market participant who lodged the request and in our opinion the Concept Paper lacks the rationale reasonably required to pursue this matter further.	The Concept Paper was published for industry comments. After publication, Section 6 (on 'Consultation') was left empty as EMC has not consulted the industry. EMC will complete Section 6 with comments from industry and EMC's response to those comments. EMC will also amend the concept paper, if necessary, taking into account industry comments / feedback. We believe that for the industry to response meaningfully to an issue especially for complex issues (e.g. the current issue we are dealing with) it is necessary to flesh out the issue because industry members will find it difficult to comment if there is no analysis or views express on that issue.
23	<u>Reserve Provider Groups</u> We note that the reserve effectiveness is defined as the average actual reserve provided for a unit of reserve requested from the reserve provider. Table 3 in the Concept Paper defines this for existing LRFs as the actual response measured during an actual disturbance event vs. expected response measured by the scheduled reserve. The load enabled for interruption by LRFs must be greater than or at a minimum equal to the scheduled reserve as measured and reported to the PSO through near real time reporting. Otherwise breach of a dispatch instruction results. We therefore question why the scaling factor for reserve effectiveness as defined above for LRFs are less than 1.0. As an example if an LRF is scheduled for 1.0 MW and the load activation is 1.1 MW then the scaling reserve effectiveness is 1.1 and a scaling factor greater than 1.0 is justifiable. This point has not been been articulated in the Concept Paper and warrants adjustment in favor of the LRFs.	As far as the scaling factor is concerned, it is determined by the PSO. We request that the PSO to consider if there is a basis for LRF to have a scaling factor of 1. However, we disagree with the suggestion of having a scaling factor of more than 1. If a LRF actually provide more reserve than the scheduled quantity, it reflects that LRF has not offered what it is actually capable of providing and hence, it is for that LRF to adjust its offers so that the offers more accurately reflect what it is actually capable of providing in reality. Hence, the scaling factor should not exceed 1.

24	<u>Table 5: Payment</u> We note that EMC's statement that GRFs receive payment even if standby capacity is not provided in real time due to a forced outage and no penalties are applicable. LRFs on the hand are liable for penalty for non-compliance. This is unfair to LRFs and warrants adjustment in favor of the LRFs	We note that the Concept paper we have published, incorrectly states that GRFs are not liable for penalty but LFRs are liable for penalty for non-compliance. (We have amended the paper to correct this.) Under the SOM, both GRFs and LRFs are liable for non-compliance for being unable to provide adequate reserve as scheduled or instructed. Penalties may be imposed by the MSCP for non-compliance. However, in terms of payment, GRFs will receive payment for standby capacity, even though such capacity may not be available in real-time (e.g. due to forced outage). Likewise, for a LRF, it too will receive payment for standby capacity even though such capacity may not be provided in real-time (e.g. due to low consumption level),
25	<u>Table 5: Limits on Scheduled Quantity</u> We would like to highlight that for security reasons the quantity scheduled from LRFs in each reserve class (geographical) reserve provider zone is capped. We understand that such limitations on LRFs have been imposed based on direction from the PSO, however, on balance we request this trade-off to be demonstrated as it has not been quantified in the Concept paper.	We understand that the limits on scheduled quantity are imposed by the PSO for system security reason. We do not see how the trade-off can be quantified.
26	<u>Table 5: Activation</u> We would like to highlight that once activated for a given reserve class an LRF requires clearance from the PSO in order to reactivate the load. GRFs on the other hand are able to continue to provide reserve, energy, and regulation. This is unfair to LRFs and warrants adjustment in favor of the LRFs	The requirement for LRF to restore load only upon clearance from the PSO is set in the System Operation Manual.

27	<u>Table 5: Immediacy of response</u> We note upon activation the LRFs load instantaneously falls to zero when the interruption tFs on the other hand require a longer response time. This is unfair to LRFs and warrants review. <u>Table 5: Response Quantity</u> As previously discussed, LRFs are capable of providing an activation quantity greater than the scheduled quantity. This is because near real time monitoring by the PSO requires the instantaneous load of the LRF to be greater than or equal to the scheduled load. The minimum offer quantity increment in the market if 0.1 MW. This is unfair to LRFs and warrants adjustment in favor of the LRFs. <u>Table 5: Response Duration</u> After activation, LRFs require clearance from the PSO in order to reactive the running load. This has the effect of non-participation in periods subsequent to the activation by the LRFs and represents an opportunity loss for the LRFs.	We have already considered these under Option 2. To alter the payment methodology to discount payment to LRFs to reflect their low probabilities of response, we would also have to discount payment to generators taking into account other dimensions in which Reserve provision differs between GRFs and LRFs. This would require a methodology that is able to distil these differing dimensions into a single parameter. However, in reality, determining such a methodology would be extremely difficult, if not impossible. Assuming even if it is possible to determine a payment methodology which accounts for each of these different dimensions, we would still need to assign different weights to each of these dimensions to reflect their relative importance in order to derive at that single parameter. Such assignment is likely to be arbitrary and indefensible.
28	<u>Consider Reserve from GRFs and LRFs as Different Services</u> We support the position proposed by the EMC in the Concept Paper that it is not appropriate to consider reserve from GRFs and LRFs as different services or different classes of service. This should also take into consideration that LRFs, according to the EMC's monthly market report, represents a very small proportion of the total reserve market.	We support the recommendation, but for a different reason. (Please refer to our comments on item 15).

29	<u>Alter Reserve Payment Methodology</u> We do not support the altering in the form proposed by the EMC in the Concept Paper. The RCP at the 9th meeting agreed that the structure that was put in place for interruptible load meets with the technical requirements for the PSO. Changes reflected in the current version of the System Operation Manual have addressed concerns of the PSO pertaining to near real time monitoring which has been introduced and is now in place	We want to highlight that EMC is not recommending Option 2 (i.e. Alter Reserve Payment Methodology) because it is inequitable to discount payments to LRFs (for their low probability of being activated to provide reserve compared to GRFs) without also discounting payments to GRFs taking into account the following: • GRFs' responses are more drawn out (i.e., gradual increase in output) as GRFs need some time to increase their output while the responses of LRFs are immediate in that their consumption falls instantaneously to zero when tripped; • GRFs generally do not provide the full scheduled quantity of Reserve when activated, while LRFs would provide the full scheduled quantity of Reserve when activated; and • GRFs' response duration is shorter than the LRFs' in the case of Primary and Secondary Reserve since LRFs can only restore power upon obtaining clearance from the PSO. To alter the payment methodology to take into account the above dimensions in which Reserve provision differs between GRFs and LRFs would require a methodology that is able to distil these differing dimensions into a single parameter. However, in reality, determining such a methodology would be extremely difficult, if not impossible. Assuming even if it is possible to determine a payment methodology which accounts for each of these different dimensions, we would still need to assign different weights to each of these dimensions to reflect their relative importance in order to derive at that single parameter. Such assignment is likely to be arbitrary and indefensible.

30	<u>Adjust Primary and Secondary Reserve Activation Frequencies of LRFs</u> We do not support the modification of the current frequency activation levels and time duration levels for LRFs. These levels were determined by the PSO at the time they were introduced in accordance with system security considerations. Diamond Energy's view is that system security should remain the primary consideration. As previously stated, LRFs can only be activated when they are first scheduled by the MCE. EMC's comments that at the existing activation frequencies LRFs have not been activated for Primary and Secondary reserve needs to be qualified. The number of LRFs in the market is small and LRFs do not offer capacity in the market on a continuous basis.	We have given options 1 and 2 due consideration but have found them to be inappropriate. We believe there is a valid case to review whether the Primary and Secondary Reserve activation frequencies of LRFs can be raised so that LRFs have an increased expectation of being activated in contingencies. Thus, we maintain our recommendation (i.e. Option 3) pending PSO's study on concerns of over frequency should the current activation frequency setting for LRFs be raised (see our comments on item 4).
31	EMC states in the Concept paper the following: "The lack of previous activations gives lRFs a close to zero expectation of future activation. This potentially distorts competition in Reserve markets because it effectively reduces LRFs to providing Reserve, giving them an unfair advantage." and "Since it is undesirable for the market to have a subset of Reserve Providers with close to zero expectation of activation, we believe that LRF activation frequencies for Primary and Secondary reserve should be raised." We find these statement to be biased and question how the EMC has come to this conclusion as this has not been substantiated by facts. We also question with what numerical data the MEC has deduced that the expected cost of LRFs is lower than GRFs. LRFs are restricted to participation in the reserve market only. Moreover, LRFs are typically price takers and do not set the reserve price in the market. On balance we do not agree with these statements by the EMC.	A Reserve Provider's expected cost of providing Reserve includes the cost of providing capacity on standby and the expected cost in a contingency (which depends on the probability of activation and the costs incurred when activated). Since the probability of activation for LRF is close to zero (based on historical evidence), hence LRFs' expected cost in a contingency would be close to zero. This reduces LRFs cost of providing reserves.

32	The EMC has implied that the historical probability of activation sets the future probability of activation. We do not share this view and question the appropriateness of EMC providing such forward reaching statements in the Concept Paper.	In statistics, it is common to use historical data for forecasting or making projections. It is also common for people to form an expectation of an event based on historical occurrence(s) of that event.
33	We do not support the concluding statement which calls for the PSO to increase the frequency settings for Primary and Secondary reserve such that an increased expectation of LRFs being activated occurs. This conclusion extends beyond the scope of the EMC as the frequency settings were set at frequency levels required to meet system security by design. The frequency settings set by the PSO should stand as they were determined to serve the security and integrity of the power system not an intended probability of activation of LRFs.	However, there is a need to ensure that we have a level playing field for all players and no party is given undue advantage in the interest of promoting fair and efficient competition.