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# Advice Pertaining to ERC Resolution No.16 and the Role of Hybrid Generation

Advice with respect to specific questions from PIPPA

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Client: Philippines Independent Power Producers Association

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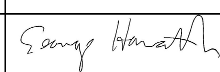
| #2 | 02-Oct-2013 | | George Horvath<br>Industry Director |  |
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# Executive Summary

It is the purpose of this report to provide technical opinions in response to a series of questions posed to AECOM by Philippines Independent Power Producers Association (PIPPA), which concern their submissions to ERC in response to ERC Resolution No 16. The purpose of Resolution 16 was to define the boundaries of ownership between power plant assets and NGCP assets, and its effect would be to require the transfer of power plant switchyards (Switchyards) currently owned by power plant owners, into the ownership of NGCP.

PIPPA's questions to AECOM are listed in Appendix A – Terms of Reference.

ERC have indicated that they wish to engage in a dialogue with PIPPA, in order to arrive at the best outcome for all concerned. PIPPA have engaged AECOM to support them in their conversation with ERC.

NGCP has made submissions which have at their heart that NGCP's ownership of the Switchyards is required in the interests of maintaining adequate power system reliability.

After consideration of PIPPA's questions, the practices in other jurisdictions that are known to us, and our knowledge of the organisation and development of the electricity industry, grid planning, grid reliability and operations, our overall opinion is that there seems to be no technical foundation for the transfer of the assets to NGCP under a notice of the requirement to improve system reliability, and it seems unlikely that such a proposal would be approved by regulators in other jurisdictions if it were made pursuant to the due process for determining the need for grid investment.

It is most likely that, if in fact there was a demonstrable need for improvement in the contribution to system reliability from the performance of Switchyards that are not owned by NGCP, then the least-cost acceptable solution would not be a transfer of ownership, but other, less costly institutional arrangements, which would be preferable from both a practical engineering perspective, and from the perspective of helping maintain and perhaps further foster a fortunate diversity and dynamism in network development, which other jurisdictions may be struggling to achieve.

The question of hybrid generation, Switchyard ownership and operation, and their effect of bypassing transmission assets, is admittedly a thorny one, but it is felt that better and more enabling solutions ought to be found than the one of circumscribing and marginalising the activities of power plant owners, through enacting the proposed resolution or any other, which may draw inflexible boundaries around what assets power producers may, or may not, own. It is felt that such policies would have a chilling effect on supply side development and may lead to a slowing and distortions in the natural development of an otherwise rapidly growing electricity sector, which indeed the Philippines is much in need of, in order to progress toward economic development as well as its renewable energy targets.

It should also be noted in this regard that denying the right of generators to operate in a hybrid fashion has the unintended effect of bypassing local communities who would thus be denied access to what is perhaps a rightful share of the benefit of an industry that has been placed in their midst. Not only does this seem unjust and a needless sacrifice of local community engagement, but experience has shown many times that lack of attention to providing a fair share of benefits to local communities creates barriers to project development, which are extremely difficult to solve by other means.

It is also almost certain that costs to transmission network users and the economy in general would rise, due to the unchallengeable technical position of a single owner, who will have no opportunity or cause to optimise the way it provides its services.

It is most likely that the right answers would come from policies and governance rules aimed in the opposite direction; towards diversifying and freeing up the ownership of transmission grid components on a contestable basis, especially with regard to new assets, which may be required for grid extension to new areas, and certainly the connection of new power plant, but may also include grid assets required for increases in grid capacity, or the improvement of grid operability or security.

In conclusion it must be noted that electricity sector policies, objectives, the rules and regulations governing network development, network investment and ownership, are by no means set in stone, and are indeed the subject of development by regulators elsewhere. The amenity of a grid offering transmission services to network users operating in a market, or otherwise, in a business environment, is very much a new paradigm whose effect on the form of the grid assets, and the practices of grid development and operations are still being determined through practical experience, and considerable experimentation. The current sets of rules in place in most

jurisdictions, although in various states of “maturity”, should still be regarded as innovative “first attempts” at setting up the terms and conditions for the offer of transmission services to network users.

Generally speaking everywhere, networks have been ineffective in changing with the times. This is probably due to the regulatory straightjacket that was developed in the process of the deregulation of the supply side of the electricity industry starting in the 1990s. In many jurisdictions there has been growing recognition that grid development has been less than effective in keeping pace with other energy sector developments and that single ownership models have produced stagnation as well as some distortions in network development decisions and investments. Efforts are currently under way to provide corrective measures through further regulatory changes and rule making.

While it is recognised that considerable additional work would need to be completed before alternative measures could be introduced into regulatory framework of the Philippines, the following recommendations are proposed based on the progress made in other jurisdictions, as a means of sharpening the focus of our advice, and hopefully, to set the direction for beneficial change in terms of the interests of transmission customers and the economy of the Philippines.

The primary recommendation is that the ERC should revisit the terms of Resolution 16 to see if a contestable regime for the construction and ownership of connection assets involving the opportunity for diverse ownership of these assets could be put in place instead. The boundaries of the definitions of what constitutes connection assets and in particular, what constitutes shared assets, should be allowed to remain flexible so that the efficient provision of these assets can be fostered, developed and tested though a competitive and transparent process.

It would be important to ensure that the revenue model for networks is adjusted to compensate the incumbent network owners for a portion of lost revenue which may result from these activities, and in particular the activities of Hybrid generators, so that overall there is some sort of profit sharing from the improvements in efficiency, in order to incentivise the stakeholders in a way that would ensure sympathetic cooperation in the operation of the new regime.

The owners of connection assets should also be remunerated according to a standard compensation model, which would put them on a par (pro-rata) with network companies undertaking investments in the network, so that overall there is some neutrality in the provision of connection assets, and so that innovation can arise to find more effective solutions for interconnections.

It would also be important to develop codes and standards that describe the technical operating characteristics of contestable network assets so that proponents of the provision of these assets will be aware of a common set of requirements. The codes and standards should be in the form of performance specifications, rather than prescriptive specifications, so as to allow sufficient scope for innovation efficiency improvements and cost reduction, while fixing the standard of performance at the appropriate levels.

The development of all kinds of Hybrid and embedded generation should be encouraged by whatever means, as long as these are sustainable and transparent to the competitive forces within the generation sector, consistent with any government policies and projects for the encouragement of such generation. Those responsible for network security should not be concerned about adverse effects of such a proliferation, provided that the performance of such interconnections are governed by a suitable set of performance standards, similar in principle (but not necessarily in the detail) to those embodied in the IEEE 1547: 2003 international standard.

# 1.0 Introduction

Through its Resolution No.16, the ERC have made a proposal for a Rule change that would require Generators to transfer ownership of their switchyard assets into the ownership of the National Grid Corporation of the Philippines (NGCP). Members of PIPPA oppose this move. The ERC have indicated that they wish to engage in a dialogue with PIPPA, in order to arrive at the best outcome for all concerned.[1] In the context of PIPPA's concerns surrounding ERC Resolution No. 16 (Resolution 16) which have resulted in our terms of reference, we note that the ERC, in revising the original Resolution 41, through its Resolution 16, is proposing significant changes to the ownership of interconnection assets. Assets that PIPPA feels are rightfully owned and operated by IPPs would henceforth be owned and operated by the grid company NGCP. PIPPA feels that Resolution No. 16 requires more consultation and has made a Petition for Rule Change.

This report is adapted from a previous version, which was prepared as a series of answers to questions posed by PIPPA, and consideration of which constituted the Terms of Reference. PIPPA's original questions are to be found in Appendix A.

It is significant that the ERC is willing to review its requirements and is set on determining matters in the best interests of all of the industry. This gives stakeholders the opportunity to develop principles that would help arrive at the best quality process which could benefit the industry overall.

The need to reorganise the management of networks infrastructure to be able to play a more supportive role within a dynamic economy, is a view that is being echoed in other parts of the world. After approximately 20 years of experience with electricity sector reforms, the networks industry is seen to be placing somewhat of a drag on the development of the electricity sector and the enactment of government policies, especially those aimed at moderating the increases in cost of electricity for consumers, meeting national electricity supply targets, and increasing the reliance on distributed resources and renewable energy. The existing business structures and operating models have a range of shortcomings that are legacies of the general reorganisation of the sector, which was commenced in the 1990s. Efforts have been underway for a number of years to make improvements, and these are crystallising into definitive action by governments and regulators over the last two or three years.

Our advice is limited to consideration of the regulation of connection assets; their construction, ownership, operation and maintenance. Our general views with regard to ownership and development of the electricity networks within the Philippine context, are that the Philippines would benefit significantly from an enabling set of regulations, codes and processes, because of the diversity in the nature and scale of its power supply requirements and also, supply possibilities. On the one hand there are diverse opportunities for distributed generation, whether from indigenous renewable resources, or whether tied to industrial, commercial, or community ventures. On the other hand, there is significant diversity of challenges involved in providing electricity supply, whether due to scale, geographic isolation, or diverse economic conditions.

We note in particular the requirement of the Renewable Energy Act of 2008 and National Renewable Energy Plan (NREP), which calls for a tripling of energy produced from renewable energy in twenty years; 2010 – 2030, to over 15 GW. We foresee that this initiative alone, mandates that hybrid generation must be given flexible access on a diverse but assured basis, wherein proponents have certain guaranteed rights, (as well as obligations and processes to follow), which are convenient, flexible and proportionate to the technical and commercial impact of their individual contributions, and which provide a framework of certainty within which they are able to make their investments and conduct their individual IPP businesses.

While the NREP, is one driver, we believe that a wider scope of investments would be encouraged and enabled by such governance, which should extend to third party investments in network assets. Mixed network asset ownership and operating regimes can be supported by suitable technical requirements, planning and development processes, as well as asset management and operating codes, so that overall an environment of reliable services provision is achieved, as well as a climate of relatively efficient, competitive market for asset provision and management. More certainty for investments in energy projects, whether in power plant, networks, or demand side, becomes possible, and projects can proceed from their conception to maturity, as diverse, profitable, independent energy businesses.

We see the role of good governance within the sector as winding back and minimising the costs, the risks, and the uncertainties associated with development; whether power plant or network development, in the areas of

[1] PIPPA have engaged AECOM to support them in their conversation with ERC.

regulatory compliance and network interconnection. This is so that investors can invest with more assurance, bringing with them the energy and creativity required for development of this new, novel and rapidly advancing industry but also, so that as a group, investors will be exposed proportionately and transparently to their respective share of risks associated with the tasks of producing, conveying and selling power on a competitive basis in an accessible open market.

We feel that pragmatic, enabling governance is an essential ingredient in the development of a diverse and sustainable market for electricity supply.

In its terms of reference, PIPPA also raised questions regarding the practice of “Hybrid” generation in various jurisdictions outside the Philippines. An “Hybrid” generator is defined in the Philippine context as a power plant that is connected to transmission and at the same time directly connected to a distribution utility or other end user. We take the view that Hybrid generation is just one particular case of “embedded” or “distributed” generators, in that a Hybrid generator is one that is embedded in the network at or near the transition between what are referred to as transmission network and other types of networks, which may be distribution or sub-transmission networks, depending on their scale and purpose. We consider, the technical attributes of Hybrid, embedded and distributed generation to be one and the same, and so treat them as a single category, though sometimes referring to one or other type as required by the context.

The following Section 2.0 provides a summary of the developments within the electricity sector, including the evolution of a competitive supply sector and regulated network monopolies. It provides context for the need to change the ways that networks have been organised and managed under what was only the “first cut” of a market-based electricity industry.

Section 3.0 addresses the Terms of Reference in detail and the ownership of connection assets, and the role and technical nature of Hybrid generation are discussed. Paragraph 3.1 compares the definition and ownership model for connection assets set out in Resolution 16, with those of the most recent recommendations of a comparable jurisdiction. It shows that the direction set in Resolution 16 is directly counter to the current thinking of regulators in that jurisdiction, and discusses the reasons why this is so. The conclusion is that there is a considerable advantage to be gained from a diverse ownership of network assets at the boundary of the core grid, and that contestability in their construction and ownership will bring about a more effective range of solutions, while improving the efficiency of the connection process.

Paragraph 3.2 discusses the role of switchyards in a transmission network, especially from the point of view of its contribution to network reliability, and in terms of what is natural and efficient in the context of power plant development. The overall conclusion is that all parts of the transmission system are mutually supportive, and reliability depends on the reliability of all contributing components, which notably includes the generation components and not just the transmission components. The inference is that system reliability depends as much on the operation of generation plant, which is in diverse ownership, as it does on transmission assets. It is intended to show that system reliability does not rely on the monopoly ownership of the contributing assets. Rather, it relies on the coordinated activities of a diverse group of qualified and competent stakeholders, who in turn are themselves dependent on the continued satisfactory operation of the assets to meet their operational and business commitments, and distinctions made about the level of commitment to ensuring reliability, are suspect.

Paragraph 3.3 drills down to examine the merits of consolidating ownership of the power station switchyards into NGCP ownership. The approach taken is to compare the proposal to a normal grid investment proposal requiring regulatory approval for a revenue reset to finance the proposed expenditure. The process is presented for determining whether such an investment in the grid would be worthwhile under the principles that guide regulatory grid investment in various jurisdictions. Although supporting facts and figures are not on hand at the time of preparation of this report, the terms of the procedure show that considerable work would need to be undertaken in order to make such a determination, and it is most likely that if the need for measurable reliability outcome were demonstrated by the analysis, there would be more cost-effective means of achieving this than through the transfer of ownership of switchyard assets.

An outline of the network company remuneration model is discussed, and the conflicts between network planning and network asset ownership is highlighted. It is suggested that NGCP may be losing revenue due to the presence of Hybrid generation, which has certainly been found to be the case in other jurisdictions. The merits of diverse ownership of connection assets is promoted for both “sole use” and shared connection assets on the basis that this provides efficiency through contestability following the recommendations of the most recent report by the Australian Energy Market Commission (AEMC). It is suggested that the current state of diverse ownership in the Philippines should be maintained and indeed enshrined in the Rules, because it represents a forward marker in the direction that regulations in other jurisdictions are heading towards.

Section 3.4 discusses Hybrid generation and possible causes contributing to their reputation for being a risk to network reliability are presented. A recommendation is made for a means of technical regulation of the interconnection with Hybrid and other embedded generation, which has been developed in our work in other jurisdictions, and which would address any concerns about on-going unreliability.

The report ends with some conclusions and recommendations.

# 2.0 Background

The rapid development of electricity networks over last 60 years has brought about a revolution in the energy supply and demand. Access to convenient, reliable supply, has multiplied the uses and the value of electrical energy many times and in many ways until nowadays it underpins the fabric of modern society. In the last 30 years, there has been acceleration in the development of energy-related technologies; in the advancements renewable energy generation; wind, photovoltaics, and tidal energy; in ultra-high power electronics, and in the coalition of energy networks, communications, and local and information technology, into the promise of tighter and more responsive control of networked energy; "Smart Grids". The proponents of these new technologies now seek sustainable opportunities to deploy them at scale.

The implications of these developments are that established networks throughout the world are facing a new era of development, wherein the accepted methods of system planning design and operation will be challenged and evolved into new norms. Government Departments of leading economies can be seen driving policies aimed at reducing costs while improving reliability and improving networks efficiency in meeting the requirements of the changing society they serve. Governments are also intent on ensuring that their nation makes advances in the development and deployment of renewable energy supply and other new technologies.

The transformation that has occurred within the supply-side industry has been fundamental. In the first phase of development of the supply industry, generation was mostly distributed, embedded in privately owned networks, whether industrial, mining or community based. These isolated systems were progressively incorporated into government owned, centrally planned, vertically integrated national electricity systems, wherein aggregation and access to low cost, large-scale sources of generation out-competed and out-developed the indigenous captive plant.

Publicly owned networks were extended to interconnect larger and larger catchments fuelling growth in demand. Through the technical nature of network interconnectedness, governments became responsible for maintaining the continuous balance of energy supply and demand at national levels, including the maintenance of a necessary margin in the growth of supply, ahead of increases in demand.

Commencing in the 1990's, governments in some economies wherein their electricity industries had completed their development phase, began to notice that central planning was leading to mis-investment in over-capacity in new power plant. They legislated into being, market-based mechanism for managing the risk of investment in new generating capacity. Other countries with less fully developed electricity sectors followed suit, as their governments perceived the economic advantages of diversifying the risk of investment in the supply side.[2] Legacy power plant was sold off, or otherwise allocated into competitive ownership, and the power pool was implemented, along with the roles of Market Operator, System Operator, and Regulatory Commission.

The structures created in the reorganisation were primarily aimed at achieving strong price competition among suppliers, equal access, and allocation of financial risk in the development of new power plant to the private sector. This was undertaken in an environment in which the further growth in demand was seen be relatively slow, and the technology of the supply side would be more or less conventional.

During what was a quite radical reorganisation of the supply side, the operational roles of electricity networks "the system", also received considerable attention from law makers. The main issues were considered to be "open access" to customers for competing generation, and assurance of continued "system reliability". System operations were rightly seen as the facilitator and the guarantor of technical market operations. The effect overall has been to create monopolies that would retain the known characteristics of the networks; to freeze their modes of ownership, administration and operations within the existing known forms.

Concerns relating to the establishment and maintenance of the right of open access "shared access" to network customers by competing generation companies, led to the development of laws requiring the separation of ownership of "shared"[3] network assets and generation. This was done as a somewhat heavy-handed and simplistic measure, to prevent the network companies from leveraging their incumbency and giving preferential access to their own generation to supply customers connected to their networks.

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[2] Although electricity markets are most often promoted as mechanisms for determining the least cost of supply, they are intended to function primarily to manage the risk of supply and demand over the longer term.
[3] Parts of a network which may convey the power generated by a number of competing power producers to any customer are sometimes defined as "shared assets".

Overall, the models of network ownership, operations and management that were entrenched by these principles, did not give sufficient weight to the requirements of network development, or foresee the pressures that would be brought about by other developments in the sector.

The influence of the networks industry structure has been far reaching, and retrospective analysis highlights the fact that the structure is not contributing to the growth, diversity and development of the overall electricity sector. The functioning of the asset ownership and administration model has been examined impartially, with regard to how this influences the network companies' relationships with its stakeholder groups, and this has led to clear directives requiring changes to be made; within the EU, in the US, in Australia and in some parts of Asia.

The reasons for this attention can be put into three main categories. The first is the lessons learnt from nearly two decades of operating in the new market based model.

The second reason is the perception of lack of efficiency in investments being made by network companies under the regulated processes. Three main problem areas are; low utilisation of existing and new assets; inefficiency in investments made for improvement of network reliability; and difficulties experienced in extending networks; into new regions; to provide interconnections between neighbouring networks; or to provide new functional capabilities.

The third reason is the perceived difficulties; both price and non-price barriers that are faced by power producers in the process of getting new power plants connected to networks. The drag on development created by procedures, terms and conditions, and compliance requirements at the interface between the supply side and the network is currently receiving considerable attention from regulators on a number of fronts.

The need for change has acquired sufficient urgency to generate action, because of the perception that the coming decades will require significant adaption by networks if they are to play a beneficial part in support of the development of renewable energy generation, as well as new technologies and business models that will occupy the grid in the foreseeable future.

# 3.0 Responses to the Terms of Reference

## 3.1 The Definition, Role and Ownership of Connection Assets:

Resolution 16 seems to be setting a course that is diametrically contrary to the latest thinking on connection assets. Resolution 16 should be compared with the findings of the Australian Energy Market Commission (AEMC) which has recently completed its review on the shortcomings of the organisation and operating model of Australian transmission networks. It has issued its final report on its "Transmission Frameworks Review", which makes recommendations that have the opposite effect to ERC Resolution 16.

ERC Resolution 16 defines Connection Assets in the following way.

***Connection Assets (CA):*** *Those assets that are put in place primarily to connect a Customer/s to the Grid and used for purposes of Transmission Connection Services for the conveyance of electricity which if taken out of the System , will only affect the Customer connected to it and will have minimal effect on the Grid, or other connected Customers.*

ERC Resolution 16 Section 4.2 states the following.

***4.2 Connection Assets for Generation Customers of Transmission Provider***

*Connection Assets for Generation Customers of Transmission Provider include those assets from the last Single Mechanical Connection of a User System or Equipment of a Generator, at its Connection Point, to the last Single Mechanical Connection which is not shared with another Generator within the Grid.*

*The specific assets which are owned by any Generation Customer and the Connection Assets which meet these boundary conditions are shown in Annex C.*

*A generation company may develop and own or operate a dedicated point to point limited facilities provided, that such facilities are required only for the purpose of connecting to the transmission system, and are used solely by the generating facility, subject to prior authorization by the ERC.*

The following diagram characterises the intent of Resolution 16.

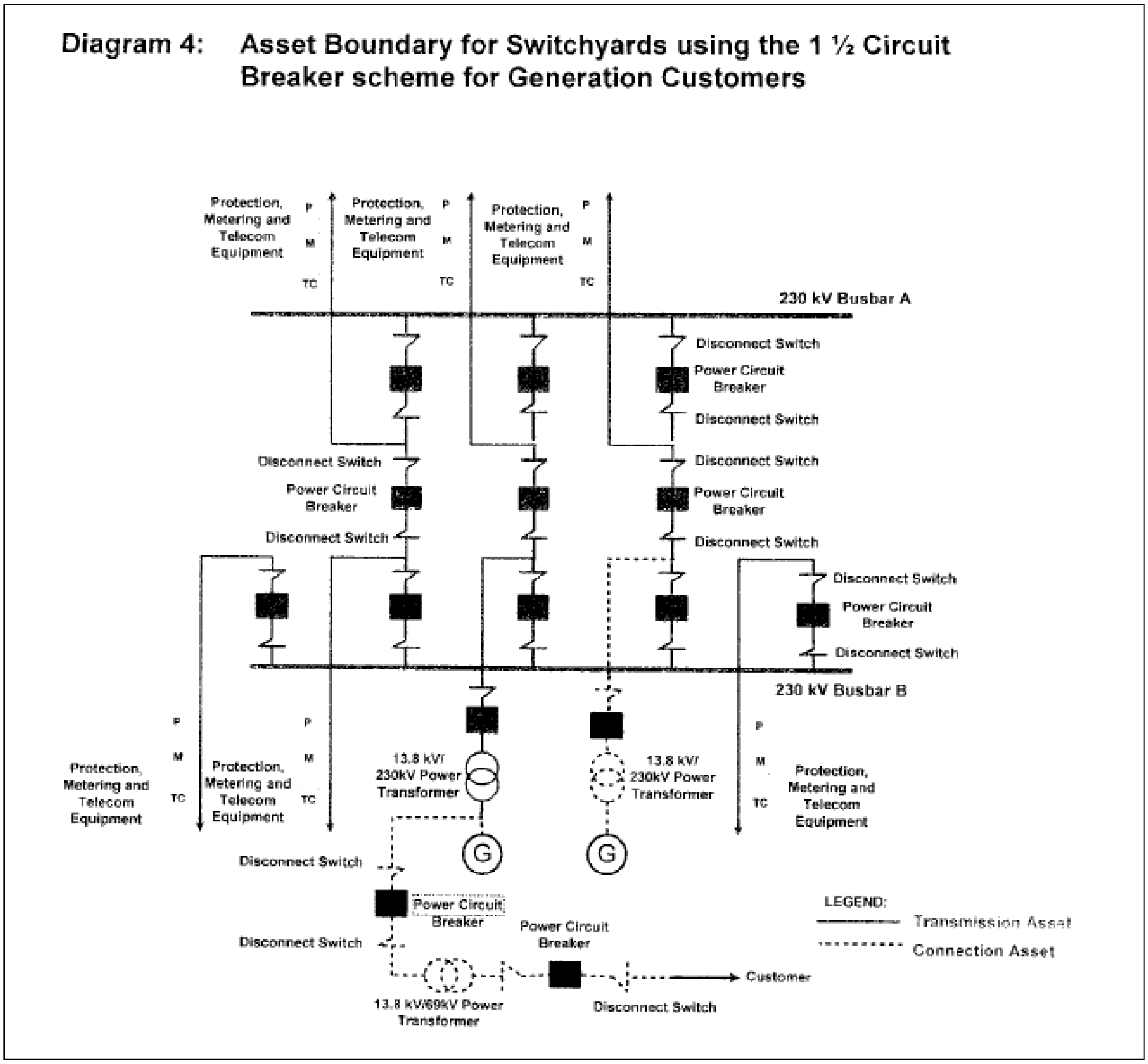


**Figure 1: Diagram 4 of ERC Resolution 16 - Annex C**

The contrast with the latest recommendations of the Australian Energy Market Commission (AEMC)[4] is striking. The following Figure 2 and Figure 3 are taken from its Chapter 11, which defines the various categories of transmission network assets. In the figures "TNSP" refers to the network owner.[5] "Shared assets" refers to switchyards or other transmission components that are utilised by more than one transmission system user. This may be more than one generator, or generators and bulk off-take customers, such as distribution network operators.

The following quotations from Chapter 12 of the report encapsulate its recommendations with regard to connection assets.

*"In particular, greater contestability should be introduced in construction of identified user shared [network] assets. A connecting party should be able to select its own contractor to construct the assets, construct them itself, or alternatively require the TNSP to carry out the construction as a negotiated service. It should also be able to negotiate whether it owns the assets, or the TNSP or a third party owns them."*

And further: -

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[4] Reference 2: - Transmission Frameworks Review – Final Report - Australian Energy Market Commission - 11 April 2013, Ref: EPR0019

[5] TNSP is Transmission Network Services Provider.

*"The Commission recommends the introduction of greater contestability in construction and ownership of identified user shared [network] assets where it will not compromise clear accountability for the on-going security and reliability of the system. Facilitating contestability in construction gives the connecting parties the opportunity to seek lower cost providers and greater control over timing, as well as increased countervailing power in negotiations with the TNSP."*

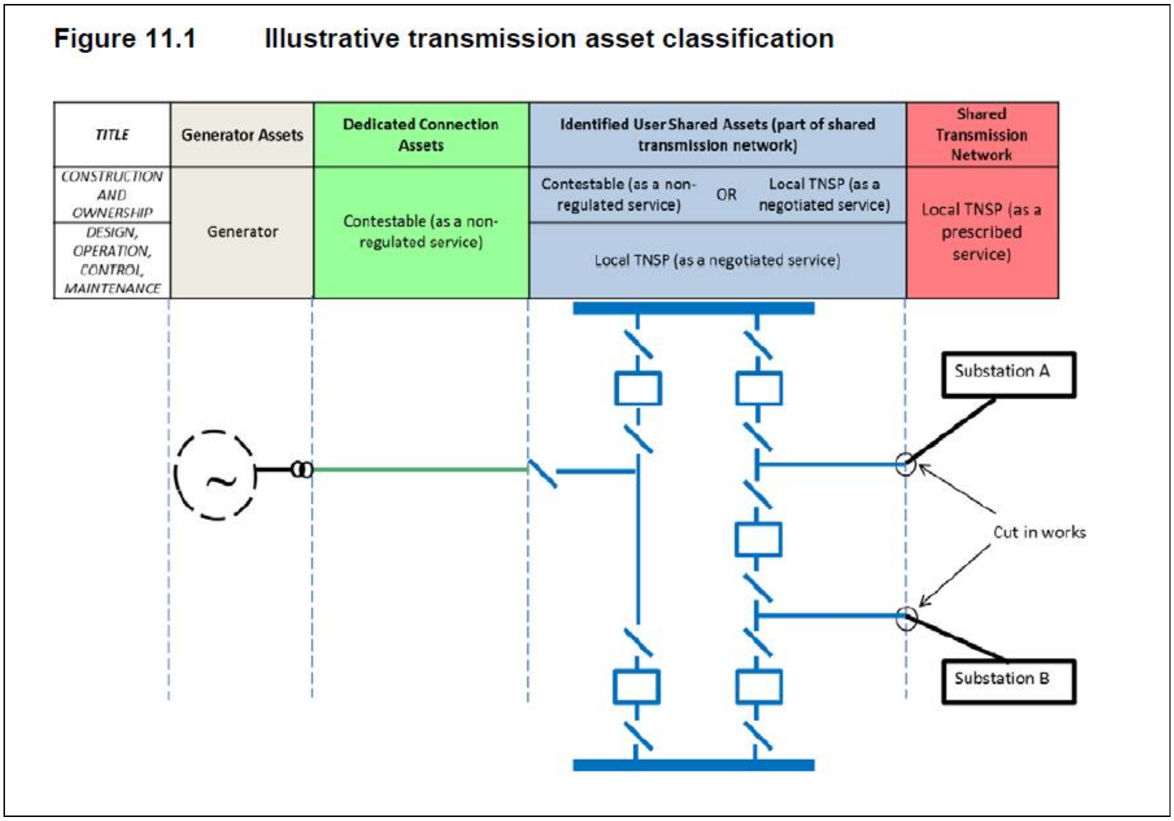


**Figure 2: Definition of Asset Types - from Reference (2)**

The reasons for these recommendations are set out in the report in detail but will not be reproduced here. The recommendations are worthy of study because they are based on years of experience with a variety of different connection policies, which pertain to the various autonomous Australian State jurisdictions, and which includes experience with the model currently being proposed. The overall purpose of the recommendation is to eliminate price and non-price barriers limiting the orderly and efficient development of power plant projects in the Australia.

In this regard the findings accord closely with the authors' own experiences, in the sometimes difficult environment of work undertaken on behalf of both IPPs and for the utilities at various times, as both sides grappled with the complexity brought about by the unintended role of the network company as the ultimate arbiter on all matters to do with network connections. We have experienced numerous instances of non-transparent processes and unjustifiable technical requirements being enforced onto the projects of connection proponents, with budgets and time-lines being disrupted as the consequence. In all instances, we have found that the connection proponents were in a position of relative weakness and were forced to comply with whatever the network company engineers proposed, often at considerable cost of time and money.

We have also been engaged by the customer-facing department of one transmission utility, which was concerned at its own poor performance in the interests of its customers. Through the course of the assignment it became clear that the connections effort was a small and relatively un-prioritised aspect of the utilities business, and considering also the shortage of competent technical staff, it was evident that connections could never receive the level of focus that would be required to meet the needs of connection customers, irrespective of the good intentions of the network company. Our overall recommendation was that the network company would only be able to fulfil its intentions if it outsourced the network connections work contestably to third parties.

**Table 11.1 Categories of transmission assets**

| Asset type | Description | Paid for by | Contestability |
|---|---|---|---|
| Shared assets | Used by the broad base of consumers. | All market customers (through TUOS). | Built, owned and operated by TNSP. |
| Identified user shared assets | Required for connecting generator or load but not used exclusively by it. | Connecting generator for generator connections.<br>All market customers, through TUOS, for load connections. | TNSP accountable for operation, control and maintenance.<br>Construction and ownership contestable. |
| Dedicated connection assets | Required and used exclusively by connecting generator or load. | Connecting generator or connecting load. | Construction, ownership and operation contestable. |

**Figure 3: Allocation of Establishment Cost, Ownership and Operation for Each Asset Type**

The effectiveness and efficiency of the network company's efforts also suffered from the added problem that it had to engage with all connection customers on a level playing field. It had to be mindful that it had to subject each customer to exactly the same process, and preferably, to standardise connections to a "one size fits all" standard, to avoid becoming captive to precedents, which may impair its abilities to discharge its obligations in future negotiations. These requirements; practices, had the unintended effect of subjecting connection proponents to needles expense, delays and frustrations.

The difficulties have come about because the Rules were set within the expectations that there would be a substantial balance of negotiating power between power plant proponents and the utilities, and this balance could be relied on to allow satisfactory progress, despite the onerous and cumbersome tools at hand. Increasing recognition that the asymmetry of power and interest, between generation proponents and the networks over connection projects, together with realisation that there would be a new tide of small to medium connection requests due to the rise of renewables, led to the revision of the processes connexions and connecting to the grid, as well as the development and ownership of connection assets.

In its recommendations, the AEMC reserves the operation, control and maintenance of connection assets to be the sole responsibility of the network company. Coupled with this, is also the role of setting design standards for the assets that would be constructed and owned by others. The important qualification is "Responsibility for", in that it is not expected that TNSPs would retreat from their widespread current practice of contracting out significant proportions of all of these activities to private contractors, other network operators, and even power plant operating and maintenance staff. Network companies discharge their responsibilities by setting and enforcing standard for others to follow, and by maintaining auditing and approvals processes, which ensure that all work is undertaken to a uniform high standard, irrespective of which entity undertakes the work. In practice, the operation and maintenance, and even the control of network assets is often shared between the stakeholders based on pragmatic considerations of availability of suitable staff at various locations, and the operation of term contracts for such services is well established.

It must be said also, that a considerable amount of conservative ideology still persists in the transmission industry, wherein network companies will opt to keep such activities in house, finding it difficult to accept or even visualise that outside agencies may be qualified and competent to share in the duties. Outsourcing design, construction operating and maintenance of networks has been successfully practiced for many years in many jurisdictions. The vibrancy, quality of work, and efficiency of the companies that provide these services in any jurisdiction, is directly dependent on the governance practiced by the incumbent network companies, and so where poor expectations lead to restrictive practices, scarce and poorly qualified contractor services are the result. However, where a strong commitment is made to creating a diverse and sustainable market for services, strong and competent services providers emerge, whose competency and performance can at least match those available from within the network utilities. It is a point that is well demonstrated in the mission-critical activities of the commercial aviation industry.

To conclude, it must be stressed that the purpose behind the definition of various categories of network assets is entirely related to arriving at a cost allocation methodology. It has no direct bearing on grid operations or grid reliability. The notion that grid reliability is underpinned by any particular ownership model or pattern of ownership of grid assets is just not supported by analysis or experience. While there may be imbalances between the capabilities and capacities of the various stakeholders within any jurisdiction that has not diversified sufficiently, other models are in operation in other jurisdictions, which sustainably support diverse centres of expertise contributing to the control, maintenance and operations of reliable, functioning transmission grids.

While a single owner model of asset ownership and asset management may appear to be the most simple and robust model, later paragraphs will argue that this is a false impression, and the single owner model suffers from excessive cost and lack of transparency in opportunities to innovation and evolution of a cost effective grid.

## 3.2 The Role of Switchyards in the Transmission Network

Most transmission switchyards are located at the network boundaries; at the interfaces with other elements of a power system. A lesser number are fully embedded within the transmission network. The embedded switchyards are constructed to marshal transmission lines together and to interconnect one transmission voltage level with another. These stations are usually referred to as switching stations. Mostly, switchyards of power plants and substations tend to be located at the boundary of the transmission network. Switchyards at power plants are the subject of Resolution 16, and these switchyards will be referred to as "Switchyards" in this report, but this will exclude other types of switchyards. Sometimes, Switchyards fulfil more than one purpose, being interconnectors of power plant, as well as serving as switching stations. The same is sometimes true for substations.

Most Switchyards are integral parts of a power system and provide a range of amenities that allow the power system overall, to function effectively and reliably. This is equally true in respect of the power plant itself. A power plant is also an integral part of a power system and it too provides a range of amenities on which the overall functioning and reliability of the network is totally dependent. The System Operator depends on the reliable and predictable behaviour of power plants acting in unison, for secure grid operations, and for recovery from contingent events. The recovery of the system from system faults "ride through" depends entirely on the cooperative action of power plants; their governors and automatic voltage regulators, and additionally, in the provision of ancillary services such as load following reserve, spinning reserve, and adequate rotational inertia.

From a technical point of view, the power system relies for its operational security, just as much on the individually owned power plants, as it does on other components of the grid. Therefore, the element of ownership of any particular category of grid components has no fundamental bearing on maintaining the secure and reliable operation of the grid.

In addition, power producers also rely on the control of their Switchyards to be able to fulfil their contractual commitments for supply of energy to their customers, which may require operations and arrangements that are solely pertinent to the businesses concerned.

It is fair to say that the owners and operators of both power plants and network assets are in a mutually reliant state of cooperation under the leadership of the System Operator, and each party is only able to meet its own commitments by being able to rely on the others for competent and professional performance of their duties.

From a technical perspective, and also from the point of view of power system operations, a Switchyard is an integral part of both the power plant *and* the transmission grid, as is the power plant itself. From the perspective of power system development, a switchyard is more naturally part of a power plant.

A new power plant is developed close to its fuel resource on land leased or owned by the generation proponent. The switchyard is usually planned and constructed as part of the power plant construction project on the same land. The location, form, orientation and functions of the switchyard are closely coordinated with the features of the power plant, by the power plant engineers. Switchyard development is closely coordinated with the development of the power plant for practical reasons of sound risk management. The Switchyard is usually constructed using funds budgeted within the overall power plant construction budget, and therefore ownership falls naturally within the overall assets of the power plant developer.

A Switchyard and power plant are closely intertied by control and instrumentation cabling. They are literally "wired together" with many control cables that interface switchyard controls and power plant controls. Power plant control systems and operator consoles are located in and around the power plant control room.

New transmission lines are usually required to be constructed to interconnect the new power plant with distant load centres. The lines connect into the Switchyard and may terminate at their remote ends at a substation associated with a particular load centre, or they may cut into the network at a convenient nearby location. Transmission lines are most conveniently developed by the network owner, because they mostly require recourse to the special powers of compulsory land acquisition, which is a power vested in a regulated authority or corporation. Transmission lines require on-going rights of access to private land for maintenance, and this also requires the overarching powers of a Government empowered organisation.

Therefore, in the normal course of project development and on-going asset management, a Switchyard would have a natural and secure ownership within the assets of a power plant, whereas the natural owner of transmission lines is the national utility empowered with rights of land acquisition and access.

In circumstances where a new power plant is developed in close proximity to an existing switchyard, (including substation or switching station), the power plant developer may find it most convenient to connect into the existing switchyard, thereby saving the considerable cost of development of new switchyard facilities associated with the new power plant. This is often the case for unitary CCGT plants, which often find a place at the boundaries of large industrial parks and urban centres, where they take advantage of the incumbent, piped bulk gas supply to these centres to generate electricity primarily for use within the same demand centres. This arrangement constitutes a primary source of conflict between the generation developer and the network company, because interconnection with the network switchyard exposes the generator to the full scale of network connection standards and network charges, whereas he rightfully considers that his use of the network is inconsequential, because his customers are within the same precinct. A contestable approach to the provision of connection assets, which are nevertheless governed by common performance requirements, would provide an agreeable way forward in such situations, by allowing costs to be allocated in an un-bundled form.

## 3.3 Discussion of the Merits of the Acquisition of Power Station Switchyards by NGCP

### 3.3.1 Introduction

The argument behind the restrictive definition of connection assets in Resolution 16 and the proposal for acquisition of Switchyards by NGCP, has been made on the basis of the need for ensuring system reliability. In various jurisdictions, such as USA, Australia and Singapore, claims are routinely made by network companies for regulated expenditure for acquiring new assets for the purpose of improving system reliability, as part of the regulatory planning cycle. The methods for preparing submissions involve a combination of network simulation and statistical and financial calculations to determine the value of the annual expected economic loss that can be assigned to a perceived weakness in the network. Projects, which are proposed to "save" this value of economic loss are considered to be worthwhile and receive regulatory approval, if the return on investment meets a declared positive target. The network utility is then authorised to reset its revenue to recover its due consideration on the capital employed and "cost of ownership" expenses. The economy is deemed to benefit through avoidance of the cost of non-supply events that would have occurred, but are then prevented from occurring by the newly created network assets.

It could also be that NGCP may be losing revenues by way of the current arrangements, which have the effect of masking the full extent of demand at the interface between its fee paying customers and the transmission network, through the action of local "Hybrid" generation, which supplies local demand through the Switchyards in question. This subject has been studied extensively in a comparative study of the barriers facing distributed generation in 13 of the EU states. The work has resulted in recommendations including that the effect on network revenues of Hybrid and distributed generation must be compensated and indeed, network companies need to be able to be incentivised to accommodate these generators, otherwise they will naturally continue to marginalise their development through price and non-price barriers.[6]

The directives on network planning in the UK, require network planners to factor in the contribution to meeting demand, when determining the requirements for new investment in network capacity.[7]

### 3.3.2 Grid Investment Test – Regulatory Procedure for Determining Grid Investment

The proposed acquisition of the Switchyards by NGCP, represents a significant new investment in the transmission network, no doubt involving significant capital expenditure, and would therefore result in increased charges levied on network users. Under the accepted practice of regulated grid investment processes practiced by most jurisdictions, any significant investment in grid expansion would normally be subjected to the processes associated with determining the merits of any new grid investment proposal.

The questions that need to be answered in this context are; (a) - whether the network company has demonstrated a sufficient requirement for seeking to augment the network in the proposed way, and (b) - (if it has demonstrated sufficient need then), has it demonstrated that its proposal is the best way of meeting the stated requirement.

In our experience, it is quite normal that insufficient analysis is undertaken in formulating proposals for grid expansion and moreover, in considering alternatives in sufficient depth. The industry tends to do what it has always done before, unless challenged to think about things in new ways.

In well-developed regulatory jurisdictions, stakeholders would seek to examine any proposal thoroughly from these perspectives, before regulatory approval for expenditure is given. The reason for this is clearly, that all expenditure on the grid is recovered from users and is an allocation of a portion the economic surplus generated by the economy. To be justified, the expenditure must be "a good investment" meaning that users, (and the economy as well) register a net surplus on account of the proposed expenditure. Whereas business and revenue growth is achieved for the grid company through the expenditure on additional capital assets, any increase in the valuation of the grid company results in an increase in fees for network users.

The additional capital expenditure can only be thought of as justified if it: a) delivers new capacity that is essential to meet a predicted increased demand on the grid or, b) if it results in an increase in efficiency leading to net reduction in costs incurred by the network users, and/ or, the economy – for example, due to reducing the cost of network unreliability, or facilitating development of more economic generation.

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[6] 1) Frías, Goméz, Rivier - Integration of distributed generation in distribution networks: regulatory challenges - 16th Power Systems Computation Conference - Glasgow July 2008

[7] References (17) and (20).

Mostly, it is best to undertake a transparent process in evaluating proposals for augmenting the network in terms of the additional network services being provided as a result of the investment, in relation to the forecast demand for these services over the current planning period. The evaluation must follow a number of logical steps that are quite simple in principle. They comprise:-

a) A identification of the type and quantity of unmet sector demand (for the planned network services),

b) Demonstration of a need - some form of calculation or preferably; simulation, which demonstrated the inadequacy of the grid in the face of the forecast sector demand,

c) Description of the utility plan (project) for meeting the inadequacy – including cost estimates and time frames for completion,

d) The consideration of a number of meaningful alternative ways of meeting the same demand (improvement in reliability in this case), which are nearly as good as the preferred option.

For example, in the case of NGCP deeming it a requirement to purchase the Switchyards currently owned by other parties to maintain or improve grid reliability, the process might work as follows.

a) System planners at NGCP identify that X number of "system minutes" above the normal expectation, are lost each year due to second order contingency events "N-2 events" within Switchyards that are not owned by NGCP. Moreover, investigations have shown that the events are excessive of the underlying norm and constitute a reliable indication of a trend, and that the problem can be identified as being due to ownership by parties other than NGCP.[8] The planners may forecast an increase in such incidents due to perceived underlying trends (which has prompted the proposed grid augmentation) or may re-value the cost of a system minute, as the increasing "value" of taking the proposed action.

b) A calculation could be used to identify an indicative "present value" from benefits accruing over the planning period or remaining asset life - (10, 20, or 30 years), from system minutes saved through the transfer of the assets into the ownership of NGCP. (NGCP would need to demonstrate of course, that assets in their ownership had fewer incidents which caused the loss of system minutes, which may not necessarily be the case.)

c) The "Project" for meeting the demonstrated demand for a decrease in loss of system minutes would in this case be the acquisition of the Switchyard assets, including any works required accomplish asset separation and to accomplish a more reliable operation of each Switchyard. The time frame would be the time taken to acquire the assets and bring them up to the necessary standard of operation, and the cost would be the estimated consideration required to be paid to existing owners, and the cost of any modifications and upgrades. The costs associated with the physical separation of the switchyard assets from the generation assets would be a significant additional cost, which would not be avoidable if a transfer of ownership were undertaken to achieve a material separation. This would be a natural requirement arising from any un-reliability argument.[9]

d) Alternatives for achieving the same result may include the preparation and implementation of operating and maintenance "asset management" codes of practice for Switchyards; audited competency requirements for power plant owners' Switchyard operating and maintenance staff; sharing of qualified staff between NGCP and power plant owners to make up any shortfalls. The costs of developing suitable reliability centred management and training infrastructure, which would achieve a common standard of operating and maintenance amongst NGCP and power plant owners, would be estimated and compared with the cost of acquisition that are set out in the previous paragraph.

If evaluation of options determined that the acquisition of the assets by NGCP was the least cost solution that would deliver the required improvement in reliability, then it would be clear to all stakeholders that acquisition would be the right course of action. On the other hand the analysis, or subsequent inquiry, may show that other solutions are similarly (or even more) effective and of a lesser cost, in which case one of these other solutions should be recognised and implemented if there is sufficient need, as constituting the least cost to all.

[8] For example, the problem may be identified as lack of sufficient training of owners' personnel, or lack of retention of sufficient qualified staff, whether maintenance or operating personnel, etc. Alternatively, the perceived shortcoming might be insufficient maintenance, or insufficient investment in asset renewal, compared with industry norms.

[9] Such work is quite invasive of power plant systems, as it would require considerably disruptive, detailed engineering works, such as the removal of switchyard control, protection and SCADA facilities from the power station control room, the separation of DC supplies, provision of additional batteries for both control and communications/ SCADA. The work required is a substantial re-engineering of the secondary systems at the heart of the combined facility, and should not be taken on lightly.

These steps direct the evaluation of any proposals towards maximising overall economic benefit to the network users and the economy. One would envisage that the acquisition of each Switchyard would be an individual case,[10] because the circumstances and any impact on overall network reliability, would be quite different in each case, and so one would expect to see the investment test being undertaken separately for each Switchyard.

The authors feel it is unlikely that the analysis has been undertaken by anyone. Furthermore, we consider it is most unlikely that a change of ownership of the Switchyards would turn out to be the most effective, or even an effective means improving system reliability.

#### 3.3.3 Conflicts in Grid Ownership and Responsibility for Grid Security

The ownership of grid assets, combined with the responsibility for maintaining grid security, comprises a conflict of interest, which has proven to be problematic for grid planning and the grid asset management processes in the regulated regimes of most jurisdictions. This is currently being recognised in some jurisdictions, such as New Zealand, Australia and Singapore, where a range of initiatives are being undertaken to solve the problems created by this conflict.

To some respects the problem is analogous to the pre-1990 supply-side over-investment problem that resulted in the introduction of competition in the supply sector in the 1990's. Something similar has been happening with network companies over the years that the industry has been made up of regulated monopoly entities. Most jurisdictions recognise the requirement for a return on investment by owners of grid assets, based on fair value of capital employed. This indexes grid utilities' income to the assessed value of their assets, under processes which adjust their replacement value relative to age and effectiveness.[11] Assets depreciate in value at rates that are not causally linked to the service lives of the assets. New assets represent new sources of revenue, whereas the cost of ownership may be quite minor for a significant number of years.[12] Over recent years, efforts at reliability-centred grid planning and expenditure have been a significant source of new assets. While this is justified in most instances, reliability centred gird enhancement has attracted a significant level of criticism of utilities "gold plating" their systems, regardless of the rising cost to users.

The fact that the proponents of the new assets also specify their technical requirements, and as they are not exposed to any competition imperative that would focus them on doing more with less, means that they are viewed as tending to propose traditional solutions, which are needlessly expensive, and make it difficult to balance expenditure with required outcomes, especially for investments directed at improvements in system reliability.

Both Australia and New Zealand are attempting reform help to reorient the culture of their industries from a focus on asset creation, towards focusing on operational outcomes; and achieving better outcomes, while reducing capital expenditure and the rate of creation of new transmission assets.

Australia is implementing regulatory change pursuant to recommendations by the AEMC that are pointed at separation of system planning from asset ownership, as well as the contestable development and ownership of new grid assets.[13] There is a drive to increase the utilisation of existing transmission assets through implementing a system of firm transmission rights[14] for participating generators. These are interesting proposals and are in all likelihood the most productive way of solving problems of perceived over-capitalisation, as well as mitigating the risks of creating stranded assets.

Separation between the planning and the procurement of grid assets and asset ownership and operation, are seen to provide transparency with regard to both the requirement for any asset, and the effectiveness of its design and operation, in meeting a stated requirement. System planning and design would be transparent and contestable, no longer be subject to the conflict of interest between ownership of assets and the provision of adequate network services. Furthermore, if the required new network services are created and delivered contestably by providers contracted through a competitive process, with their incentives tied effectively to fulfilling

[10] Different with regard to age, reliability (MTBF), size (number of bays etc.), location within the network, prospective loss of load for a double contingency occurring at the switchyard.
[11] Under a process sometimes described as "Optimised, Depreciated Replacement Cost" (ODRC) system of valuation.
[12] Assets that provide 100% service, but can only be valued at fractions of the value of equivalent new assets because of their age, fill up the asset registers of grid companies.
[13] In the state of Victoria the ownership and operation of new grid assets is determined on a contestable basis. Recently, Origin Energy has completed construction of its Mortlake Gas Peaker power plant, including the provision of a 500 kV bus-in Switchyard, which it owns and operates.
[14] The subject of firm transmission rights is not addressed within this report, but is explained in Reference (2).

the network services requirements over the term of their contracts then an opening is created for innovation and the contest of alternative ideas in the means of providing system requirements.[15]

Competitive markets in grid asset creation and ownership are really no different to competitive markets for power plant development and ownership and would foster innovation in the way that grid services are regulated and delivered, which would ensure that services are delivered (and are seen to be delivered) in a cost-efficient manner. The effectiveness of capital assets could then be measured in terms of their contribution to grid security outcomes,[16] through their on-going operation and maintenance, against appropriate contractual terms and audit processes.

In this context, the ownership of Switchyards by power producers of the Philippines can be seen as a *forward marker* in the evolution of energy policy, and points to the future direction, which is a more widespread application of a diverse ownership at the margins of new developments in the grid. Diverse ownership and operation of grid elements promise to provide the sought after answers to balancing expenditure with grid outcomes and should be closely examined by the ERC as the recommended alternative. This regime could be applicable within the Philippines at transmission level, if the practice of diverse ownership of transmission assets could be retained and developed further.[17] The asset owners' performance could be measured against operational and asset management targets, with remuneration for the support of the grid being linked to performance in a way that is supportive of the sustained delivery of cost-efficient grid services.

There is no natural correlation to be found between the monopoly ownership of grid assets and high reliability outcomes. This can be appreciated from a comparative assessment of the performance of grids around the world. Some are good and some are bad. One thing is clear, that a transparent system of benchmarking, which is linked to incentives, is a powerful tool for managing compliance and betterment. This tool is used extensively by regulators of distribution network companies, wherein a number of distribution companies exist under single regulatory jurisdictions.

There is no apparent connection to be made between improved grid security and monopoly ownership of switchyards, as NGCP have proposed. Our impression is that rather, it is the opposite, because the singular ownership model engenders a poverty of alternatives, which hinders the creation of new and more effective ways of meeting objectives, and moreover acts to obscure the means to betterment. If there were such a connection between ownership and reliability, then the onus is on NGCP to show this by accepted means in order to justify the cost and complication involved in making the proposed acquisitions. It must show that its ownership of the Switchyards would have a reliability dividend, and beyond that, a sufficient reliability dividend to justify the cost of the relevant expansion of the assets under its ownership.

It is quite likely that NGCP is losing customer market share and revenues as a result of the existence of distribution networks connecting into Switchyards. If this is so then the correct approach would be to compensate them through suitable adjustments the method of calculating revenues.

It should also be noted that other owners of shared assets should be compensated for the network services they provide, in a similarly structured and transparent manner. It is foreseen that this would be possible to do on the basis of a simple regulated network tariff that recognises the fair value of capital employed and other expenses.

This would allow a level playing field to exist between the network company and other competing providers of shared assets, which would remove distortions, and allow the most efficient and suitable connection assets to be developed in each application.

#### 3.3.4 Interconnection of Generation and Switchyards with Distribution Networks

Provided it is undertaken with due regard for the technical requirements, there will be no negative effect on reliability arising specifically from a Switchyard being connected to both the transmission and a distribution network. In that role, the particular Switchyard services all of the functions associated with switchyards namely, performing as a generation interconnection asset, a switching station, and a substation. A duly engineered and configured switchyard is technically well able to perform all of these functions simultaneously. In fact, making an

[15] This is in fact very similar to long term power purchase agreements, which form the cornerstone of many power plant developments. Instead of developing assets to produce power, proponents would develop assets to convey power.
[16] One of the most difficult areas referred to in the paper by Frías and Gómez, was the reluctance of grid planners to take proper account of the conntribution of hybrid power plant servicing local demand when estimating new investment for increases in grid capacity. They suggest that network companies should share directly, in the amenity value of hybrid generation.
[17] In a way that is similar to the current provision of "Energy Production and Ancillary Services" by power plant owners, against a tightly specified, published set of technical and operating requirements – a Grid Code for transmission system assets.

asset serve multiple purposes, reduces overall cost. It may indeed increase reliability, because of the proximity of generation to local demand, and because the overall asset count is reduced, leaving a smaller number of components in the system that could fail.

Allowing a power plant to directly connect to a distribution utility enhances the efficiency of the power plant and the efficiency of the overall power system. Locating generation close to demand: "embedding" it, "bypasses" the transmission network and reduces the network capacity required to service that segment of demand and that segment of generation. While this may be seen as a net negative effect, in fact, in an environment of demand growth it has a positive effect, because network reinforcements can be deferred to later years through the contribution of Hybrid generation.

The local supply and the local demand tend to cancel each other out, allowing the combination to be serviced by a lesser capacity network (and therefore at a lesser cost), than would be the case if the two were interconnected across the network. Typically, over 50% of the cost of retail energy is incurred through the requirement to make use of transmission and distribution networks to convey energy from the source of generation, to the end customer. If generation can be provided close to its customers within the distribution network, then a large proportion of the cost is potentially avoidable. In addition, energy lost in transmission and distribution is minimised when power plant and demand are co-located.

Network-related costs are often a disproportionate burden for smaller generating plants, and on local communities seeking supply. These costs have the effect of suppressing the development of many small power plants that would otherwise usefully convert indigenous sources of energy into electricity, which could then be utilised by the community. The ability to connect in Hybrid form, by means of interconnecting assets that are of appropriate scale, enable developments which would otherwise be prohibited due to their cost.

In most generation development projects that we have been involved with in South-east Asia, there is a positive requirement from the national electricity company, for the power station development to provide supply for local communities.

Also, where this is not done, and HV lines bypass the villages of local communities without offering them supply there is usually considerable community unrest and opposition to the project created by this omission. We have encountered this in situations where these lines convey generation to the grid and also in the context of rural electrification projects, where some smaller villages are by passed at sub-transmission voltage to provide power to more distant but larger communities. The local villages rightly, cannot understand why they don't benefit from the lines encroaching on their lands.

Network companies complain that embedded generation does not reduce the cost of providing either transmission or distribution. However, this is clearly not the case if planning processes are made sensitive to the contribution that this type of generation makes. The requirement to take into account the positive contribution of co-located power plant when undertaking grid capacity planning, is a requirement of many regulatory jurisdictions[18]. Network utilities prefer to ignore the contribution of co-located power plant when planning system capacity and reliability, on the grounds that the level of availability of supply from power plant is not consistent with the reliability delivered from the transmission grid; that in effect, the power plant supplies and sells energy, while the grid supplies the back-up reliability, for which it must maintain assets that are rendered uneconomic by the presence of the co-located generators.

This is a valid objection, which needs to be addressed through a tariff structure that adequately balances present business needs with future development opportunities, in ways that allow rational development of both.

The New Zealand transmission company Transpower manages the threat of by-pass, by offering to connect any generator to its network for the fairly assessed equivalent cost of connecting through a by-pass arrangement. This is equivalent to offering generation customers who have an alternative, a "shallow connection" option, with the difference between minimum assessed cost and actual cost of the grid connection being socialised among other grid users.

In some individual cases, there can be some technical problems where distribution system connections are located near to power plant. The main problem is that a short circuit fault within the distribution system can affect the transmission system voltage and current balance, and if the distribution system is slow to clear the fault, this can be a stability concern for the power plant. It must be stressed that this issue is not specifically related to a distribution system connection and power plant connections sharing the same switchyard, but rather generically,

[18] Including the EU, the UK, and parts of the US.

the relative proximity of the distribution connection to the power plant connection within the system. Wherever there is an adverse influence in the transmission system from slow-acting distribution system protection, this can be addressed relatively simply, with due insight, by re-engineering the distribution system protection so that it can achieve faster fault clearance.

Connecting distribution system off-take within the same switchyard as power plant is an advantage to both the distribution company and the transmission company. High voltage transmission assets are relatively expensive, and the close interconnection of generation and distribution networks, where possible, saves on valuable transmission system capacity, which is then available to other users.

There are no real disadvantages if network development and engineering is undertaken in a manner that takes account of both the requirements and the behaviour that characterises embedded generation.

## 3.4 "Hybrid" Generation

"Hybrid" embedded generation is defined in the Philippine context as power plant that is connected to transmission and at the same time directly connected to a distribution utility or other end user. We have been asked to comment on the general applicability of this concept in other jurisdictions and the considerations; (technical and other) associated with its connection and operation.

In our experience, Embedded Generation, Distributed Generation (DG), or "Hybrid Generation", is sought after, and actively encouraged by government policies throughout most well developed electricity sectors. They are permitted to be interconnected simultaneously with; the transmission network; the sub-transmission network; and distribution network via shared network assets. The interconnecting shared network assets can comprise widely diverse arrangements, involving distribution feeders or substations, sub-transmission lines or substations, transmission substations, or power station switchyards. Usually preference is given to whichever connection arrangement is technically most efficient and convenient for the relative disposition and scale of the network assets, the energy resource and the local demand. Besides generation interconnection, a power station switchyard may serve a number of functions simultaneously, including; a transmission switching station; a sub-transmission node; a distribution substation, or a combination of two or more of these additional functions.

In each case, the specific network arrangements are determined in the project development phase, from a number of engineering alternatives. These decisions are best made in the process and context of the generation development project, because they typically add a component of cost and complexity to the design of the interconnection, which is material to the progress of the generation development. The main consideration is to assure acceptable performance while minimising the combined capital and operating costs over the future operating life of the facilities, as far as these can be foreseen. Limiting cost is important, not just so that the project will be more profitable, but because the viability of a project may be adversely affected excessive connection costs which may cause projects to be deferred. This may be in circumstances where there are no competitive options left to develop. Sometimes network companies enforce excessive connection requirements on generation developers. These excessive formats must rightly be viewed in the context of network management vocabulary, as "sunk assets", because they are typically underutilised, waiting for major developments in the area, which may never come.[19] They highlight the importance of allowing the contestable provision of interconnection assets that are focused on the needs of the specific development project, and not governed by prescriptive specifications that may be purported to be generally applicable standards for interconnection.

The technical requirements surrounding the various types of Hybrid, and other types of embedded generation, are typically not well understood by engineers who have developed their careers in either the transmission or the distribution industries, and who have not had experience with the technical requirements for generator stability and the specific types of control and protection systems required to achieve acceptable performance. Neither are they understood by generation developers, whose expertise and focus is typically on the energy conversion part of the power plant, and who are ill-equipped with technical knowledge regarding power systems operation and dynamics. Therefore often, inappropriate engineering provisions are made, and these types of generators perform badly. They are often less than welcome on networks, because they have gained reputations for causing difficult and troublesome network operating conditions.

It needs to be stressed that this is entirely due to inadequate engineering. With the proper technical insight applied during planning, design and acceptance testing, perfectly acceptable performance can be achieved.

The incumbency of network companies and their engineers as "system operators" responsible for network security, has made them "gate keepers" of generation connections and has imposed an unwarranted drag on the development of generation, through escalation of grid compliance costs and technical difficulties, which contribute considerably to the costs and uncertainties in the process of generation development. Arrangement of the network requirements by bilateral negotiations, are often fraught with unexpected technical provisions, calls for unforeseen additional investment, and uncertain technical compliance requirements, process and time-frame.

In order to be able to achieve sound and compliant engineering on a routine basis, appropriate (but not excessive) technical requirements need to be defined impartially within suitable, freely available codes of practice, so they

[19] The irony is that whereas the costs of establishment and ownership of the under-performing assets could easily be borne by the network company, because they would comprise only a marginal impairment over the entire network assets, the investment rules require that they be borne by the developer of the power plant, who may have a much more limited asset base against which to off-set the cost.

can be considered as part of the proponents' project requirements and cost estimates at an early stage in project development.

The author has been involved in preparation of a number of such codes of practice and standards for Hybrid generation, for various jurisdictions wherein the networks associations, or the regulators the network utilities themselves, have recognised the need to bridge the technical gap between their grid codes, the requirements of the network company engineers, and the everyday needs of generation developers. The key feature of a successful code is that it concentrates on defining the performance required from a generator, rather than prescriptive specification of the equipment and the arrangements that must be constructed. This then allows individual proponents to build up their systems to be able to meet the technical performance requirements, which suits their specific technologies, constraints and approaches.

Approval for connection of the proponent's plant can then be established by a selection of tests, which demonstrate compliant behaviour. Therefore, there can be a shared clarity between a network company and generation developers about what to expect and what actions and provisions are necessary to ensure adequate network performance. Generators are then permitted to connect and operate as long as they continue to perform within the parameters specified in the code, as established from time to time by routine testing. No technical opinions or judgement calls are required as to the suitability or otherwise of various equipment, or interconnection formats, because the acceptability or otherwise, is established by performance only, and the onus is on the developer to maintain his plant within the performance criteria, or lose his ability to connect.

The additional benefit of such a regime is in that the set of performance requirements can be used as a template for network planning purposes, in that the network can be simulated to determine the effects of future generation, which will have a known set of performance criteria. Any unsuitability or weaknesses in the technical disposition of the network can be foreseen and earmarked for attention prior to the commencement of a specific project, meaning that the applicable network capabilities are fully known at the time when the generation proponent seeks connection, avoiding delays and uncertainty, as well as hurried engineering, when project time lines press for progress and accomplishment of project milestones.

The international standard IEEE 1547:2003,[20] is an example of such an approach. It sets out the required operational characteristics for small to medium power plant, including the generic processes for qualifying for connection to the power system through a series of performance tests. The standard takes the approach that if certain common behavioural characteristics are complied with at the point of its connection with the system, then the system operations and overall system security will not be adversely affected by the operation of such power plants.

In recent years, the progressive emergence of national policies encouraging renewable energy generators in all of its forms; hydro, geothermal, as well as wind and photovoltaic generation, and energy efficient co-generation (Combined Heat and Power – CHP) much of which is inherently distributed generation, embedded in networks that afford suitable scale, whether LV, MV distribution, or HV transmission and sub-transmission. The diversity of distributed generation has thrown up new challenges with respect to grid access and the process of qualification, which have resulted in a sharpening and growth in significance of the need to reorganise the methods of investment in the supporting networks, as well as the elimination of technical barriers standing in the way of the development of these resources[21].

The methodologies and regulations pertaining to the connection of hybrid generation are diverse amongst various jurisdictions. Standardisation is being developed within various national and international organisations, universities and standards organisations. It is clear that policies of adoption are being actively pursued by most governments in their drive towards clean energy and this is giving considerable impetus to technology development and a wider participation by business in investment in renewable generation.

The broad consensus is that there are no significant disadvantages in permitting connection of "Hybrid" and also, fully embedded generation, and it is clear that they should be (and are being) enabled and encouraged to the maximum extent consistent with exposing them to fair and rational competition related solely to the efficiency and desirability[22] of their means of electricity production.

[20] Also, equivalent EU standard IEC/IEEE/PAS 63547.
[21] Other facts of life, concerning renewable energy generation have also played an equal, or greater part in moderating the rate of growth in renewable generation including cost, the immaturity of the technologies, and the detrimental effect of intermittency of renewable energy sources. However, a combination of demand and technology progress over the first few years of this century are progressively and rapidly eliminating the plant-side barriers to deployment of renewable energy power plant.
[22] Desirable from the perspective of the national energy policy.

It is the author's opinion that considerable leeway should be granted to proponents of diverse power plant to connect to the networks in the most practical and cost-effective ways which are consistent with sound technical operation. Stemming from the observation that in a reasonably competitive electricity supply market, the rate of power plant connections will not outstrip the rate of growth of demand, and considering that the bulk of the new investment in networks will continue to be driven by the response to meet demand, it is concluded that even the significant infusion of small to medium scale hybrid generation will not have an adverse effect on system reliability because networks will have the resources to adapt, over the time-frames wherein significant changes will take place on the supply side.

# 4.0 Conclusions and Recommendations

There is a broad array of perspectives from which one needs to approach consideration of the questions that have been posed by PIPPA, and which constitute the Terms of Reference. It is hoped that the responses contained in the above sections will at least start the debate and point the direction on what to do in the circumstances of the introduction of ERC Resolution No 16, and the role of Hybrid generation.

After consideration of PIPPA's questions, the practices in other jurisdictions that are known to us, and our knowledge of the organisation and development of the electricity industry, grid planning, grid reliability and operations, our overall observation is that there seems to be no technical foundation for the technical advantage sought from the enactment of Resolution 16, and it is unlikely that it would pass normally acceptable network investment tests for development, if it were evaluated under the recognised principles and techniques for determining new grid investment.

It is most likely that, if in fact there was a demonstrable need for improvement in the contribution to system reliability from the performance of Switchyards that are not owned by NGCP, then the least-cost acceptable solution would not be a transfer of ownership, but other, less costly institutional arrangements, which would be preferable from both a practical engineering perspective, and from the perspective of helping maintain and perhaps further foster a fortunate diversity and dynamism in network development, which other jurisdictions may be struggling to achieve.

The issues surrounding Hybrid generation, Switchyard ownership and operation, and their effect of bypassing transmission assets are complex, but it is felt that better and more enabling solutions ought to be found than the one of circumscribing and marginalising the activities of power plant owners and developers, through enacting the proposed resolution or any other, which may draw inflexible boundaries around what assets power producers may, or may not, own. It is felt that such policies would have an unwarrantedly chilling effect on supply side development and may lead to inefficiencies and distortions in the natural development of an otherwise rapidly growing electricity sector, which indeed the Philippines needs in order to progress toward economic development as well as its renewable energy targets.

It is most likely that the right answers would come from policies and governance rules aimed in the opposite direction; towards diversifying and freeing up the ownership of transmission grid components on a contestable basis, especially with regard to new assets, which may be required for grid extension to new areas and certainly, the connection of new power plants, but may also include grid assets required for increases in grid capacity, or the improvement of grid operability or security. An adequate regime of technical governance of such assets could be by means of a set of compliance obligations that are analogous to those governing the owners and operators of power plant.

In conclusion it must be noted that the policies objectives, rules and regulations, governing network development, network investment and ownership, which all affect network reliability and the amount that network users must pay for these amenities, are by no means set in stone, and are indeed the subject of development by regulators elsewhere. The amenity of a grid facility offering transmission services to network users operating in a market, or otherwise, in a business environment, is very much a new paradigm whose effect on the form of the grid assets, and the practices of grid development and operations are still being determined through practical experience, and considerable experimentation. The current sets of rules in place in most jurisdictions, although in various states of "maturity", should still be regarded as innovative "first attempts" at setting up the terms and conditions for the offer of transmission services to network users.

Disruptive technology change and business innovation, as well as development of new objectives in national energy policies; the role of renewable energy, are in the current mix and offer up a new paradigms for network operations and amplify the need for changes in network governance. The rules that would govern their impacts on the form of the grid, the practices of grid development and operations, are very much under development.

Governments in most jurisdictions have recognised the need for encouragement of supply side development through the adoption of new technologies, integration of renewable energy technologies, distributed generation and "Smart Grids" ventures such as advanced interactive metering, and are searching for the best ways to give these policies effect within a market context.

Generally speaking everywhere, networks have been ineffective in changing with the times. This is probably due to the regulatory limitations that were enacted in the process of the deregulation of the supply side of the electricity industry. In many jurisdictions there has been recognition that grid development has been less than effective in keeping pace with other energy sector developments and that single ownership models have produced stagnation as well as some distortions in network development decisions and investments. Efforts are currently under way to provide corrective measures through further regulatory changes and rule making.

While it is recognised that considerable additional work would need to be completed before alternative measures could be introduced into regulatory framework of the Philippines, it would leave our arguments unfinished if no recommendations were proposed, and therefore the following ideas are presented for consideration by those whom it might interest or concern.

The primary recommendation is that the ERC should revisit the terms of Resolution 16 to see if a contestable regime for the construction and ownership of connection assets involving the opportunity for diverse ownership of these assets could be put in place instead. The boundaries of the definitions of what constitutes connection assets and in particular, what constitutes shared assets, should be allowed to remain flexible so that the efficient provision of these assets can be fostered, developed and tested though a competitive and transparent process.

It would be important to ensure that the revenue model for networks is adjusted to compensate the incumbent network owners for a portion of lost revenue which may result from these activities, and in particular the activities of Hybrid generators, so that overall there is some sort of profit sharing from the improvements in efficiency, in order to incentivise the stakeholders in a way that would ensure sympathetic cooperation in the operation of the new regime.

The owners of connection assets should also be remunerated according to a standard compensation model, which would put them on a par (pro-rata) with network companies undertaking investments in the network, so that overall there is some neutrality in the provision of connection assets, and so that innovation can arise to find more effective solutions for interconnections.

It would also be important to develop codes and standards that describe the technical operating characteristics of contestable network assets so that proponents of the provision of these assets will be aware of a common set of requirements. The codes and standards should be in the form of performance specifications, rather than prescriptive specifications, so as to allow sufficient scope for innovation efficiency improvements and cost reduction, while fixing the standard of performance at the appropriate levels.

The development of all kinds of Hybrid and embedded generation should be encouraged by whatever means, as long as these are sustainable and transparent to the competitive forces within the generation sector, consistent with any government policies and projects for the encouragement of such generation. Those responsible for network security should not be concerned about adverse effects of such a proliferation, provided that the performance of such interconnections are governed by a suitable set of performance standards, similar in principle (but not necessarily in the detail) to those embodied in the IEEE 1547: 2003 international standard.

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# Appendix A – Terms of Reference

In order to progress the dialogue over Resolution 16, PIPPA has requested AECOM to prepare a written report to answer questions in five parts, surrounding the following basic points PIPPA wish to carry in their ERC petition:

Part I: Section 4.2, Annex A of Energy Regulatory Commission ("ERC") Resolution 16, series of 2011 ("Resolution. 16")[23] is inconsistent with diagram 4 of the same ERC Resolution.

(a) Is the definition of "Connection Assets" in Section 2.0, Annex A of Resolution. 16[24] consistent with the definition of connection assets in other jurisdictions?

(b) What specific types of assets or equipment are considered "Connection Assets" in other jurisdictions?

(c) Is the definition of "Connection Assets for Generation Customers of Transmission Provider" in Section 4.2, Annex A of Resolution. 16[25] consistent with the definition of connection assets in other jurisdictions?

(d) What specific types of assets or equipment are considered "Connection Assets for Generation Customers of Transmission Provider" in other jurisdictions?

Part II: "A switchyard is an integral part of a power plant."

(a) Do you agree with this proposition? Why or why not?

(b) Are you aware of any power plant without its own switchyard? If yes, please explain the circumstances in which that plant is being operated.

Part III: "The acquisition of a power plant's switchyard does not affect Grid Security."

(a) NGCP has asserted that it needs to acquire the switchyard of certain power plants (particularly those that also directly connect the plant to a distribution utility) for grid security. What are your comments on this?

(b) Assuming that the acquisition of a power plant's switchyard may enhance grid security, are there other more effective ways to achieve such purpose? If yes, what are they? Why are they more effective?

(c) What is the impact, if any, upon grid security if a power plant's switchyard connects the plant to the grid and at the same time directly connects the plant to a distribution utility?

Part IV: "Allowing a power plant to directly connect to a distribution utility enhances a power plant's operational efficiency."

(a) Do you agree with this proposition? Why or why not?

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[23] Section 4.2, Annex A of Resolution. 16 provides:

Connection Assets for Generation Customers of Transmission Provider include those assets from the last Single Mechanical Connection of a User System or Equipment of a Generator, at its Connection Point, to the last Single Mechanical Connection which is not shared with another Generator.
The specific assets which are not owned by any Generation Customer and the Connection Asset which meet these boundary conditions are shown in Annex C.

[24] Section 2.0, Annex A of ERC Resolution. 16 defines "Connection Assets" as: "Those assets that are put in place primarily to connect a Customer/s to the Grid and used for purposes of Transmission Connection Services for the conveyance of electricity which if taken out of the System, will only affect the Customer connected to it and will have minimal effect on the Grid, or other connected Customers."

[25] Section 2.0, Annex A of ERC Resolution. 16 defines "Connection Assets" as: "Those assets that are put in place primarily to connect a Customer/s to the Grid and used for purposes of Transmission Connection Services for the conveyance of electricity which if taken out of the System, will only affect the Customer connected to it and will have minimal effect on the Grid, or other connected Customers."

(b) What are the technical advantages and disadvantages of connecting a distribution utility directly to the switchyard of a power plant? If there are disadvantages, what are the mitigating measures that can be implemented?

Part V: "Hybrid embedded generation (where a power plant is connected to a grid and at the same time directly connected to a distribution utility or other end user) is allowed in other jurisdictions."

(a) Do you agree with this proposition? Why or why not?

(b) What are the issues (technical or otherwise) that were considered in determining whether or not hybrid embedded generation should be allowed?

(c) In other jurisdictions where hybrid embedded generation was allowed, what were the consideration for allowing this?

(d) In other jurisdictions where hybrid embedded generation was allowed, how were these implemented (e.g., how was the plant connected the grid and to a distribution utility or other end user)?