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# Final Report on Review of Draft Namibian Grid Code

*In collaboration with the*

***Electricity Control Board of Namibia***

Prepared By:

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# Tables

# Acronyms and Abbreviations

| | |
|---|---|
| ABOM | Agreement Between Operating Members |
| COUE | Cost of unserved energy |
| ECB | Electricity Control Board (of Namibia) |
| ESI | Electricity supply industry |
| Eskom | National utility of RSA |
| IPP | Independent power producer |
| IPS | Interconnected power system |
| km | Kilometer |
| NamPower | National utility of Namibia |
| NT | NamPower Transmission |
| QOS | Quality of supply |
| RED | Regional electricity distributor |
| RSA | Republic of South Africa |
| SAPP | Southern African Power Pool |
| SB | Single buyer |
| SO | System operator |
| TNSP | Transmission network service provider |
| TS | Transmission system |
| TSB | Transmission supply business |
| TWB | Transmission wires business |
| USAID | United States Agency for International Development |

# 1 Introduction

## 1.1 *Summary*

### 1.1.1 Summary Assessment

Table 4-1 shows that all the draft Grid Code addresses all necessary topical areas except the administrative functions associated with it. All of the areas covered in the draft Grid Code are necessary and should be addressed in the Grid Code, with one exception. We conclude that for Namibia it would be preferable to handle transmission pricing outside the Grid Code, as the ECB presently handles it, and thus the Transmission Tariff Code is not needed. In our opinion the draft could serve as a working Grid Code for a single buyer power sector structure. It is adequate for its purpose, which we take to be to establish a Grid Code for a power sector structure based on a single buyer, IPPs, and NamPower unbundled but owner of the unbundled parts and still Government owned. It would need some modification to be adequate for an open access power sector structure that permits transactions between generators and end-use customers. Various items need to be completed for it to reach full effectiveness, for example operational procedures referred to in the System Operation Code, approved tariffs for transmission pricing referred to in the Transmission Tariff Code, and others.

In some areas the draft is inconsistent, vague, or general and would benefit from elaboration. It leaves considerable discretion in the hands of NamPower Transmission. One of the reasons for establishing a Grid Code is to provide transparent rules so that participants will know what is needed. Such rules protect participants from potentially heavy-handed (or worse) applications of discretion on the part of central organizations such as the TNSP, the SO, or the Single Buyer. Accordingly, the use of vague or general requirements or procedures should be avoided to the extent possible.

The main areas that would benefit most from elaboration or revision are:

- Adding direct statements of key points such as Government policy on power sector structure, Namibia forming its own control area, the scope of the IPS, and equitable sharing of under-frequency load shedding.
- Acceptable network performance standards. We note that network performance standards have been agreed among a large group of electricity sector participants and approved by ECB. Section 3.2.4 should refer to these standards.
- Criteria for transmission investment. Section 4.3.2 discusses this in more detail.
- Scheduling conflicts between the terms of the System Operation Code and the Information Exchange Code. Section 4.3.3 discusses this in more detail.
- Treatment of reserves. Sections 4.3.1 and 4.3.3 discuss this in more detail.
- How emergencies will be handled. Section 4.3.3 discusses this in more detail.
- Transmission pricing methodology, if this section of the code is retained. Note that we recommend that it not be retained.
    - The above comment applies to the treatment of transmission losses as well.

With the major exception noted below, the code is consistent with the policies of the Government as expressed in the documents we reviewed.

The exception is that the draft Grid Code does not provide for open access, in the sense of permitting transactions between generators and end-use customers. This does not necessarily represent a flaw in the Grid Code, as discussed below. We mention it here as an inconsistency with the written policy that we are aware of. Perhaps the Preamble reflects more recent policy or a different interpretation of what Section 28 of the Electricity Act means. Most of what is in the draft is equally relevant to either structure, but some areas are consistent only with the single buyer structure.

Appendix A indicates that balancing the trade-offs between the relative advantages and disadvantages of single buyer and open access structures is a policy choice for the Government, which apparently has selected single buyer initially and open access at some undefined point in the future. Given the circumstances, this seems to us to be a reasonable approach.

### 1.1.2 Recommendations

Our assessment leads to the following recommendations.

#### *1.1.2.1 Key Issues*

- State directly in the Preamble that the Grid Code is based on a single buyer power sector structure, and changing to an open access structure that permits transactions between generators and end-use customers will require revision of the Grid Code. Remove all other references to an open access structure.
- Clarify directly whether Namibia will form its own control area, or remain part of South Africa's control area. Tailor the Grid Code, especially the System Operation Code, to whatever the answer is. The System Operator's responsibilities are different depending on whether Namibia is a separate control area or part of Eskom's control area.
- Improve the discussion of reserves in the System Operation Code Section 4.
- Improve the treatment of emergency in System Operation Code Sections 8 and 9.
- Proceed as quickly as practical with the process of completing and approving the Grid Code. However, we conclude that an approved Grid Code is not necessary to support the development of Kudu, although the existence of an approved Grid Code might speed the process of agreeing on technical terms.
- Remove the Transmission Tariff Code and all references to it.
- Implement the Grid Code (when complete and approved) whether or not the market rules have been developed.
- Undertake the process of developing and approving market rules.

#### *1.1.2.2 Other Areas for Improvement*

- Define the scope of the IPS in the Preamble's Glossary.
- Revise the discussion of acceptable network performance standards in Network Code Sections 3.2.4 and 3.2.5. We note that network performance standards have been agreed among a large group of electricity sector participants and approved by ECB. Section 3.2.4 should refer to these standards.

- Establish that under-frequency load shedding will be shared equitably among customers. This should be stated directly in Network Code Section 5.2.1.
- Revise Network Code Sections 7.4.1, 7.4.2, 7.4.3, and 7.4.4 so that they are address directly the critical fact that Section 7.5 establishes the basic criteria for transmission investment.
- Review whether the break point for the need for higher reliability connections should be 1,000 MW in Network Code Section 7.4.5 and revise if necessary.
- Limit the scope of NT's discretion in expansion planning in Network Code Section 7.5 as much as possible without compromising the results of the analysis, such as by expanding the ECB-approved process for establishing the discount rate and COUE.
- Add details to the discussion of planning criteria in Network Code Sections 7.5.1 and 7.5.2, possibly by including sample cases for each, either in the text or as appendices.
- Review the need for the first year test of cost effectiveness for grid expansion investments in Network Code Section 7.5.2 and revise or eliminate as appropriate.
- Provide that customer who pays for added reliability per Network Code Section 7.10 may recapture some of his investment if it improves reliability for other customers either immediately or following load growth.
- Resolve the scheduling conflicts between the terms of the System Operation Code, Section 3, and the Information Exchange Code, Section 5.4.

## 1.2 *Background*

The preparation, conclusion, and implementation of a national Grid Code are among the regulatory functions of the Electricity Control Board (ECB) of Namibia. The ECB requested NamPower, the Namibian national electric utility, to come up with the first draft for review and processing by the ECB. Earlier this year the ECB received from NamPower a draft based on the Republic of South Africa (RSA) grid code that was initially prepared by Eskom, the South African utility.

The ECB also decided to appoint two separate consultants, one regional and one international, to review the draft documents.

For international review, the ECB requested assistance from the United States Agency for International Development (USAID). The ECB and USAID selected Nexant to conduct this review. Nexant received approval to conduct the review in early August 2004. The USAID contract with Nexant that covered the work terminated before the end of August 2004. Accordingly, Nexant's initial review was limited in scope and duration. Nexant delivered the "Report on Review of Draft Grid Code of Namibia" in late August 2004.

Although this review provided useful comments and recommendations, ECB believed it would benefit from detailed discussions to understand more fully the implications and to discuss optional approaches to address issues. A second USAID – Nexant contract, this one terminating on about 18 December, was used to support a limited amount of additional work. Nexant received approval to conduct this work in early December 2004. The work involved having a two-person team travel to Windhoek, Namibia to:

- Hold detailed discussions with ECB, reviewing all comments and recommendations.

- Discuss options and implications.
- Refine specific recommended changes to the Grid Code.
- Meet with NamPower and relevant Government of Namibia entities to discuss their concerns.

Upon return to the United States, Nexant's final responsibility was to produce a final version (this report) of its review of Namibia's draft Grid Code.

During the Nexant team's visit to Namibia, ECB and NamPower identified a critical issue not apparent from the documents reviewed previously. Namibia wants to develop an offshore gas field to provide natural gas to a to-be-developed 800 MW independent power producer (IPP) plant to be located near Oranjemund in southern Namibia. The development and financing of this Kudu power plant will require negotiation of one or more agreements governing:

- Gas supply.
- Power purchase.
- Transmission service and charges.
- Interconnection, operations, dispatch, and related requirements.

The Grid Code may address issues that otherwise would need to be addressed in these agreements. Thus it is important to the development of the agreements to know how (if at all) the Grid Code addresses them.

The ECB asked Nexant to discuss three specific issues in the final report.

- Is it necessary or desirable to have a Grid Code in place to support the development of IPP projects in general and Kudu in particular?
- Is it necessary or desirable to have a transmission tariff section in the Grid Code? The draft version reviewed has such a section.
- Is it necessary or desirable to have market rules in place for the Grid Code to be implemented?

The draft Namibian Grid Code consists of six documents providing a Preamble and the following five codes:

- The Namibian Grid Code - The Network Code
- The Namibian Grid Code - The System Operation Code
- The Namibian Grid Code - The Metering Code
- The Namibian Grid Code - The Transmission Tariff Code
- The Namibian Grid Code - The Information Exchange Code

Nexant's review included these documents and the Energy White Paper (May 1998), Namibia's Electricity Act, 2000 (8 February 2000), and Electricity Regulations – Administrative, Electricity Act, 2000 (12 July 2000).

The Preamble refers to Market and Ancillary Services codes operating in parallel with the Grid Code. These separate codes are not part of the scope of our review, though in some countries market-oriented codes are considered to be part of the Grid Code.

The objective of Nexant's work in August was to provide a thorough initial review with specific recommendations for going forward. Our approach was to review all the documents mentioned above, determine the Government of Namibia's objectives for the Grid Code, apply our own judgment regarding what the objectives and contents of the Grid Code should be, identify what needs to be added, removed, or changed to achieve those objectives, and prepare the "Report on Review of Draft Grid Code of Namibia", dated August 2004. That report provides general comments on what needs to be done. It does not provide detailed comments on all the contents of the documents, or the exact wording of what needs to be changed, added, etc.

This "Final Report on Review of Draft Namibian Grid Code" revises the August report by:

- Incorporating the comments provided by ECB during the December trip to Namibia.
- Reorganizing the report to a limited extent to emphasize the more important points.
- Expanding Sections 4 and 5 at the request of ECB.
- Adding subsections to address ECB's request for discussion of the three issues noted above related to the Grid Code and the development of Kudu.

## 1.3 *Overview of Rest of Report*

The remaining sections cover the following topics:

- Section 2 discusses objectives for the Grid Code.
- Section 3 describes the components of the draft Grid Code.
- Section 4 provides our assessment of the draft Grid Code.
- Section 5 addresses the three issues related to the Grid Code and the development of Kudu.
- Section 6 presents our recommendations on the draft Grid Code.
- Appendix A provides a more detailed discussion, from source documents, of the Government's objectives for the Grid Code.

# 2 Grid Code Objectives

## 2.1 *What Is a Grid Code?*

There is no standard definition of a Grid Code. The term Grid Code is widely but not universally used to refer to a document that legally establishes technical and other requirements for the connection to and use of an electrical system by parties other than the owning electric utility in a manner that will ensure reliable, efficient, and safe operation. The draft Namibian Grid Code is entirely consistent with this sense of what a Grid Code is. A Grid Code, with the effect of law in that it is binding and enforceable, is distinct from operating procedures, though it may refer to or incorporate them.

Countries differ in the scope of issues addressed in their Grid Codes, depending for example on industry structure, whether they need to cover commercial as well as technical issues, whether they need to cover distribution systems as well as transmission systems, and the details of the physical transmission and generation infrastructure itself.

## 2.2 *Motivation for Developing a Grid Code*

When a single organization owns and operates the entire power system in a country, there is not much need for a Grid Code. The single organization can establish rules and procedures governing the interconnection of loads, the interconnection of generating units, planning, operations, protection, and other technical factors. It can forecast loads and build accordingly for the whole system. The rules it establishes provide for the power system's proper planning and operation. The rules, especially with respect to customers, may be subject to review and approval by the Government directly or through a regulator. Apart from interactions with customers, coordination and enforcement of the rules can be accomplished through the authority of the single organization over its employees and contractors.

The rules and procedures, formal and informal, perform the function of a Grid Code, though they do not necessarily address as many issues as a Grid Code must.

Rarely is the single organization the only power sector participant other than its customers. Typically some industrial facilities have generation to serve as backup, to use burnable waste gases or liquids, to consume waste heat, or to capture the efficiencies of cogeneration. These facilities need rules for interconnection, even if they do not deliver power into the grid directly. They may sell excess or emergency power to the utility, creating a need for commercial as well as technical arrangements.

The first big step in power sector reform is often the expansion of third party generation. Independent privately owned generating plants are built, initially selling to the central organization. When a central organization is the only authorized buyer, one way of characterizing the power sector structure is as "Single Buyer". These plants are known as independent power producers (IPPs), build-own-operate-transfer (BOOT) projects, and by other names. The government or regulator may mandate equitable commercial and technical terms for these facilities.

Later steps may involve some or all of the following:

- The single organization is separated into multiple independent organizations, such as multiple Generation Companies, a Transmission and National Dispatch Company,

multiple Distribution Companies, and companies serving functions such as design, construction, and others.

- Large customers gain the right to buy from the central organization, not just their local Distribution Company.
- A regulatory authority is established, eventually to become independent of direct government control. The regulatory authority replaces government edict with licenses, rules, regulations, and tariffs based on established guidelines and principles.
- When large and later small customers gain the right to buy from independent generators using the transmission system, the power sector structure can be characterized as "Open Access".
- A short-term market may develop, in the form of some kind of power pool.

These new parties will differ in their needs, objectives, levels of knowledge, and other factors. Providing for the safe, reliable, economical planning and operation of the system becomes more complex as the number of power sector participants increases. A Grid Code provides the rules and procedures that enable the power system to be planned and operated reliably while all these independent parties use the power system.

Accordingly, the need for a Grid Code arises as a natural consequence of an ongoing process of reform. This is clearly the case in Namibia today, as the review of documents in Appendix A demonstrates.

## 2.3 *Grid Code Objectives*

### 2.3.1 For Purposes of This Study

The fundamental function of a Grid Code is to establish the rules and procedures that provide interconnection to the power system and permit the power system to be planned and operated safely, reliably, efficiently, and economically while independent parties use the power system. Thus the primary objective of the Grid Code must be to perform this function adequately.

We believe that in order to achieve this objective, the Grid Code must also be objective, transparent, and non-discriminatory.

The Grid Code must also be consistent with Government policy. As Appendix A indicates, most Government goals, objectives, and policies in areas relevant to the Grid Code are general but clearly consistent with typical reform and restructuring processes leading to the need for a Grid Code.

Section 28 of the Electricity Act, 2000 states:

"A licensee who is licensed to transit electricity may not, upon the request of another licensee, refuse that licensee the right of transmitting electricity through its electrical or transmission line against payment of compensation at a rate approved by the Board, except if such refusal is reasonably based on an insufficiency of technical availability of capacity."

Section 28 appears to require open access transmission. The use of the phrase "electrical or transmission line" implies that distribution systems also are included in the scope of this requirement. The draft Namibian Grid Code addresses access to the transmission system, not the distribution system as well.

### 2.3.2 Preamble to the Grid Code

The Preamble states that Government policy is to permit open and non-discriminatory access to the transmission system (TS).

The Preamble to the Grid Code indicates that its primary objective is "to establish the reciprocal obligations of industry participants around the use of the TS and operation of the interconnected power system (IPS)". This appears to be consistent with the primary objective asserted in the first paragraph of this subsection.

The Preamble states other characteristics the Grid Code will have. One may assume that the achievement of these characteristics is an objective for the Grid Code. They are described in Section 3, in the description of what the Grid Code must ensure, what the responsibilities of the service providers are, and in the assurances that the Grid Code will provide the various participants.

The Preamble also asserts that the Grid Code defines what is understood by non-discrimination through the definition of consistent and transparent principles, criteria and procedures, and that the Grid Code clearly spells out, in a transparent way, the rights and obligations of all role-players to be achieved through industry consultation.

We find no conflict between these implied objectives and the primary objective asserted in the first paragraph of Section 2.3.1. However, we believe the Grid Code should address its administration, which is not included in the list of items that the Grid Code must ensure.

# 3 Components of Draft Namibian Grid Code

The draft Namibian Grid Code consists of a Preamble and five Codes, summarized below.

## 3.1 *The Namibian Grid Code - Preamble*

The Preamble provides the context for the sections of the Grid Code and definitions of the terms used in it. Because it addresses overarching issues, we devote special attention to it here.

It describes the Government-approved structure of the electricity supply industry, which is not done within the other Code sections and is thus very useful in understanding the other documents. It states that:

- The Namibian Government has approved proposals for a strategy to ensure a managed liberalization of the energy sector.
- Government policy is to permit open and non-discriminatory access to the transmission system.
- A Grid Code Review Panel, constituted of industry participants and stakeholders, will review proposed changes to the Grid Code and make recommendations regarding the Grid Code. This provides stakeholders and future market participants an opportunity to provide input to the development and on-going updating of the Grid Code.
- The Grid Code makes provision for the following elements of the Namibian electricity supply industry (ESI) structure:
  - A generation sector consisting of NamPower-owned generators and independent generators.
  - NamPower Transmission, ring-fenced from NamPower and incorporating a sub-ring-fenced System Operator (SO), Transmission Supply Business (TSB) and Transmission Wires Business (TWB).
  - One or more independent TNSPs as licensed by the ECB only for specific purposes such as facilitating cross-border trade.
  - A distribution sector within which regional electricity distributors (REDs) are formed from Premier Electric, Local Government and Housing and municipal distributors.
  - A Single Buyer (SB) in the short term.
  - In the long term a “multi-buyer, multi-seller model” will be developed to ensure transactions between generators, traders and power purchasers take place on a variety of platforms.
  - Market and ancillary service codes operating in parallel with the Grid Code.
  - Directly-connected end-use customers, either contestable and participating in the wholesale market, or being supplied via a retailer;
  - International trading via the interconnectors with other countries, and in line with the SAPP rules.

The Preamble also indicates that the general objective of the Grid Code is to establish the reciprocal obligations of industry participants around the use of the transmission system (TS)

and operation of the interconnected power system (IPS). To achieve this objective, the Grid Code must ensure that:

- Obligations and accountabilities of all parties are defined for the provision of open access to the TS.
- Minimum technical requirements are defined for customers connecting to the TS.
- Minimum technical requirements are defined for service-providers.
- The System Operator obligations are defined to ensure the integrity of the IPS.
- Obligations of participants are defined for the safe and efficient operation of the TS.
- The relevant information is made available to and by the industry participants.
- The major technical cost drivers and pricing principles of the service-providers are transparent.

The responsibilities of the service-providers under the Grid Code are:

- To show total neutrality and impartiality in whose product is being transported.
- To ensure that investments are made within the requirements of the Grid Code.
- To provide access on agreed standard terms, to all parties wishing to connect to or use the TS.

The Preamble lists the sections of the Grid Code and describes the assurances it will provide the various participants:

- To the ECB, the assurance that the service-providers operate according to the respective license conditions
- To customers, the assurance that service-providers operate transparently and provide open access to their defined services
- To service-providers, the assurance that customers will honor their mutual Grid Code obligations and that there is industry agreement on these.

It also asserts that the Grid Code clearly spells out, in a transparent way, the rights and obligations of all role-players to be achieved through industry consultation.

The bulk of the Preamble is a glossary and table of acronyms and abbreviations. The final sections provide information on notices and acknowledgment.

## 3.2 *The Namibian Grid Code – The Network Code*

The Network Code addresses issues that are critical elements of any Grid Code. In this case they include:

- The right of generators, distributors, and end-use customers to connect to the transmission system.
- Interconnection requirements for generators and distributors and end use customers.
- Technical design requirements imposed on the existing TNSP (NamPower Transmission) and potentially new TNSPs.
- Equipment and system protection requirements, including typical settings, for NamPower Transmission and other TNSPs.

- Transmission system planning and development.

Appendix 2 provides considerable detail on the procedures to be followed in carrying out the surveying, monitoring, or testing to confirm compliance by power stations with the Grid Code, or provision by power stations of ancillary services which they are required or have agreed to provide.

Its Table of Contents provides more detail on the issues it addresses.

1. Introduction

2. Applications for transmission connections

3. Connection conditions
3.1 Generator connection conditions
3.1.1 Protection
3.1.2 Ability of units to island
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3.1.4 Reactive capabilities
3.1.5 Multiple unit tripping (MUT) risks
3.1.6 Governing
3.1.7 Restart after power station black-out
3.1.8 Black starting
3.1.9 External supply disturbance withstand capability
3.1.10 On load tap changing for generating unit step-up transformers
3.1.11 Emergency unit capabilities
3.1.12 Facility for independent generator action
3.1.13 Automatic under-frequency starting
3.1.14 Testing and compliance monitoring
3.1.15 Non-compliance suspected by the System Operator
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3.1.17 Equipment requirements
3.2 Distributors and end-use customers
3.2.1 Power factor
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4. TNSP technical design requirements
4.1 Equipment design standards
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4.7 Busbar protection CT's
4.8 Telecontrol
4.9 Transformer tap change
4.10 Substation drawings

5. Protection requirements

5.1 Equipment protection requirements
5.1.1 Feeder protection: 220kV and above
5.1.2 Feeder protection: 132kV and below, at TNSP substations
5.1.3 Teleprotection requirements
5.1.4 Transformer and reactor protection
5.1.5 Transmission busbar protection
5.1.6 Transmission bus coupler and bus section protection
5.1.7 Transmission shunt capacitor protection
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5.2.4 Subsynchronous resonance protection
5.2.5 Protection against near 50 Hz Resonance
5.2.6 Protection Settings impact on Network Stability (Dynamic Stability)
5.3 Protection system performance monitoring

6. Nomenclature

7. TS planning and development
7.1 Planning process
7.2 Identification of the need for TS development
7.3 Forecasting the demand
7.4 Technical limits and targets for planning purposes
7.4.1 Voltage limits and targets
7.4.2 Other targets for planning purposes
7.4.3 Reliability criteria for planning purposes
7.4.4 Contingency criteria for planning purposes
7.4.5 Integration of power stations
7.5 Criteria for network investments
7.5.1 Least economic cost criteria.
7.5.2 Cost reduction investments
7.5.3 Statutory or strategic investments
7.6 Development investigation reports
7.7 Transmission investment plan
7.8 Mitigation of network constraints
7.9 Interfacing between participants
7.10 Special customer requirements for increased reliability

8. Network maintenance

Appendix 1 Generator Connection Conditions

Appendix 2 Surveying, monitoring and testing for generators

## 3.3 *The Namibian Grid Code – The System Operation Code*

The System Operation Code addresses issues that are critical elements of any Grid Code. In this case they include:

- The rights, responsibilities, and roles of the participants.
- The ultimate authority of the System Operator over the transmission system.
- Scheduling and dispatch of generation and ancillary services.
- Emergency planning and operation.
- Maintenance coordination / outage coordination

Its Table of Contents provides more detail on the issues it addresses.

15.3 Risk-related outages
15.4 Maintenance planning between NT and generators
15.5 Refusal/cancellation of outages

16. Communication of system conditions, operational information and IPS performance

17. Telecontrol

## 3.4 *The Namibian Grid Code – The Metering Code*

The Metering Code addresses an issue that is a critical element of any Grid Code: the requirements for metering related to the Grid Code.

Its Table of Contents provides more detail on the issues it addresses.

1. Introduction

2. Application of the Metering Code

3. Principles of the Metering Code

4. Responsibility for metering installations

5. Metering installation components

6. Data validation and verification
6.1 Data validation
6.2 Meter verification

7. Metering database

8. Testing of metering installations

9. Metering data base inconsistencies

10. Access to metering data

11. Confidentiality

## 3.5 *The Namibian Grid Code – The Transmission Tariff Code*

The Transmission Tariff Code addresses an issue that is a critical element of any Grid Code: transmission pricing.

Its Table of Contents provides more detail on the issues it addresses.

1. Introduction

2. Objectives of the transmission tariff framework

3. Principles for regulation of revenue

4. Determination of tariff structures and levels

Appendix 1: Details of the TNSP tariff structure

## 3.6 *The Namibian Grid Code – The Information Exchange Code*

The Information Exchange Code addresses issues that are critical elements of any Grid Code. In this case they include:

- The information that must be exchanged.
- Communication facilities required.
- Infrastructure at point of supply
- Data storage and archiving.

Its Table of Contents provides more detail on the issues it addresses.

APPENDIX 5: Operational data

APPENDIX 6: Market operational schedules

APPENDIX 7: Post-dispatch information

APPENDIX 8: Generator performance data

APPENDIX 9: Planning schedules

# 4 Assessment of Grid Code of Namibia

Our assessment takes the following form:

- Elaborate on the necessary elements of a grid code.
- Identify areas that the draft Grid Code does not address.
- Comment on the individual sections of the draft Grid Code.
- Provide summary assessment of the draft Grid Code.

## 4.1 *Grid Code Elements*

The list below is one way of specifying the topics that a Grid Code should address. We found organizing in this manner was useful in outlining what the Grid Code should include. We emphasize that this does not imply that there is anything wrong with other ways of organizing a Grid Code, in particular the draft Namibian Grid Code. For example, the draft Network Code includes sections on both interconnection requirements and on planning and expansion.

Some Grid Codes address the pricing of transmission and related services, whereas others do not. We discuss this topic in Section 5 and conclude that for Namibia it would be preferable to handle transmission pricing outside the Grid Code, as the ECB presently handles it.

**Table 4-1 Topical Coverage of Draft Grid Code**

| TOPIC | WHERE ADDRESSED IN DRAFT GRID CODE |
|---|---|
| Administration, addressing how the Grid Code will be administered, enforced, changed, etc. | A single reference to Grid Code Review Panel in Preamble |
| Interconnection, establishing the right to connect and connection conditions | NC (primary), IEC |
| Planning and System Expansion, addressing the process of planning the transmission system | NC (primary), IEC |
| Operation, addressing the process of operating the transmission system | SOC (primary), IEC |
| Scheduling and Dispatch, addressing the scheduling and dispatch of the power system | SOC (primary), IEC |
| Communication, addressing communications equipment and procedures | IEC (primary), SOC |
| Information Exchange, addressing the requirements and format for data exchange | IEC (primary), SOC, NC, MC |
| Monitoring and Reporting, addressing the need to monitor and report performance and other data | IEC (primary), SOC, NC, MC, TTC |
| Performance, addressing the technical performance requirements for participants | NC (primary), SOC, IEC |
| Metering, establishing the requirements and procedures for measuring energy use | MC (primary) |

| TOPIC | WHERE ADDRESSED IN DRAFT GRID CODE |
|---|---|
| Pricing, addressing the pricing of transmission and related services (optional for Grid Code if covered elsewhere) | TTC (primary) |
| NC = Network Code; SOC = System Operation Code; MC = Metering Code; TTC = Transmission Tariff Code; IEC = Information Exchange Code | |

## 4.2 *Areas Not Addressed*

The Preamble refers to a Grid Code Review Panel that would be part of the process of making changes to the Grid Code, but provides no details on it or further elaboration on how the Grid Code will be administered, other than a definition in the Glossary of the Grid Code Secretariat. Perhaps documents that we are not aware of other than the Grid Code itself cover its administration.

Establishing the administration of the Grid Code includes items such as the following:

- Identification of who is code administrator
- Defining the scope of code administration
- Functions of the code administrator
  - Monitoring and reporting
  - Enforcement
  - Dispute resolution
- Governance
- Obligations of participants
  - Binding on all parties
  - Record-keeping and reporting
- Code compliance procedures
- Appeals
- Exemption from obligations
- Composition of the code review entity
- Managing changes
- Consulting with industry
- Recommending modifications
- Approving changes

## 4.3 *Comments on Sections of Draft Grid Code*

### 4.3.1 The Namibian Grid Code - Preamble

Section 1: There is a conflict between the statement that Government policy is to permit open and non-discriminatory access and the use of a single buyer structure in the short term.

It is not clear what "contestable and participating in the wholesale market" means. Presumably the single buyer is also the single seller, and there is no wholesale market in a more meaningful sense than there is a retail "market" from the local distributor.

Section 4: The definition of "Control area" notes that South Africa, Namibia, Botswana, Mozambique, Swaziland, and Lesotho currently operate as one control area. Section 9 of the System Operation Code implies that the System Operator will be a control area operator. If the intent is that Namibia become a control area of its own, that should be clearly stated because that affects the responsibilities of the System Operator.

Glossary: A planned outage is one confirmed 14 days in advance. A forced outage is an outage that is not a planned outage. Thus all outages are either planned or forced. An unplanned outage is not confirmed 14 days in advance and thus is not planned, and also is not a forced or emergency outage, or opportunity maintenance. This is an inconsistency in definition. The definitions of outages need to be re-worked to be consistent. For example, one might define:

- An emergency outage occurs when plant has to be taken out of service immediately.
- A forced outage occurs when plant has to be taken out of service before the next weekend (and thus emergency outages are also forced outages).
- An unplanned outage is one that can be postponed past the next weekend but has not been confirmed at least 14 days in advance.
- Opportunity maintenance is as defined in the Glossary and would be a subset of unplanned outages.
- A planned outage is one that has been confirmed at least 14 days in advance. .

Glossary: It is not clear what the scope of the interconnected power system is. For example, is it limited to facilities in Namibia? To facilities owned by TNSPs that want to be subject to the Grid Code?

Glossary: Who buys ancillary services? The Glossary says that the Single Buyer is the entity responsible for administering the electric energy market and the ancillary services market. This includes daily scheduling and settlement.

Glossary: Definition of emergency carries no sense of urgency and should be revised so it could form the basis for the invoking of emergency procedures under the System Operation Code.

### 4.3.2 The Namibian Grid Code – The Network Code

It is unclear what "these risks" referred to in Section 3.1 are. Section 3.1 states that some generators may have to purchase reserves. This seems a clumsy way to address risks. Better would be for the Single Buyer to consider such risks in agreeing payments to such generators.

Section 3.1.6.5 states that low frequency response is defined as an ancillary service as instantaneous reserve. We cannot find reference elsewhere to either low frequency response or instantaneous reserve being ancillary services. Section 4 of the System Operation Code lists (among others) operating reserve as an ancillary service. There are three categories of operating reserves: spinning reserve, regulating reserve, and quick reserve. This is part of a general issue with the definitions of reserve categories discussed in more detail in the discussion of the System Operation Code in Section 4.3.3 below.

Section 3.2.4 establishes acceptable network performance standards for distributors or end-use customers. By the use of the word "and" it appears to require that three separate standards must be met, none of which are defined in detail in the draft Grid Code. It does not provide quantifiable measures such that one could determine whether performance is or is not acceptable. This is an example of vague or general requirements that is likely to leave considerable discretion in the hands of a central organization such as the TNSP or SO. We note that network performance standards have been agreed among a large group of electricity sector participants and approved by ECB. Section 3.2.4 should refer to these standards.

Section 3.2.5 provides that the TNSP and its customers shall agree in writing on quality of supply (QOS) parameters for every point of supply. It notes that customer responsibilities could also be included in the agreement. This too is vague and general, especially given the likely imbalance in power and knowledge between the TNSP and a customer.

Section 4.2 requires that clearances comply with the requirements of the Electricity Act 2 of 2000. It is not clear if this refers to clearances to work on equipment or ground clearances for transmission lines. We can't find any reference to either in Electricity Act 2 of 2000

Section 5.2.1 states that the SO will determine the installation of under-frequency load shedding relays in the IPS. All discretion is in the hands of the SO. We cannot find a reference in the Grid Code for equitable sharing of load shedding among customers, which should be a goal of the load shedding arrangements.

In Section 7.4.1, the entry in Table 7.4.1.1, bottom row, right cell is somewhat ambiguous. It appears to mean that voltages must be within plus or minus 10% nominal voltage, but the definition refers to voltage, not voltage variation.

Sections 7.4.1, 7.4.2, 7.4.3, and 7.4.4 all fail to address directly the critical fact that Section 7.5 establishes the basic criteria for transmission investment. It would add clarity if the sections made this point directly rather than indirectly. References to target voltages, transmission line ratings, and transformer ratings indicate that the targets and ratings can be exceeded and are consistent with the concept that the economic tests of Section 7.5 can be the determining factor. The criteria for series capacitors, shunt reactive compensation, circuit breakers do not have this qualification.

Sections 7.4.3 and 7.4.4 address reliability criteria for planning. Common transmission planning practice is to apply so-called N-1, N-2, or similar criteria. We understand that the application of even an N-1 criterion is not practical in sparsely populated Namibia. Instead, Section 7.5 specifies economic criteria for network investment. Section 7.4.3 should refer directly to Section 7.5 rather than use the vague reference to justifiable redundancy. Section 7.4.4 is particularly confusing and needs clarification. It can be read to imply that N-1 or N-2 contingency criteria will be applied. Perhaps what it means is that N-1 and N-2 contingencies will be studied, with the results used in evaluation, but decisions will still be based on the analysis outlined in Section 7.5.

Section 7.4.5 is clear but the use of a 1,000 MW dividing line for power plants seems odd for a system with peak demand under 400 MW. We realize that the next plant in Namibia may be more than 1,000 MW based on Kudu gas. It also might be 800 MW and still vital to the Namibian system, justifying the more reliable connection reserved for plus-1,000 MW plants. Perhaps the 1,000 MW break point is left over from the source Eskom document and needs revision.

Section 7.5 is a laudable, conceptually sound effort to rationalize the transmission planning process. The key element is the least economic cost criteria. We have several observations. First, the approach is impossible to implement without massive assumptions. Presumably the TNSP makes them, apart from the ECB-approved process for establishing the discount rate and COUE. Second, much more work is needed than if (for example) a simple N-1 criterion were used instead. Both these factors leave great discretion in the hands of NamPowe Transmission (NT). It would be desirable to limit the scope of NT's discretion as much as possible without compromising the results of the analysis, such as by expanding the ECB-approved process for establishing the discount rate and COUE.

Sections 7.5.1 and 7.5.2 present the concepts adequately but are short on details. It would be desirable to add details, possibly sample cases for each, either in the text or as appendices.

The use of R/kWh in Section 7.5.1 is probably left over from the Eskom source document.

Section 7.5.2 indicates that a proposed asset must reduce costs in its first of operation, not just over its lifetime. Considering the front-end loading of costs due to financing and depreciation practices, this stringent test that could prevent good investments from being made. This section should elaborate on the procedure for applying the first year test, and revise it if it prevents good investments from being made.

Under Section 7.10, a customer can obtain a more reliable connection than the one provided by the TNSP if he is willing to pay the cost of providing the extra reliability. There should be some provision for the customer recapturing some of the investment if what he is paying for improves reliability for other customers immediately or following load growth.

### 4.3.3 The Namibian Grid Code – The System Operation Code

The draft Grid Code in general and the System Operation Code in particular use "schedule" and "dispatch" nearly synonymously. Only the Information Exchange Code mentions dispatch more than once. For example, it has an entire section on "Post-dispatch information". We think of scheduling as a pre-real time process producing a plan (for example) to meet demand through specified generation levels from different power plants. Dispatching occurs in real time or near real time as the SO issues instructions (to generators, in this case) to adjust generation levels in response to changing conditions. It would be useful to clarify this distinction.

Section 3, scheduling of generation and ancillary services, is sparse even for the single buyer structure. Its schedule for the SO receiving the daily energy schedules, by 16:00 CAT, conflicts with the Information Exchange Code's specified 2140. It does not specify the schedule for the SO providing a demand forecast, or to whom it must provide the forecast. It states that ancillary services scheduling shall be a System Operator responsibility. This conflicts with the Information Exchange Code, which states "The Single Buyer shall provide the System Operator with the daily twenty-four (24) hours day-ahead ancillary service schedule before 21h40 each day."

In a single buyer structure, handling mismatches between scheduled generation and actual generation is straightforward. Other units are dispatched. We assume that the Single Buyer pays for all generation and charges its customers for all its costs, so there is no question of who is responsible for paying for generation dispatched due to changing conditions, outages, etc.

Scheduling and dispatch would be much more complex in an open access structure that permitted transactions between generators and end-user customers. In that case potentially many parties would provide generation schedules to the SO. There would often be mismatches between:

- A customer's forecast and actual demand.
- The generation the customer contracted for and its actual demand.
- The generation contracted for and the generation actually delivered.

Responding to the impact of these mismatches on the system, and then identifying and accounting for them, would require many changes to the Grid Code and especially the Market Code.

The most important problem with Section 4's discussion of reserves is that it does not establish the requirements for the different categories of reserves. Section 4.1.1, 4.1.2, and 4.1.3 all refer to requirements from SAPP's Agreement Between Operating Members (ABOM), but do not present that text or the resulting numerical requirements that applies to Namibia today. At least the current numerical values should be presented.

The unnumbered figure in Section 4.1 is not consistent with the text. Section 4.1 states there are three categories of operating reserves: spinning, regulating, and quick.

The figure shows six kinds of reserves, only one of which (regulating, or regulation in the figure) is among the three categories. It shows instantaneous reserve, 10-minute reserve, and emergency reserve along with regulating reserve as being part of 10 minute operating reserves. It also shows supplemental reserve.

Quick reserve and regulating reserve are defined in the System Operation Code but not in the Preamble. Quick Start Plant is defined in the Preamble.

Instantaneous reserve, ten minute reserve, emergency reserve, and supplemental reserve are defined in the Preamble but not in the System Operation Code. Ten minute operating reserve is defined in the figure as being the sum of regulating reserve, instantaneous reserve, 10-minute reserve, and emergency reserve. The figure also states that "no capacity can be used more than one Reserve", possibly meaning no capacity can be used in more than one Reserve category.

Spinning reserve is not defined in the System Operation Code or in the Preamble.

This confusion should be resolved by:

- Defining spinning reserve.
- Replacing or revising the figure presented with one that more clearly illustrates the three categories of reserve mentioned in the text and their components.
- Making sure that the definitions in the System Operation Code are identical to those in the Preamble.
- Providing numerical values for the current required levels of each kind of reserve.

Section 8 addresses emergency and contingency planning. Section 9 addresses some system frequency and ACE control under abnormal frequency or imbalance conditions. There are several problems with these sections.

The Preamble's definition of emergency is inadequate and should be revised. See Section 4.3.1 above.

It is not clear whether "abnormal conditions" constitute an emergency and, if they do, if these are the only conditions that constitute an emergency. If they are the only conditions, then the use of the word abnormal only serves to confuse matters. Section 9.2 refers to the use of emergency resources, implying that abnormal conditions do constitute an emergency.

Section 9 does not describe what actions (other than "corrective") the SO must or may take during emergency conditions.

The problems noted above could be resolved by:

- Revising the definition of emergency.
- Clarifying the distinction, if any, between emergency and abnormal conditions.
- Stating what will happen in the event of an emergency. For example, this could involve declaring an emergency, communicating that declaration to the participants, requiring participants to undertake actions not consistent with normal operation, bypassing normally required procedures, declaring the emergency over and communicating that, and so on.
- The contingency plans to be developed per Section 8 may include some of the above information, but the System Operation Code itself should provide at least a framework for such plans.

It does not describe what steps the SO may take in emergencies.

Section 9 implies that the SO operates a control area. The text should clearly state whether or not the SO operates a control area.

The System Operation Code does not include a requirement for equitable sharing of under-frequency load shedding. There is no mention of settings for under-frequency load shedding relays.

### 4.3.4 The Namibian Grid Code – The Metering Code

We have no specific comments. We note that if the Grid Code in general is to be aligned with an open access structure, more complex metering arrangements likely will be needed. More complex metering may also be necessary depending on the treatment of ancillary services decided upon within the single buyer structure.

### 4.3.5 The Namibian Grid Code – The Transmission Tariff Code

Some Grid Codes address the pricing of transmission and related services, whereas others do not. We discuss this topic in Section 5 and conclude that for Namibia it would be preferable to handle transmission pricing outside the Grid Code, as the ECB presently handles it. Specific comments on the code as written follow.

The objectives for the framework and principles for the regulation of revenue described in Sections 2 and 3 are clear and in our opinion appropriate. The issue of flow-based charges is discussed more in the discussion of section A6 below.

Section 4 should recognize that prices could decrease or increase.

Appendix 1's transmission pricing philosophy, components of the transmission tariff, and determination of revenue requirements are clear and in our opinion appropriate.

Section A4 uses the energy tariff times the volume of energy consumed as losses to determine the cost of losses. It is not clear whether this refers to a retail energy tariff or the price charged by the single buyer to customers. In either case, it is not known whether the tariff includes a component designed to recover asset-based costs. Such a component should be included to reflect the full cost of losses.

Section A6 is vague on the details of the proposed calculation procedures. This section is far from transparent. Flow-based methodologies can have huge variations in the charges assigned to different transactions depending on the specifics of the methodology. We reserve our opinion on the suitability of this approach. It would be desirable to provide much more explanation on the details of the methodology, including principles, outlines of calculation methodologies, and examples.

Several points in Section A6.1.iv need elaboration:

- Why are costs allocated to portions dealing with redundancy and security of supply vs. utilized? What equipment or other cost factors are these portions associated with?
- What principles govern the calculation of prices at different geographical locations? It would be helpful to provide an outline of the calculations, with explanations.
- How are zones determined? Are they geographical areas with similar prices? If so, how are anomalies within the area handled?

The penalty applied for forecasting demand too low in Section A6.1.vi may not be a penalty. The section should describe in more detail how the future charges are adjusted. This should be defined so that the organization that forecasts low always winds up being charged more than if it provided an accurate or high forecast.

The connection charge of Section A6.2 should provide for sharing of costs if a new connection serves (say) two customers. It should also provide for recovery of some of the costs if other customers later benefit from the connection.

In Section A6.3, the calculation of losses will produce a different level of losses than actual forecast losses if the calculations use average annual demand as the basis. Total losses at average annual demand are usually lower than average annual losses. Using marginal losses at average demand compensates for this to some extent. The calculated losses from the procedure described should be adjusted to correspond to forecast actual losses based on historical data and other factors.

The starting "energy rate for losses" is to be used to determine a new "losses energy rate" is not defined. Then, in the following paragraphs the "losses energy rate" is not used. The section ends with a discussion of the possible need to adjust loss factors due to variation in actual vs. forecast prices for losses. This adjustment of loss factors to address errors in forecasting prices is ironic, in that there is no adjustment proposed to account for difference in actual vs. forecast loss fraction. This difference also should be taken into account as long

as adjustments are to be made. The discussion of the charges for losses should be revised so that the text reflects the proposed way the calculations and charges actually will be made.

### 4.3.6 The Namibian Grid Code – The Information Exchange Code

We have no specific comments. We note that if the Grid Code in general is to be aligned with an open access structure, more complex information exchange arrangements likely will be needed. More complex information exchange arrangements may also be necessary depending on the treatment of ancillary services decided upon within the single buyer structure.

## 4.4 *Summary Assessment of Draft Grid Code*

Table 4-1 shows that all the draft Grid Code addresses all necessary topical areas except the administrative functions associated with it. All of the areas covered in the draft Grid Code are necessary and should be addressed in the Grid Code, with one exception. We conclude that for Namibia it would be preferable to handle transmission pricing outside the Grid Code, as the ECB presently handles it, and thus the Transmission Tariff Code is not needed. In our opinion the draft could serve as a working Grid Code for a single buyer power sector structure. It is adequate for its purpose, which we take to be to establish a Grid Code for a power sector structure based on a single buyer, IPPs, and NamPower unbundled but owner of the unbundled parts and still Government owned. It would need some modification to be adequate for an open access power sector structure that permits transactions between generators and end-use customers. Various items need to be completed for it to reach full effectiveness, for example operational procedures referred to in the System Operation Code, approved tariffs for transmission pricing referred to in the Transmission Tariff Code, and others.

In some areas the draft is inconsistent, vague, or general and would benefit from elaboration. It leaves considerable discretion in the hands of NamPower Transmission. One of the reasons for establishing a Grid Code is to provide transparent rules so that participants will know what is needed. Such rules protect participants from potentially heavy-handed (or worse) applications of discretion on the part of central organizations such as the TNSP, the SO, or the Single Buyer. Accordingly, the use of vague or general requirements or procedures should be avoided to the extent possible.

The main areas that would benefit most from elaboration or revision are:

- Adding direct statements of key points such as Government policy on power sector structure, Namibia forming its own control area, the scope of the IPS, and equitable sharing of under-frequency load shedding.
- Acceptable network performance standards. We note that network performance standards have been agreed among a large group of electricity sector participants and approved by ECB. Section 3.2.4 should refer to these standards.
- Criteria for transmission investment. Section 4.3.2 discusses this in more detail.
- Scheduling conflicts between the terms of the System Operation Code and the Information Exchange Code. Section 4.3.3 discusses this in more detail.
- Treatment of reserves. Sections 4.3.1 and 4.3.3 discuss this in more detail.
- How emergencies will be handled. Section 4.3.3 discusses this in more detail.

- Transmission pricing methodology, if this section of the code is retained. Note that we recommend that it not be retained.
  - The above comment applies to the treatment of transmission losses as well.

With the major exception noted below, the code is consistent with the policies of the Government as expressed in the documents we reviewed.

The exception is that the draft Grid Code does not provide for open access, in the sense of permitting transactions between generators and end-use customers. This does not necessarily represent a flaw in the Grid Code, as discussed below. We mention it here as an inconsistency with the written policy that we are aware of. Perhaps the Preamble reflects more recent policy or a different interpretation of what Section 28 of the Electricity Act means. Most of what is in the draft is equally relevant to either structure, but some areas are consistent only with the single buyer structure.

Appendix A indicates that balancing the trade-offs between the relative advantages and disadvantages of single buyer and open access structures is a policy choice for the Government, which apparently has selected single buyer initially and open access at some undefined point in the future. Given the circumstances, this seems to us to be a reasonable approach.

# 5 The Grid Code and the Development of Kudu

The ECB asked Nexant to discuss three specific issues in the final report.

- Is it necessary or desirable to have a Grid Code in place to support the development of IPP projects in general and Kudu in particular?
- Is it necessary or desirable to have a transmission tariff section in the Grid Code? The draft version reviewed has such a section.
- Is it necessary or desirable to have market rules in place for the Grid Code to be implemented? The draft version +reviewed did not have a market rules section. The Preamble contemplates that market and ancillary services codes will be operating in parallel with the Grid Code. We do not know the status of development of either code.

The short answer is that a Grid Code is not necessary to support development of Kudu, but would be desirable as soon as they can be practical developed. Having a transmission tariff in the Grid Code is not necessary or desirable. Market rules are not necessary for the Grid Code to be implemented, but would be desirable.

## 5.1 *Background*

NamPower will have at least the following functions:

- Owner and operator of generation.
- Single buyer (and seller) of generation from non-NamPower facilities including Kudu.
- Transmission system owner and operator.
    - Probably including a sole use high voltage line from Kudu to the nearest main substation.
- System operator, directing the operation of the generation and transmissions systems.

Given that NamPower will be carrying out these activities, the arrangements necessary to regulate the activities fall into a number of categories:

- Codes are often used to define the technical and commercial responsibilities of power sector participants.
    - A Grid Code (sometimes with a different name) provides the technical requirements similar in most cases to those covered by the draft Namibian Grid Code. This is important to ensure that the reliability of the grid is not compromised with the connection of a new generation plant, and to ensure that the IPP is treated in an equitable manner with respect to access to the grid and dispatch. These generic standards would apply to all entities connected to the grid. Thus it can be more efficient and less subject to conflict in requirements to put technical standards into a Grid Code, rather than into possibly many separate power purchase agreements (PPAs).
    - Market Rules provide some of the commercial requirements. In the case of a Single Buyer, they might be called a Bulk Supply Code and would define the responsibilities of the Single Buyer. Key responsibilities would be to ensure least cost procurement of sufficient generation to meet forecast demand both in the

long-term, through negotiation of long-term contracts, and in the short-term, through economic dispatch. The Code would guard against discrimination in favor of NamPower's own generation in purchase and dispatch.

- Tariffs are normally used to specify payments for use of monopoly facilities. The tariff methodology (rules for tariff setting) is usually published by the regulator, and implemented by the relevant company – e.g., the transmission company or the distribution company.
  - The transmission tariff establishes the charges and other conditions governing the use of the transmission system.
  - A bulk supply tariff specifies the charges and other conditions to distributors and other bulk users for wholesale energy.
- Licenses are normally used to specify the obligations of the license holders with respect to their licensed activities. This would include both technical requirements that a generator must meet, plus other financial obligations such as the obligation to pay transmission tariffs (if applicable). The license would then refer to the licensee's obligation to meet the requirements of the Grid Code.
- Other contractual agreements, such as PPAs between IPPs and the Single Buyer.

Each of these is generally a separate document that can be changed in different ways. That is one of the reasons for not combining different factors in the same document.

## 5.2 *Is a Grid Code Necessary to Support Kudu Development?*

Because it provides for the reliable, efficient, and safe operation of an electrical system when parties other than the owning electric utility connect to and use it, a Grid Code is desirable and eventually mandatory as the reform process evolves. The draft Grid Code, if approved, would assist in the development of IPPs in general and of Kudu in particular by:

- Providing legal assurances of objective, transparent, and non-discriminatory treatment with respect to technical requirements.
- Assuring that a proposed generation project will have reasonable access to necessary transmission.
- Providing for equitable commercial terms for use of the transmission system, backup power, and sales of power to the monopoly utility.
- Providing for stability in terms.
- Removing uncertainty regarding specific details affecting the project.

However, there are other ways to provide those same assurances. For example, the ECB has approved a transmission tariff methodology and tariff schedule. The PPA between Kudu and NamPower will address the key power pricing issues, provide for stability in terms, and remove uncertainty in specific details. If necessary, it can incorporate any necessary technical requirements that otherwise would be included in the Grid Code.

In Namibia today the reform process is in its early stages. Grid Code development is desirable to prepare for later stages, especially an open access power sector structure as envisioned in the Preamble. The need for a Grid Code increases as more participants connect to the grid. Now a Single Buyer power structure is planned, only Kudu is in an advanced

stage of planning, and no other IPP generators are on the horizon. Accordingly, the need for a Grid Code is limited. The technical issues relevant to Kudu that are addressed by the draft Grid Code can be incorporated into the PPA.

Namibia's peak demand is roughly 400 MW. Kudu will be at least 800 MW, and possibly 1,600 MW if more gas supplies can be confirmed. Namibia has no known significant undeveloped primary energy resources other than the Kudu gas field and the undeveloped electrical generation potential of the Cunene River. If Kudu develops at either 800 or 1,600 MW, it will assure Namibia's electricity supply for many years. It will be many years before additional generation will be needed. An approved Grid Code might well apply to only one significant non-utility generating plant for many years. Most of the power from Kudu must go to buyers (most likely Eskom) outside Namibia, at least in the first years of operation. Kudu's gas supply will be from a single source with large fixed costs doubtless requiring large take-or-pay gas demand charges, or similar arrangements that will mandate near-baseload dispatch of the electrical generation. As we understand it, Kudu will be the largest single project ever built in Namibia.

Thus Kudu is so large compared to existing demand and generation, so important to Namibia, and with such complex issues involved that it seems certain that arrangements to accommodate it will be negotiated on a one-off basis. If an approved Grid Code existed with some terms that were unnecessarily restrictive for Kudu, those terms would no doubt be discussed in the negotiations for the PPA between Kudu and NamPower.

Because an approved Grid Code does not exist, it is questionable whether going through an approval process for the Grid Code, rather than including technical terms in a PPA, would speed the process of agreeing on them for Kudu. The Grid Code significantly affects many more parties than just Kudu, for example the regional electricity distributors, who to our knowledge have not yet provided comments and should be given an opportunity to review and comment. Although NamPower prepared the draft of the Grid Code, we understand that it too has some concerns about its contents, especially with regard to their impact on Kudu.

In the early years of reform in the United States, Grid Codes did not exist. Nevertheless, tens of thousands of MW of IPP generation capacity was built. The technical requirements for interconnection and operation were addressed in the PPAs.

For all these reasons we conclude that an approved Grid Code is not necessary to support the development of Kudu, although the existence of an approved Grid Code might speed the process of agreeing on technical terms, including any necessary exceptions to the terms of the approved Grid Code. An approved Grid Code would be useful for other purposes as well, and is therefore desirable. We recommend that the process of completing and approving the Grid Code proceed as quickly as practical.

## 5.3 *Should the Grid Code Include a Transmission Tariff?*

We understand that ECB has approved and put into place a transmission tariff methodology and established a transmission tariff schedule. Thus that element of the arrangements needed to support Kudu development exists.

A Grid Code is usually a technical document, developed jointly by many parties such as the transmission and distribution companies as well as generators and then approved by the regulator. Grid codes can often be "living" documents, in that they are updated regularly in response to changes in grid operating standards, equipment availability, etc.

Tariffs are usually set by the regulator. They are changed periodically, depending on the tariff methodology. The Regulator effectively imposes the tariffs – they are not developed jointly by many parties.

Thus the Grid Code and transmission tariffs are changed in different ways for different reasons. That is one important reason for keeping them as separate documents.

Many Grid Codes or similar documents, such as in England/Wales, Ireland, the California Independent System Operator (CAISO), and Jordan, do not include transmission tariffs. Grid Codes that do include a tariff section, such as the Australian Grid Code, the draft Namibian Grid Code, and presumably the South African Grid Code, establish general principles rather than the prices included in actual tariff schedule.

The Transmission Tariff Code in the draft Namibian Grid Code conflicts with the methodology used for the actual ECB transmission tariffs.

We recommend that the tariff methodology (approach to setting tariffs) and the actual tariff values should not be included in the Grid Code. In other words, we recommend that the Namibian Grid Code not include a Transmission Tariff Code.

## 5.4 *Must Market Rules Be in Place for the Grid Code to be Implemented?*

As applied to a Single Buyer structure, market rules such as a Bulk Supply Code would establish NamPower's obligation to plan properly and at least cost. They would also establish principles and procedures for purchasing from IPPs and proscribe discrimination in favor of NamPower's own generation.

Such rules are separate and independent from the Grid Code. The Grid Code deals with technical issues, the market rules with commercial issues. Market rules can be a companion code to a Grid Code, especially when some form of competitive short-term market is established concurrently with the Grid Code, as was the case in England/Wales, in Australia, and in California's botched reform process.

In the early years of reform in the United States, market rules establishing pricing principles were imposed to require utilities to deal reasonably with IPPs and other non-utility generators that provided lower cost generation than the utilities' own generation. Legislators and regulators viewed the utilities' reluctance to deal with IPPs as an abuse of their monopoly position that was harmful to fuel efficiency and the economy in general. Grid Codes did not exist. The legislation that established the requirements for market rules also mandated that utilities provide reasonable terms for interconnection with the electrical system, and for backup power supply to the IPPs in the event of the non-operation of their generators.

Thus the market rules were established to force utilities to deal reasonably with IPPs.

NamPower gives every indication that it wants Kudu to proceed, and that it need not be forced to deal with the Kudu project. In fact NamPower's multiple roles in the project, including as majority owner of the proposed facility, provide a regulatory challenge to assure that Kudu not be treated too favorably by NamPower. We discuss this issue in the next subsection.

The sections of market rules that deal with pricing typically rely on competition to establish prices for generation. For example, for a single buyer structure the rules might mandate a bi-yearly competitive auction for new generation and an "avoided cost" approach for economy energy between auctions. Kudu is so large and unique that it is difficult to conceive of

market rules that would be of much use in establishing specific prices for the project, which we believe must be negotiated as part of the PPA.

In other words, it appears that the primary motivations (willingness to deal, pricing) for having market rules in place do not apply for the Kudu project. NamPower appears to be willing to deal with the project, and pricing will be the result of a negotiation in any event.

We conclude that it would be desirable to have market rules in place, but they appear not to be necessary for the development of Kudu and are not necessary for the Grid Code. The Grid Code can and should be implemented whether or not the market rules have been developed. We also recommend that the process of developing and approving market rules be undertaken. Even if not timely or necessary for Kudu, they would support (for example) smaller cogeneration facilities that might some day develop. The Preamble specifies that the elements of the industry structure for which the Grid Code makes provision include market and ancillary services codes operating in parallel with the Grid Code. We do not know the status of development of either code.

## 5.5 *Regulatory Issues Associated with Kudu*

Several regulatory issues will face ECB as Kudu development proceeds, which may include:

- Licensing the project itself.
- Providing some form of approval for the transmission line that will need to be constructed.
- Applying the transmission tariff to whatever transmission arrangements are agreed with Kudu, NamPower, and Eskom.
- Approving a PPA between NamPower and/or Eskom and Kudu.
- Approving a power purchase/sales agreement between NamPower and Eskom.
- If ECB's responsibilities are expanded, possibly licensing the gas field development and approving a tariff to cover gas supply to Kudu.

These issues would be complicated enough if Kudu was planned to be a truly independent power producer. However, we understand that the current plan is for NamPower to be up to 75% owner of the project. This arrangement gives rise to a concern of self-dealing. NamPower is both buyer and seller of Kudu's output. NamPower may have buy/sell arrangements for surplus Kudu power with Eskom. NamPower will also provide transmission services. Thus NamPower will be buying and selling several services, with corresponding revenue streams.

NamPower's incentive to negotiate the lowest possible price from Kudu could be compromised by its ownership position in Kudu. The other transactions (transmission, sales to/from Eskom) could also directly or indirectly improve Kudu's revenues. The danger would be that NamPower's captive customers would have to pay more than appropriate to provide higher than normal profit levels to Kudu.

We recommend close ECB scrutiny of all aspects of the project, including the bulleted list above, so that ECB can make fully informed regulatory decisions. We also suggest ECB consideration of a range of regulatory treatment of Kudu, including cost-of-service based pricing similar to that for other NamPower generating plants.

# 6 Recommendations

As noted above, we believe that the draft could serve as a working Grid Code for a single buyer power sector structure. We offer the following suggestions for improving some aspects of the current draft.

## 6.1 *Key Issues*

- State directly in the Preamble that the Grid Code is based on a single buyer power sector structure, and changing to an open access structure that permits transactions between generators and end-use customers will require revision of the Grid Code. Remove all other references to an open access structure.
- Clarify directly whether Namibia will form its own control area, or remain part of South Africa's control area. Tailor the Grid Code, especially the System Operation Code, to whatever the answer is. The System Operator's responsibilities are different depending on whether Namibia is a separate control area or part of Eskom's control area.
- Improve the discussion of reserves in the System Operation Code Section 4, as discussed in this report's Section 4.3.3.
- Improve the treatment of emergency in the Preamble's Glossary and System Operation Code Sections 8 and 9. We address this in our Sections 4.3.1 and 4.3.3.
- Proceed as quickly as practical with the process of completing and approving the Grid Code. However, we conclude that an approved Grid Code is not necessary to support the development of Kudu, although the existence of an approved Grid Code might speed the process of agreeing on technical terms.
- Remove the Transmission Tariff Code and all references to it.
- Implement the Grid Code (when complete and approved) whether or not the market rules have been developed.
- Undertake the process of developing and approving market rules.

## 6.2 *Other Areas for Improvement*

- Define the scope of the IPS in the Preamble's Glossary.
- Revise the discussion of acceptable network performance standards in Network Code Sections 3.2.4 and 3.2.5. We note that network performance standards have been agreed among a large group of electricity sector participants and approved by ECB. Section 3.2.4 should refer to these standards.
- Establish that under-frequency load shedding will be shared equitably among customers. This should be stated directly in Network Code Section 5.2.1.
- Revise Network Code Sections 7.4.1, 7.4.2, 7.4.3, and 7.4.4 so that they are address directly the critical fact that Section 7.5 establishes the basic criteria for transmission investment.
- Review whether the break point for the need for higher reliability connections should be 1,000 MW in Network Code Section 7.4.5 and revise if necessary.

- Limit the scope of NT's discretion in expansion planning in Network Code Section 7.5 as much as possible without compromising the results of the analysis, such as by expanding the ECB-approved process for establishing the discount rate and COUE.
- Add details to the discussion of planning criteria in Network Code Sections 7.5.1 and 7.5.2, possibly by including sample cases for each, either in the text or as appendices.
- Review the need for the first year test of cost effectiveness for grid expansion investments in Network Code Section 7.5.2 and revise or eliminate as appropriate.
- Provide that customer who pays for added reliability per Network Code Section 7.10 may recapture some of his investment if it improves reliability for other customers either immediately or following load growth.
- Resolve the scheduling conflicts between the terms of the System Operation Code, Section 3, and the Information Exchange Code, Section 5.4.

# Appendix A - Grid Code Objectives - Sources

## *A.1 Energy White Paper*

The Energy White Paper lists six key goals for energy policies, listed below in no particular order:

1) Effective governance, referring to stable policy, legislative, and regulatory frameworks for the energy sector.
2) Security of supply, referring to the ability to provide reliable energy through diversification of economic and reliable energy supplies, with emphasis on development of Namibian resources.
3) Social upliftment, referring to providing access to households and communities.
4) Investment and growth, referring to energy sector expansion through investment.
5) Economic competitiveness and efficiency.
6) Sustainability, referring to the sustainable use of natural resources for energy production and consumption.

The White Paper specifically states that the Government recognizes that some of these goals may be contradictory, and trade-offs may have to be agreed in policy implementation.

The White Paper also notes that:

- Electricity supply is dependent on imports from one single source: Eskom.
- Hydropower from the Ruacana plant on the Cunene river supplies from 45% to 60% of Namibia's electricity.

The White Paper presents specific policies intended to achieve these overall goals. Those most relevant to the Grid Code include:

- Government is committed to supplying reliable, competitively priced energy to productive sectors of the economy within the constraints of the competing demands of social equity and sustainability.
- Government will investigate options for improving efficiency through electricity supply industry restructuring.
- Government will introduce an institutional system, with both regulatory and policy making functions, to monitor and regulate electricity price developments.
- Electricity tariff structures and prices will be based on sound economic principles, generally and as a whole reflecting the long-run marginal cost of electricity supply.
- Electricity supply in Namibia shall be based on a balance of economically efficient and sustainable electricity sources including gas, hydro-power, other renewable energy sources and imported electricity. In creating this mix, the risks associated with stranded investments as well as the benefits of improved security of supply will be taken into account.
- Government will facilitate the establishment of new high-voltage interconnections to neighboring countries to increase Namibia's possibilities of engaging actively in regional electricity trading.

- Government will promote a dialogue with private investors and financiers with a view to facilitating economically viable and competitive investments in the electricity sector. It will also ensure the establishment of the necessary legal, regulatory, fiscal, and environmental frameworks to create a favorable investment climate.
- Government will implement a modern and appropriate legal and regulatory framework for the electricity sector through the Electricity Act and associated regulations, and the creation and resourcing of a competent Electricity Board to regulate the sector's operation.
- Government will ensure that adequate protection of electricity end-users and licensees is established through the creation and resourcing of the Electricity Board to be established under the Electricity Act.
- Government will promote sound energy planning principles throughout all government ministries.
- Government will base decisions regarding new energy projects on principles and procedures for environmental and socio-economic assessment, mitigation and compensation, which take account of the environmental and social costs of the projects.
- Government will seek to achieve security of energy supply through an appropriate diversification of economically competitive and reliable energy sources, with particular emphasis on the development of Namibian resources. Government will regularly assess the regional risks and opportunities in order to achieve the optimal balance and diversification.
- Government will work to ensure positive and committed Namibian participation in the Southern African Power Pool to maximize potential economic and political benefits from increased electricity trade.
- Government will also ensure the development of legal, regulatory and institutional frameworks that are in harmony with SAPP agreements.
- Government will co-operate with the SADC Energy Sector Action Plan, which seeks to promote a competitive investment and pricing environment for energy projects targeting regional energy markets.

These goals and objectives are general but clearly consistent with typical reform and restructuring processes leading to the need for a Grid Code.

## *A.2 Electricity Act, 2000*

The Act establishes the Electricity Control Board. The Act defines the objects of the Board as being "to exercise control over the electricity supply industry and to regulate the generation, transmission, distribution, use, import and export of electricity in accordance with prevailing Government policy so as to ensure order in the efficient supply of electricity." In order to achieve its objects, the Board:

- Must make recommendations to the Minister regarding licenses and the approval of license conditions.
- May and at the Minster's request must advise the Minister on any matter relating to the electricity supply industry.

- Must, at the request of any interested party, act as mediator for the settlement of disputes between licensees or between licensees and their customers.
- Must perform other functions assigned by the Act or any other law.
- May carry out investigations to perform its duties.

Much of the Act establishes or provides requirements for the Board's composition, terms of office, meeting procedures, disclosure of interests, Chief Executive Officer and other staff, sources of funding, accounts and audits, furnishing of information and annual report appeals, inspections, offenses, transitional provisions, and other administrative details.

With respect to licenses, the Act requires that a license must be obtained for any undertaking for the generation (except small own-use facilities), transmission, supply, distribution, import, or export of electricity. Each activity requires a separate license. It establishes procedures for applying for a license, criteria for consideration of applications, duration and renewal of licenses, license conditions, transfer of license, amendment of license, schedule of approved tariffs and revision thereof, obligations of the licensee, cancellation or suspension of license, and related functions.

Under the Act, the Minister may make regulations.

Thus, the Board's primary function is licensing, but it lacks the authority to issue licenses. It must make recommendations to the Minister regarding licenses issuing, transferring, amending, etc. The Minister is the party who grants or refuses licenses. The Act makes no mention of the authority or responsibility of the Board to make regulations, but presumably the Board, on its own initiative or at the Minister's request, would develop and submit regulations it deemed necessary to the Minister for approval.

Of particular interest is Section 28, which states:

"A licensee who is licensed to transit electricity may not, upon the request of another licensee, refuse that licensee the right of transmitting electricity through its electrical or transmission line against payment of compensation at a rate approved by the Board, except if such refusal is reasonably based on an insufficiency of technical availability of capacity."

The Act's establishment of a regulator is a step in the direction of reform, but the approach falls short of creating a truly independent regulator. Section 28 appears to require open access transmission, which would require a grid code for implementation. The use of the phrase "electrical or transmission line" implies that distribution systems also are included in the scope of this requirement.

## *A.3 Electricity Regulations – Administrative, Electricity Act, 2000*

Most of this document provides details on procedures dealing with license applications, a register of licenses, appeals, fees, and offenses. However, the requirements of Section 2 in effect are goals or objectives for the Board. Section 2 specifies that the Board must in performing its functions:

- Promote an efficient, reliable, and economic system of electrical generation, transmission, supply and distribution within and importation into and export from Namibia.

- Regulate licensees in a manner that maintains and improves efficiency, economy and reliability on the part of licensees so as to enable all reasonable demands for electricity to be met, in accordance with prevailing Government policy.
- Have regard to the needs of licensees to be able to finance the carrying out of their licensed activities.
- Encourage efficiency, economy and safety in the use of electricity.
- Regulate the quality of supply and the tariffs, fees and charges payable for electricity keeping in view both the interests of consumers and of licensees.
- Act in a manner that is transparent and fair.
- Have regard to promotion of health, safety and the environment.
- Oversee the effectiveness of the mechanisms, processes and forces prevalent in the electricity sector to ensure that there is a reasonable balance between the demand for electricity and the supply thereof.
- Act in a manner consistent with the objects of the Act and any regulations made thereunder.

As with the White Paper, these goals and objectives are general but clearly consistent with typical reform and restructuring processes leading to the need for a Grid Code.

## *A.4 Namibian Grid Code Preamble – March 2003*

The Preamble makes many statements about the structure and policies of the Government that, although not all directly stated in the documents reviewed above, appear entirely consistent with their intent.

- The Namibian Government has approved proposals for a strategy to ensure a managed liberalization of the energy sector.
- Government policy is to permit open and non-discriminatory access to the transmission system.
- A Grid Code Review Panel, constituted of industry participants and stakeholders, will review proposed changes to the Grid Code and make recommendations regarding the Grid Code. This provides stakeholders and future market participants an opportunity to provide input to the development and on-going updating of the Grid Code.
- The Grid Code makes provision for the following elements of the Namibian electricity supply industry (ESI) structure:
  - A generation sector consisting of NamPower-owned generators and independent generators.
  - NamPower Transmission, ring-fenced from NamPower and incorporating a sub-ring-fenced System Operator (SO), Transmission Supply Business (TSB) and Transmission Wires Business (TWB).
  - One or more independent TNSPs as licensed by the ECB only for specific purposes such as facilitating cross-border trade.

- A distribution sector within which regional electricity distributors (REDs) are formed from Premier Electric, Local Government and Housing and municipal distributors.
- A Single Buyer (SB) in the short term.
- In the long term a "multi-buyer, multi-seller model" will be developed to ensure transactions between generators, traders and power purchasers take place on a variety of platforms.
- Market and ancillary service codes operating in parallel with the Grid Code.
- Directly-connected end-use customers, either contestable and participating in the wholesale market, or being supplied via a retailer;
- International trading via the interconnectors with other countries, and in line with the SAPP rules.

The Preamble also indicates that the general objective of the Grid Code is to establish the reciprocal obligations of industry participants around the use of the transmission system (TS) and operation of the interconnected power system (IPS). To achieve this objective, the Grid Code must ensure that:

- Obligations and accountabilities of all parties are defined for the provision of open access to the TS.
- Minimum technical requirements are defined for customers connecting to the TS.
- Minimum technical requirements are defined for service-providers.
- The System Operator obligations are defined to ensure the integrity of the IPS.
- Obligations of participants are defined for the safe and efficient operation of the TS.
- The relevant information is made available to and by the industry participants.
- The major technical cost drivers and pricing principles of the service-providers are transparent.

The responsibilities of the service-providers under the Grid Code are:

- To show total neutrality and impartiality in whose product is being transported.
- To ensure that investments are made within the requirements of the Grid Code.
- To provide access on agreed standard terms, to all parties wishing to connect to or use the TS.

The Preamble lists the sections of the Grid Code and describes the assurances it will provide the various participants. It also asserts that the Grid Code clearly spells out, in a transparent way, the rights and obligations of all role-players to be achieved through industry consultation.

The bulk of the Preamble is a glossary and table of acronyms and abbreviations.

The Preamble states that Government policy is to permit open access to the transmission system, yet also states that the Grid Code makes provision for a Single Buyer in the short term. The establishment of a Single Buyer is inconsistent with the usual definition of open access, the key feature of which is open access to the transmission system to permit transactions between customers and generators. The Preamble avoids this issue by defining

open access as the supply of transmission services to any qualifying participant on non-discriminatory terms and conditions.

## *A.5 Reform and Restructuring*

The Energy White Paper, the Electricity Act, and the draft Grid Code are all elements of reform and restructuring processes that are reshaping the electric power industry all around the world. Many motives drive the reform, including objectives of:

- Improving poorly performing power sectors.
- Attracting needed investment.
- Creating more competitive power sector businesses.
- Raising money from the sale of government-owned assets.
- Harmonizing with regional norms.

The direction of reform is based on several fundamental beliefs:

- Free, competitive markets maximize economic benefits.
- Private ownership provides the most effective incentives for efficient operation and investment.
- In the power sector, generation and supply (sales to end-use customers) are potentially competitive functions. Transmission and distribution (ownership and operation of the physical low-voltage system) are natural monopolies.
- Monopoly functions should be regulated in an evenhanded manner.
- The role of government is to set policy, not operate businesses.
- Expanded trade improves efficiency and reduces costs.

There are many aspects to reform. Not all are present in a given reform process, nor does any one aspect necessarily proceed to the full extent possible. Nevertheless, power sector reform in Namibia appears to contemplate almost all of these areas to some extent.

- Reduction / elimination of direct government control over electric utility organizations.
  - Namibia's willingness to permit private ownership of independent power producers (IPPs) reduces direct government control.
- Functional unbundling of existing organizations.
  - The Preamble to the Grid Code describes an industry structure formed by functional unbundling of NamPower.
- Corporatization and commercialization of resulting organizations.
  - None of the documents address this directly, but NamPower itself is corporatized and has a clearly commercial orientation.
- Independent regulation of monopoly functions.
  - The Electricity Act establishes a regulator, but one that is not independent because most authority remains in the hands of the Minister.

- Free markets for competitive functions.
  - There is no competition in supply to end-use customers. Generators will compete in sales to the monopsony Single Buyer.
- Establishing conditions to attract private investment.
  - NamPower is financially sound and the reviewed documents clearly reflect a desire to maintain / establish conditions conducive to attracting private investment, and a willingness to take the necessary steps to do so.
- Rationalized tariffs.
  - NamPower indicates in its 2003 Annual Report that a tariff increase in 2003 addressed the problem of inadequate tariff levels due to inflation. We cannot tell whether the tariff calculations link prices to cost causation, but the White Paper and Electricity Act contemplate cross subsidies to support social upliftment and rural development.
- Privatization.
  - The reviewed documents do not address the issue of privatizing part or all of NamPower, but do reflect a desire to attract private investment
- Open access to transmission and distribution grids.
  - The Preamble indicates that the ESI structure does not provide for this in the short term, but will in the long term.

Namibia's power sector does not suffer from the severe structural, technical, and commercial problems than plague many countries. NamPower is financially strong, its technical performance satisfactory, its human resources capability excellent, its investment program rational and properly funded, and its tariffs low but adequate to provide necessary revenues. It would be desirable to improve efficiency and lower costs, but lack of competition in generation probably has less impact on efficiency and power cost in Namibia than in most other places. Almost all of NamPower's generation comes from zero marginal cost Ruacana or low cost imports. The potential for lowering costs is either small or outside NamPower's unilateral control. Thus the urgency for action to achieve reform is not great.

Nevertheless, reform and restructuring do offer benefits worthy of obtaining. If RSA restructures and requires reciprocity, Namibia will have a very strong incentive to follow suit. In the long run there is little doubt that most elements of reform must occur. A reasoned pace through the steps of reform is likely to capture nearly all of the benefits with the least risk of failures. This appears to be the approach Namibia has selected.

The Namibian power sector does have potential problems. Namibian generation is not sufficient to meet national demand economically. Ruacana is dependent on variable water availability, and NamPower's contract with Eskom expires in 2005. The Namibian market (2003 peak demand of 377 MW) is too small to achieve economies of scale in thermal generation. The only identified substantial thermal resource, Kudu gas, is 170 km offshore, requiring power plant development of 800 MW or more to have a chance of being economically viable in the short term. This implies the need for multi-national arrangements such as joint development or power sales agreements to support the gas field and power plant projects.

Eskom has thousands of MW of reserves, thousands more in "reserve storage" and a concern to parties thinking of building new generation, and extensive low-cost coal resources. Eskom can and has been selling power below the cost of power from new plants such as Kudu. Depending on what happens in RSA, the availability of low cost power from Eskom may change.

Extending access to electricity to low income and/or remote (rural) households will require subsidies. Subsidies are difficult to maintain if the customer group providing a subsidy, for example a group of large customers with low cost of service and ability to pay, has a choice of suppliers, as customers do in a true open access structure.

From the point of view of NamPower, the single buyer structure offers several advantages over the open access structure. These NamPower advantages are disadvantages from the point of view of the customers who would pay more for power under single buyer than under open access.

- With single buyer, cross subsidies can be maintained, requiring one customer group in effect to support the cost of providing service to another.
- With single buyer, customers must bear the cost of relatively high cost generation (e.g., Van Eck, Paratus, or Kudu vs. Eskom imports, if Eskom prices stay low), avoiding the potential problem of stranded investment. With open access, customers can buy from the lower cost supplier.

Balancing the trade-offs between these advantages and disadvantages is a policy choice for the Government, which apparently has selected single buyer initially and open access at some undefined point in the future. Given the circumstances, this seems to us to be a reasonable approach.