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**EVALUATION OF OPTIONS FOR
AN ANCILLARY SERVICES MARKET FOR THE
AUSTRALIAN ELECTRICITY INDUSTRY**

**A Project Commissioned by the
NEMMCO Ancillary Services Reference Group
DRAFT FINAL REPORT (EXEC SUMMARY ONLY)**

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This is a draft for discussion only. It has not been fully checked for errors, clarity or had full peer review. Some appendix material is intended for background purposes only and should be read as such



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EXECUTIVE SUMMARY

In its final determination on the Code, the ACCC required that NEMMCO review the arrangements for providing ancillary services in the National Electricity Market (NEM). This review should consider the possibility of developing market-based arrangements in ancillary services, including a short-term market. The review has two phases:

- Phase 1 will review the framework established by the ASRG, and then evaluate the different Ancillary Services and advise appropriate arrangements;
- Phase 2 will address the mechanism for “who pays and how much” for the various Ancillary Services.

A Framework report for Phase 1 was finalised in December 1998 and is available on the NEMMCO Web site¹. This report deals with the evaluation component of Phase 1. The mechanism for “who pays and how much” is the subject of a separate brief. This separation posed difficulties for this review as it presumes that the question of who pays is separate from market arrangements. Wherever possible, however, this distinction has been maintained.

What are Ancillary Services?

The Framework defines Ancillary Services as those services that provide for the power system security, quality of supply and enhanced spot market trading benefits that would not be voluntarily provided by participants on the basis of energy prices alone. They are required to ensure that discrepancies between the commercial model in the NEM and the underlying physical behaviour of the electricity industry are dealt with. The Framework then goes on to define and describe the characteristics eight specific services. For the purposes of analysis in this report, these have been assembled into three broad groups as set out below.

- Ancillary Services concerned with balancing power supply and demand over short time intervals throughout the system; the *Frequency Control Ancillary Services (FCAS)*;
 - Frequency management – small deviations (including time error management)
 - Frequency management – large deviations
- Ancillary Services concerned with operating and maintaining the operational efficiency and capability of the network within secure operating limits; the *Network Control Ancillary Services (NCAS)*
 - Voltage control – continuous

¹ NEMMCO: “Framework for the Development of an Ancillary Services Market to Support the National Electricity Market”, December 1998.

- Voltage control - contingency
- Stability control
- Network loading contingency control
- Spot market trading benefits
- The Ancillary Service concerned with recovery from a partial or total power system failure; the *System Restart Ancillary Service (SRAS)*
 - System restart

It should be noted here that the dominant (but not the only) motivation for providing the ancillary services defined above is to manage the risks associated with generally short-term contingencies in the system, such as generator and transmission line outages, for a given system operating pattern. If not so managed, such contingencies could cause the system to fail. The Code defines the criteria that NEMMCO are required to satisfy to maintain a secure system. These criteria require translation into operating policies and in so doing many judgements are required. Robust and transparent procedures for regulating this process will be central to any development of markets in ancillary services.

Significance of Ancillary Services

NEMMCO's estimate for the cost over 12 months under current arrangements is about \$130 million, including Queensland. Early figures from the south-east Australian system based on current arrangements suggest the following approximate breakdown between the groups defined above:

- Frequency Control Ancillary Services (FCAS) 65%
- Network Control Ancillary Services (NCAS) 25%
- System Restart Ancillary Service (SRAS) 10%

In very broad terms, the total cost of ancillary services is likely to be around 5% of wholesale energy market turnover at current prices. The impact of this not insignificant amount is magnified by the fact that costs are passed on to retailers by NEMMCO. That cost is difficult to hedge, and the resultant uncertainty has a very significant impact on retailer margins, said to be about 2-3%.

While the balance between services and their total cost might change, the current predominance of FCAS in the cost breakdown is clear. FCAS can be provided from many sources over a wide geographic area and so the scope for market arrangements sustained by high levels of competition is good. For these reasons, FCAS has been selected as most suitable for early market development. There are reasonable prospects to develop markets in NCAS as well, although not

necessarily short-term markets as proposed for FCAS. However, there are more steps to be traversed before markets in NCAS could develop.

Related National Electricity Market Issues

The approach to ancillary services affects, and is affected by, other areas of the NEM that are currently subject to reviews by NECA.

- **Transmission & Distribution Pricing**

NECA's draft report canvasses and provides guidelines for entrepreneurial network inter-connectors, considers the further development of an inter-regional hedge market and canvasses nodal spot pricing and congestion contracts along the lines of that implemented in the PJM system in the US. These matters are closely related to the NCAS group in particular, to the extent that progress on the matters canvassed by NECA will affect progress in the establishment of markets in NCAS, and vice-versa.

- **Capacity Mechanisms and the Value of Lost Load (VoLL)**

The concern about the adequacy of the remuneration to generators that will encourage adequate investment in the "top end" of the market is closely affected by the approach to the provision of FCAS, and how it is paid for in particular. This issue will be addressed further in the "who pays and how much" phase of the ancillary services project, but the relationship is noted here.

- **Development of the demand-side of the NEM**

NECA has recognised the role of the demand-side in clearing the market at the "top end" and intends to promote its development. The demand-side, and even the same flexible demand-side facilities that NECA intends to encourage to help the energy market clear, will play a closely similar role in the development of ancillary services markets. This mutual dependency should be recognised and re-enforced.

Evolution of Ancillary Service Arrangements in the NEM

The monopoly utilities that preceded the current disaggregated electricity industry arrangements had a broad brief to supply reliable electricity of adequate quality. Elements now defined as ancillary services were provided as a matter of course. There was no functional or legal separation between the production and delivery of energy (to distribution system boundaries, if not to end-users) and the provision and maintenance of a secure and reliable power system, to which ancillary services contribute. The provision of ancillary services was *internalised* within the organisation that produced and delivered energy.

Under the new dispensation the institutional arrangements relating to this are very different. The primary exchange of tradeable goods in the form of electrical energy in the energy spot market is

functionally and legally separated from the provision, maintenance and regulation of a stably operating market system based on a secure and reliable power system. Energy trading occurs between producing and consuming Participants, while regulatory maintenance of a secure and reliable system is the responsibility of the market manager NEMMCO, with NECA responsible for Code administration. Ancillary services are now provided *externally* to the energy market.

In terms of regulatory economics, the current model is that of a central public regulator (NEMMCO) procuring resources necessary to maintain set system standards of security and reliability to ensure market stability, *without enquiring into the responsibility or accountability for whatever it was that produced the need for the service*. The cost of procuring and dispatching these services is recouped by levying taxes on the purchasers of the primary traded good according to their consumption of that good. This is an unusual method for defraying the costs of regulation and of maintaining the integrity of a system. Such costs are more usually allotted to those who produce them so that they bear the results of their actions. It is this model that the ACCC had in mind when it instigated the current review.

At present procurement proceeds with the following priorities:

- utilisation of resources available to NEMMCO under the mandatory provisions of the Code and connection agreements;
- competitive tenders where there are competing providers (who, to date, with the exception of interruptible loads, have been energy suppliers in the energy market);
- negotiated contracts where the potential provider(s) of the service have market power, either generally or because of spatial considerations; and
- direction, if necessary and as a last resort.

Payment by NEMMCO to providers of ancillary services is split into *availability*, *enablement*, *use* and *compensation* components. Not all components apply in a specific case. Payment for *availability* is intended to cover ongoing fixed costs. Payment for *enablement* covers the cost of making a resource ready for use; sometimes it is a substitute for a usage payment because of measurement difficulties, sometimes because the resource is seldom used. Payment for *use* covers additional costs incurred when the resource is actually used. *Compensation* covers the assessed opportunity cost of providing the service when it might otherwise have been used for energy production. Dispatch of FCAS for enablement is achieved through facilities coded into system pricing and dispatch logic for the energy market. However, for this and other ancillary services, all the resources used are under long term contracts, and they are enabled and used according to long-term offer prices written into those contracts.

None of the parties most involved in the current arrangements finds them satisfactory. Contract negotiations have been protracted and difficult both for NEMMCO and the parties that responded to NEMMCO's invitation to tender. Generators feel they are unfairly and unreasonably required

to provide too many services free under the mandatory requirements of the Code and connection agreements. Retailers feel they are unreasonably required to pay for all services when they are often not the cause of the requirement. Many of these real or perceived problems are inherent to the central procurement of ancillary services overlaying a competitive energy market. However, even within this model some significant improvements are possible in the relatively short term. These include:

- reviewing the standards, management and public reporting applied to each ancillary service group, with a view to rationalising current expenditure levels;
- shortening and widening the current FCAS “enablement” market by supporting short-term bidding by all capable participants and paying a common clearing price to each; and
- as part of the later “who pays and how much” stage of the review, allocating the costs of providing ancillary services to those who caused the need for those services, following the principles set out by the ACCC.

While these changes should reduce ancillary service costs, difficulties arising from the current functional and legal separation between the energy market and ancillary services will remain. It is worth recalling that the current separation was a compromise to allow a clean and relatively simple energy market to be established. Now that this has been achieved, it is reasonable to consider the development over time of arrangements that will once again *internalise* these services into the businesses of the current energy market and other Code Participants. Such a re-integration of the energy and ancillary services regulatory logic is the essence of the “light on the hill” proposed by this report.

The “Light on the Hill”

The theory of externalities was addressed by the English economist AC Pigou in 1932. His analysis suggested the now widely known and implemented “polluter pays” principle, whereby the cost of market externalities is corrected by imposing a tax on the causers of the externality. This principle has so far not been applied to ancillary services in the NEM, but is the basis for the ACCC determination that prompted the current review.

Pigou’s analysis was re-visited by the American economist Ronald H. Coase in 1960. Coase showed that if property rights are clearly allocated, if parties can negotiate costlessly and there is perfect information (i.e. along the lines of the standard assumptions for a competitive market), then efficient outcomes result no matter how the law assigns responsibility for damages. In practice these idealised conditions are never realised. But Coase’s analysis does suggest policy options broader than those proposed by Pigou, even though application requires analysis of each circumstance. Specifically, there may be opportunities to trade a well-defined product even where that product might initially be perceived as an externality.

Emissions trading is an example of this approach. Sulphur emissions trading is established in the US and greenhouse gas emissions trading is also mooted. To establish such a regime, a target or *standard* for the emissions must be set, probably as an upper limit on the total quantum of emissions each year. Rights to emit are then established as well as regulatory and monitoring arrangements to enforce them. After an initial allocation of rights by a public regulator, all the parties may trade them for a price determined by the forces of supply and demand. Trading parties include those who tend to increase and those who tend to decrease emissions that affect the achievement of the standard. Theory as well as some experience suggests that trading parties will then act to achieve the standard. It is noteworthy that a regulatory process is required at several points; first to establish the standard to be achieved; second, to ensure the necessary information flows; third, to define, assign and secure property rights in the products that affect the achievement of the standard; and, finally, to provide oversight and take remedial measures should the trading system not work adequately.

There are good prospects of applying similar concepts to FCAS and some NCAS in the longer term as outlined below. In each case the broad steps are:

- Define through some rigorous public process the standard to be achieved; this will involve an economic, social and technical analysis that will usually involve assessments of risk.
- Define and provide the necessary information requirements.
- Define a tradeable product whose production and consumption affect the achievement of the standard;
- Implement and enforce arrangements that allow this product to be traded between the interested parties.
- Define and provide arrangements for regulatory oversight and intervene should the standard be breached.

In the case of NCAS and FCAS, it can be expected that the trading arrangements will be closely integrated with the energy market.

Frequency Control Ancillary Services (FCAS)

The main distinction to be made within this group is that the small frequency deviation service is used more or less continuously, while the large deviation service is enabled always but used only occasionally, and less so as the system grows larger through interconnection. FCAS products are currently defined in three timeframes; 6 and 60 second for the fast-acting large deviation requirement, and 5 minutes for the slower-acting small deviation requirement. These products are generally sourced from generators and potentially from load shedding in the large deviation case. Only a limited number of potential providers is signed up long term. The potential contribution from the non-dispatchable demand-side is largely excluded.

Requiring providers to commit to FCAS offer prices well ahead of spot time, together with the limited number of providers that can be signed up long term, almost certainly increases the cost of FCAS provision and limits the competition that might be marshalled under more flexible arrangements. For this reason there is scope to enhance competition by procuring these services much closer to the time of need; in essence, in the same-day timeframe in which the energy spot market operates. This would require no fundamental change to current dispatch logic for either FCAS or energy, although additional IT communication and related facilities would be required. Thus the immediate steps proposed for FCAS include:

- Existing FCAS product definitions to be retained at least for the time being (review this!).
- Frequency standards and the FCAS requirements to meet those standards to be determined in a robust public process overseen by the NECA Reliability Panel.
- Resource procurement to be achieved through an on-the-day bidding process integrated with the energy spot market. There will be no longer term contracts between NEMMCO and providers except during an initial transition period when a form of vesting contract will allow the short term FCAS market to begin with minimal financial exposures.
- A common clearing price for enablement to be determined for each FCAS product in each trading interval, obtained from the System Pricing and Dispatch process just as the regional energy spot prices are determined now.
- In the short term there will usually be no additional payment for use of the small deviation service. However, additional usage costs may be incurred for the large deviation service.

These steps should increase the competition for provision of these services and drive the cost down. Procedures for charging the centrally-incurred costs will still be required and will be considered in the next stage of this project.

The “light on the hill” for FCAS envisages a two-way market arrangement where very short term-energy deviations (relative to the energy market and occurring within the current 5-minute dispatch period) are traded directly between the causers of those deviations and those who are acting to correct them. This would be achieved through a pricing rule that would increase the energy deviation price when there is a short-term energy (power) deficiency and decrease it (to a negative value) when there is an energy (power) excess. While there are several possible approaches, the pricing rule would need to be consistent with the current arrangements for the central dispatch of plant in the energy market for the regulation (control) of small frequency deviations. When implementing this approach:

- There will need to be a period of experimentation and testing to determine a suitable energy deviation pricing procedure.

- Use of SCADA-level data would be suitable for an initial and partial implementation. Later, specialised metering would be desirable, especially to deal with fast responses.
- The proposed short-term energy deviations market essentially adds a usage component to the current enabling market price. The enablement market would be retained but should reduce in turnover as the usage price element is increased.
- Initial participation could be optional to some Participants at least, noting that participation would remove the obligation to pay for the “use” component of FCAS incurred under this arrangement.

A short-term energy deviations market offers the prospect of developing metering that will support and promote greater demand- side participation.

Network Control Ancillary Services (NCAS)

Generally, services in the NCAS group act to improve the ability of the network to transfer energy (power) within secure operating limits. These limits are complex and have many dimensions. Relatively few of them currently have sustained current or potential commercial significance for energy trading; most are intended to deal with particular network outage conditions. The most visible limits are those applying to trade across inter-regional boundaries, such as between Victoria and South Australia.

In the NEM, these network limits are identified and defined in technical studies by NEMMCO and the NSPs. Those relevant to the spot market energy dispatch over the transmission network are then expressed in mathematical form and used to limit the pattern of dispatch arising from the bidding and system pricing and dispatch (SPD) process. The limits imposed on the SPD depend on the ancillary services available and the way NEMMCO had dispatched them. Currently NEMMCO does this, and incurs the associated costs, *without reference to the value that these services provide to the energy market.*

The SPD logic has an in-built mechanism to shadow price the ancillary services that affect each network limit. Each shadow price values the benefits to trade in the energy spot market of a marginal increase in the provision of the relevant NCAS. The validity of these shadow prices depends on the adequacy of the underlying network model in modelling the physical system and, even more strongly, on the validity of the constraints imposed to manage network risks. Accepting this, it is possible to draw a direct relationship between the provision of NCAS and energy market trade, in a way that could support two-way trade between some NCAS providers and participants in the energy market. Such trade could be on a spot basis or by longer-term bilateral negotiation.

NCAS is expected to be around 25% of total ancillary service costs. Most NCAS are geographically specific which may limit the scope for competition. More fundamentally, the current regulatory arrangements define NEMMCO as the sole provider of such services.

Alternatives buyers could be entrepreneurial NSPs interested in increasing network capability. Thus the prospects for two-way markets in this areas depend to a significant extent on how the reform of network pricing progresses, as noted earlier. Despite this, significant improvements could be made over time with the following strategy, which essentially defines the transition to the “light on the hill” for NCAS.

- For the short term, current procurement and dispatch arrangements should remain, subject to changes that might arise from the “who pays and how much” phase of this project.
- Further consideration of markets in NCAS should be preceded by a review of the basis for and structure of the currently defined generic (security) constraints applied in the SPD.
- NEMMCO should extract and publish the pattern of shadow prices and related information associated with each (or at least the most significant) generic constraint used in the SPD process. NEMMCO should take account of these shadow prices when determining the appropriate quantum to acquire in its contract tenders and negotiations.
- After investigation on a case by case basis and if feasible and desirable given market power and materiality considerations, either short term markets or longer term bilateral markets should be established in the relevant NCAS, integrated with the spot energy market, using the shadow pricing logic previously described.
- Regardless of whether a service is procured by competitive tender or through a short term market, NEMMCO should stand aside to allow other parties to contract with NCAS providers should the transmission pricing regime support such entrepreneurial activity.

Some NCAS are likely to be more amenable to competitive arrangements than others, or require specific measures to “level the playing field”, whether or not a market can be developed for them. Specifically:

- There are prospects for early implementation of enhanced spot trading by recognising that energy dispatch affecting constraints would require few additional IT facilities.
- The next most likely service for competitive provision, based on materiality and other considerations, is the voltage contingency service, which also covers some of the peak period component of the continuous voltage control service. Levelling the playing field for this service would require formal recognition that potential (reactive power) providers should be treated on an equal basis. At the moment there is a bias in favour of provision of reactive power by NSPs under regulated network pricing arrangements, and a bias against the management of reactive within the distribution network.
- The continuous voltage service requires the biases outlined above to be corrected, but also more investigation of pricing approaches. Parallel operation and testing of an AC load flow

nodal pricing model that could price reactive in the context of energy spot trading would be a first step.

System Restart Ancillary Services (SRAS)

There are no prospects for two-way trade in this service but there is scope for making provision more competitive and robust against the range of “system black” conditions that could occur at various levels in the system. There is a need to recognise and make maximum use of embedded facilities that may be maintained and used (and therefore tested) from time to time in other duties. The main recommendation is to develop a strategy for system re-start, co-ordinated with more local needs, under the auspices of the NECA Reliability Panel.

Code Changes

Code changes in the following areas will be required to implement the recommendations of this report:

- Define the short-term market in FCAS enablement in terms sufficient to allow early implementation.
- Define the objectives and broad approach to the “light on the hill:” for each group of services, in sufficient detail to allow implementation with reasonable flexibility in timing and extent, and noting the milestones to be achieved on the way.
- Formalise and extend the role of the NECA Reliability Panel in co-ordinating regular reviews of FCAS and NCAS security standards and SRAS strategy
- Remove TNSP reactive facilities from the regulated rate base and oblige NEMMCO to consider TNSP and DNSP reactive production and consumption explicitly and equally in procurement and pricing of both NCAS and FCAS