Future Power Systems 19 – DER Participation in Operator Timescales.

Both the system and distribution operators need to forecast and monitor the transmission and distribution flows in terms of security and stability. They therefore need a reliable base for predicting demand and generation, both totals for matching and by location for security analysis. The system operator also needs adequate resources allocated to response and reserve duty. Both operators will also have plant allocated for emergency action, (e.g. intertripping), in parts of the system where this is required post fault to avoid breaching circuit thermal limits or local system voltage/stability limits. Introducing such generation control schemes has permitted extra plant, especially renewables, to be installed in parts of the system where they would not be accommodated under conventional (passive continuous operation) security criteria.

Active Distributed Energy Resources can thus be employed by the operators for matching, ancillary services and active local security management.

Matching Mechanism and DER

The matching mechanism is designed to allow submission of matching mechanism unit profiles and data to the system operator who can then make adjustments to those profiles as necessary. Demand units, which include all Distributed Energy Resources (DER), are by default configured by supplier within distribution groups. Individual large active customers, or aggregations of active groups of smaller customers, can be configured as separate demand units to enable participation.

As DER premises are part of the system operator's estimate of demand, only the variation of premises import-export should be modeled as part of the matching process.

All the major decisions which affect genset running profiles, principally commitment, are made in market timescales. Some operator intervention is permitted to ensure adequate plant margins and system security.

The matching mechanism takes banded prices called Bid-Offer data ranges (BOD). The range indexes have the same sense across all Generation and Demand units.

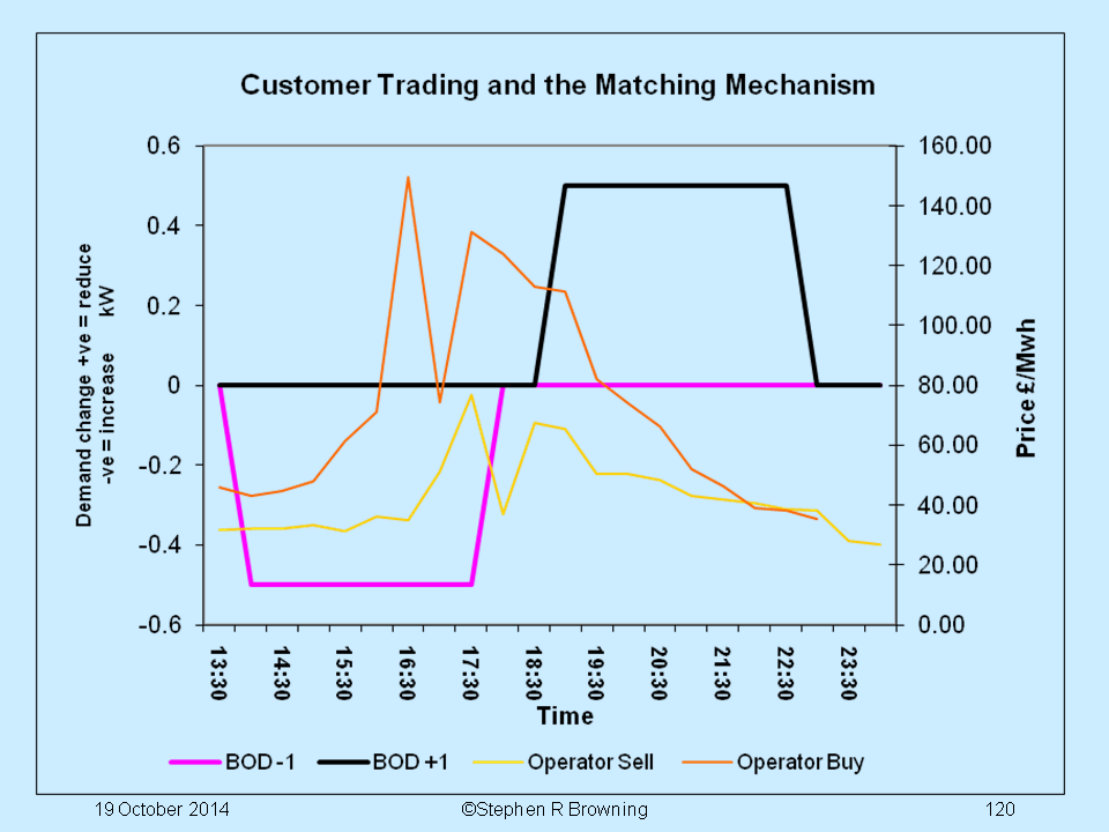
BOD positive ranges represent increasing genset output, increasing DER export or decreasing DER import as against the submitted unit profile.

BOD negative ranges represent decreasing genset output, decreasing DER export or increasing DER import as against the submitted profile.

Each range has a Bid Price, which represents the price the customer will pay for increasing his demand or reducing his export and an Offer price which the customer will receive for reducing his demand or increasing his export. The are shown as BOD +n ranges and BOD –n ranges on the next diagram

The operator outturn sell and buy prices are also shown. These are the averages of Offers accepted (Buy) or Bids accepted (Sell) within the period, or the market closing marginal price where no offers or no bids have been made. Note that these are outturn prices and are not known in advance.

Lets say that in this case the customer has decided he can offer one range to decrease demand (BOD +1 Offer), the laundry demand for 4 hours from 1800. He therefore makes an Offer to increase demand for 4 hours from 1400 (BOD-1 Bid) which represents shifting the laundry run to the afternoon.

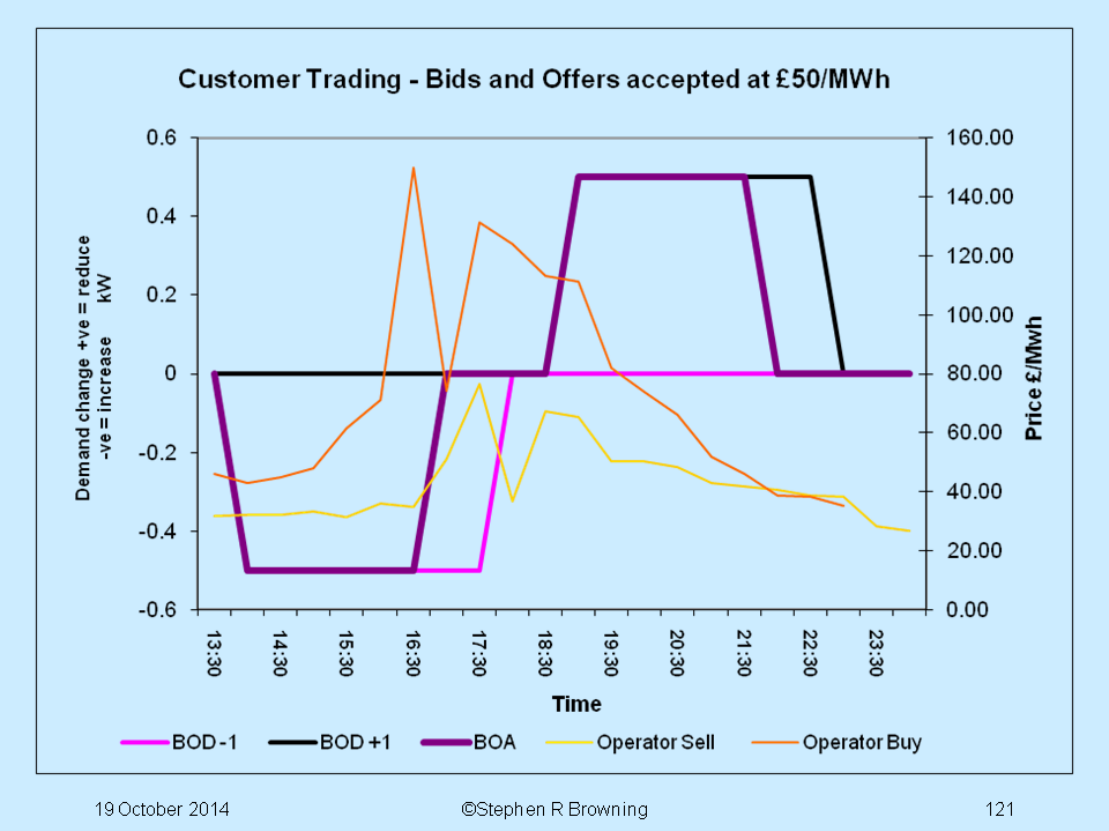


The operator can only 'accepts' offers and bids up to the third half hour ahead. If he accepts DER ranges then the customer's profile and his use will start to change and the remaining future data will no longer be valid.

For example, let's say the customer quotes a Bid price (pay to increase demand) on his BOD-1 range of 5p/kwh (£50/Mwh) between 1400 and 1700. If the operator has surplus output to sell across this period (starting at £30/MWh), then he will accept the bid in stages, say one half hour at a time. However when we get to 1700, the operator has less output to sell and the price rises; thus he will not take the Bid for that half hour. However the customer's extra demand is contiguous (laundry) and cannot be interrupted…

Now let us look at the matching demand reduction over the period 1800 to 2300. Here the customer would be looking to reduce demand (BOD +2 Offer) and be paid at or above the £50/Mwh he paid earlier, say £55/Mwh. Up to 2100, the operator Buy price is above that level. But, for last two hours the operator buy price dips below that level and the offer will not be taken.

The Bid and Offer acceptances are shown as BOA on the next diagram.

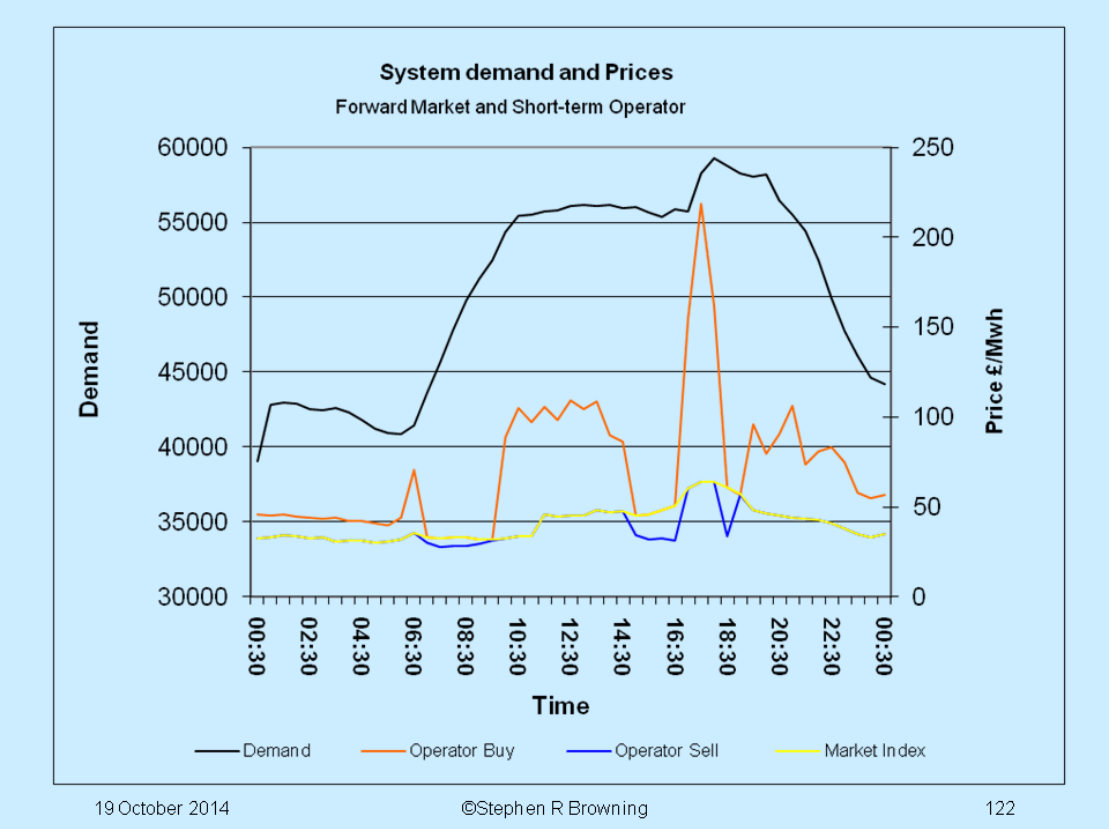


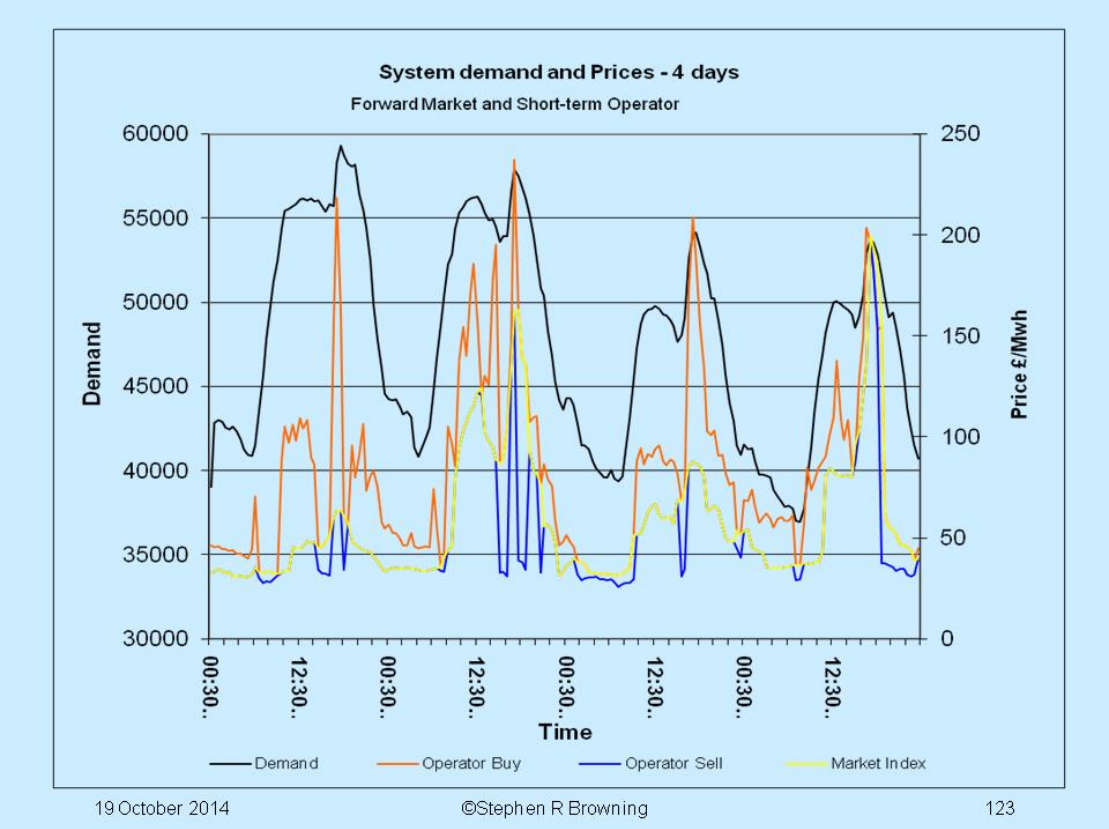
So the problem here is predictability, this time from the point of view of the customer. The matching mechanism is only really designed for short term adjustments to output on synchronised generation, not really for commitment for a period of running. As we said above such 'commitment' is really the province of the market although, as you will see from the previous article, attempting to trade DER in that arena also encounters problems.

Tariff Mechanisms

So, once again let us look at using dynamic price messages to influence DER operation. In this case, however, we have an extra complication. The primary retail tariff is between the customer and his supplier. Thus, any contract to provide price related power change services to the operator must differentiate between the energy attributed to such operator initiated action and the import or export to be paid or credited at the normal premises tariff with the primary supplier. To make such distinction is not easy and the primary premises supplier may not wish to be involved in such DER activity. However, because the energy attributed to operator request is separated, administration of operator contracts with a number of premises can be managed by a unique agency holding a supplier licence. Also the primary supplier's metered energy within settlement can be adjusted by any 'operator action' premises energy change to avoid consequential imbalance liabilities on that primary supplier.

Once again the price message has to be carefully constructed to give the desired result. The operator is working very much at the margin when instructing changes to plant profiles in the short term which translates to buying and selling energy. The buy and sell prices can be very different over the same period and also fluctuate significantly between periods. Also, at any one time, the marginal up and down price position will only be known to the operator for up to 3 half hours ahead, not as a complete profile over long periods. Here are examples of System demand, market and Operator Prices over a single day and over 4 consecutive days



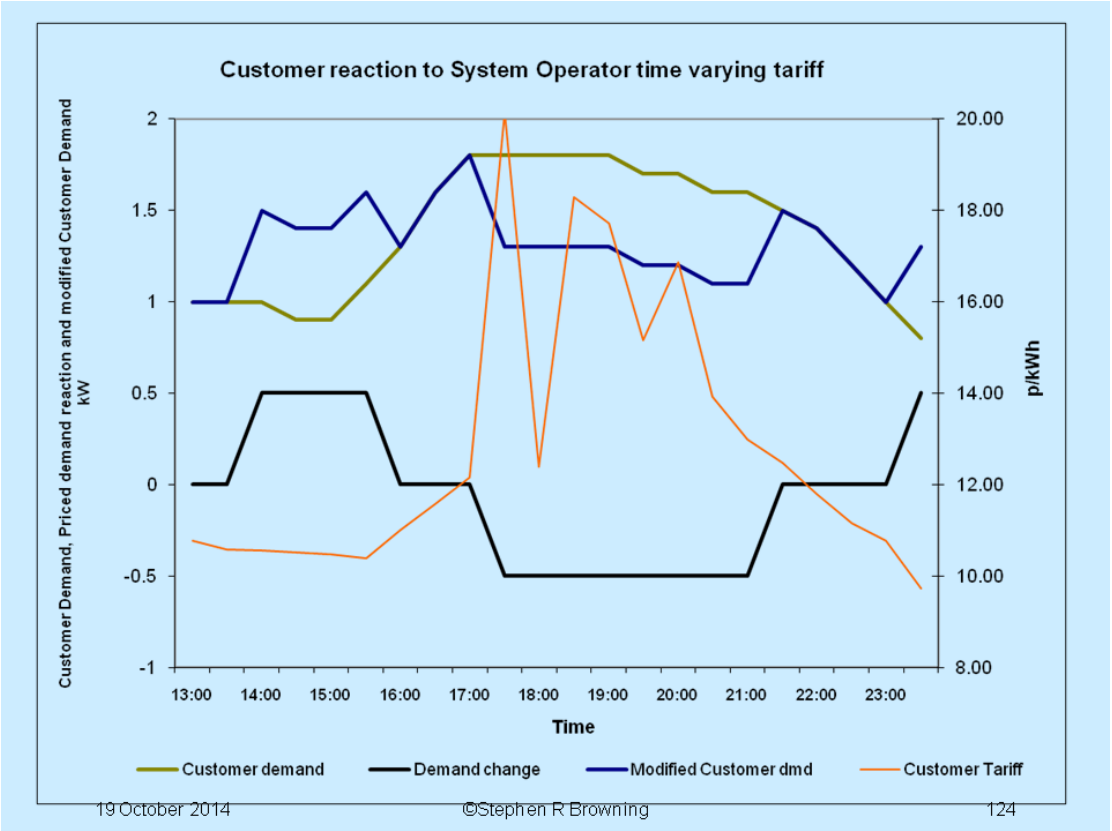


As you can see, the marginal operator prices can fluctuate violently from day to day and the marginal market prices also show a degree variation; all due to the changing plant-demand positions.

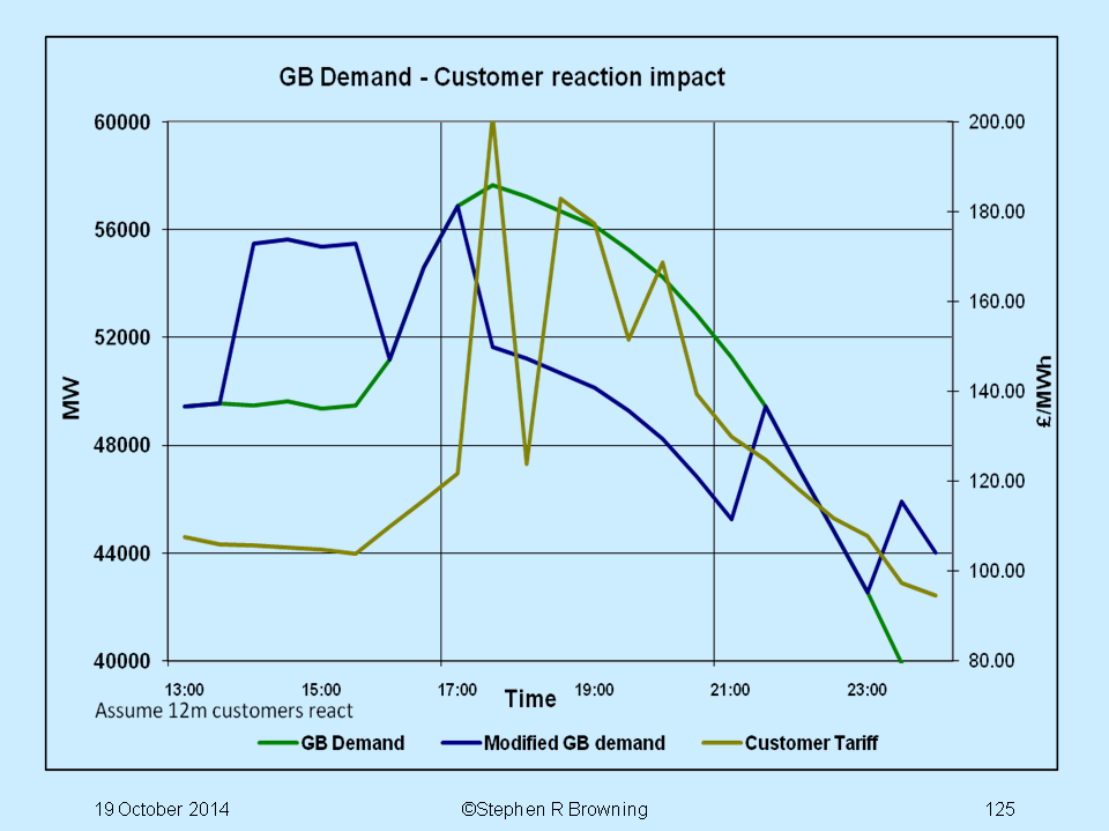
It is again important to remember that the matching mechanism prices are wholesale energy only while the retail customer tariff consists of energy + system use charges. These elements again need to be kept segregated so that benefits and charges are correctly accounted for the customer, the operator, the 'operator contract' agency and the premises primary supplier!!!.

The classic model for priced DER participation is when the system is running on expensive plant. The operator will have high up (BOD +n) offer and high down (BOD -1) bid prices from conventional generation. If the operator has a selection of contract DER sites he can try and signal a price between the up offer and down bid to try and get a cheaper solution to achieving the match by influencing the customers to perform demand/import reductions or export increase. However, analysis of the likely customer reaction, the consequent change to the match position and the modified up and down prices is required. If the customers overreact, it could then cause the operator to reduce output on less expensive plant (more BOD-n Bids) than the DER price offered. The other point here is that the customer is being paid for reducing demand/import while also reducing his tariff payment to his primary supplier for the appropriate period. This all has to be carefully managed in respect of the overall tariff position.

Here is a possible scenario for operator price signals; a use of system element has been added to the average of the matching mechanism (wholesale level) prices.



However, the setting of the DER signal price is crucial to avoid excess, fast, demand reduction and then extra demand recovery at the end of the period. This can be handled by staggering the application of changing price signals across times and geographical groups. If this customer behaviour were to be reflected across say half the domestic premises in GB, then the result would be as follows.



Now, there is also a serious ethical regulatory, settlement and billing argument against such a practice of using priced DER management within matching mechanism timescales. Basically, the method violates the principle of the mechanism itself, namely that all power trading should be carried out within the mechanism framework, by unilateral instructions from the operator to the generator and supplier matching mechanism units. Although the operator can carry out ancillary service actions to secure the network and his ability to match demand and generation, he cannot use such facilities to carry out trading outside the mechanism. If he does so he is effectively bypassing the suppliers and trading direct with the customers, thus creating a dual tariff structure.

In a vertically integrated organization the problems do not arise in the same way. The Generator, Supplier and System Operator functions are combined, with a single primary tariff interface to the customer. Thus operator trading simply changes the primary customer tariff price for the period required.

Ancillary services - Control mechanisms

These enable the Operator to send simple control signals to cause groups of customers to reduce or to increase demand/import, based on predetermined prices for the activity. The method can be employed by both system and distribution operators, to provide real time reserve and system security services. It is already configured to allow demand interruption at large participating premises.

Suppliers or supplier licensed agencies will act as the aggregators/disseminators to allow smaller sites to participate in this activity. Due to latency in the instruction process, for real time support this method can only be used to provide secondary response (30 sec to 5 minute) and reserve (5 minute delivery).

Anything beyond reserve requires dispatch instructions (BOA) within the matching mechanisms framework, subject to the rules stated above. However, the distribution operator (DSO) does not instruct plant within the matching mechanism. Therefore, when a DSO needs to exercise control over a prolonged period, some form of matching mechanism instrument is required.

The resultant energy from execution of ancillary control actions has to be calculated and included in the supply account contracted energy, for each supplier with participating sites. Such compensatory action is already carried out in respect of reserve delivery by generating units or large sites; the method simply needs to be incorporated in the aggregation/dissemination mechanism.

Ancillary services - Automatic mechanisms

These involve instantaneous reaction to compensate for system problems, triggered by detection within the premises. As regards local stability, sites with distributed generation are already required to isolate the plant in the case of mains failure. As regards wider participation, it is possible for DER premises control systems to respond to frequency and voltage excursions. Contracts with the operator will normally relate to payments for providing the facility and setting it to operate. Energy delivery will again need to be evaluated and compensated to the relevant suppliers of sites where reaction has been executed.