energy
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PROPOSED IRP PLANNING PROCESS

EXECUTIVE SUMMARY

The Integrated Resource Plan (IRP) in the South African context is not the Integrated Energy Plan but purely an Electricity Plan and is therefore only a subset of the Integrated Energy Plan (IEP). The IRP is not a short or medium-term operational plan but a medium to long-term plan that directs the expansion of the electricity supply over the given period (at least 25 years).

1. Integrated Energy Plan (IEP)

The Department of Energy (DOE) is responsible for developing the National Integrated Energy Plan (IEP), which incorporates the formation of a general equilibrium model involving the economy as a whole, and energy component specifically. This plan is significant due to the inherent interaction between components of the energy industry.

From an electricity point of view the IEP should incorporate the interaction between electricity and liquid fuels and between electricity and coal. Whereas the interaction is bi-directional (including the demand of refineries and mines for electricity), the significant impact is the demand placed by existing and new power stations on the fuel capacity in the country.

2. Integrated Resource (Electricity) Plan

The policy environment provides the direction to the Integrated Resource Plan (IRP). The DoE remains responsible for the development of the IRP as described in the "Regulations for New Generation Capacity" published on 5 August 2009.

The plan is a mechanism by which key electricity system, sustainability and government policy requirements are met, so that the following questions are answered:

- What are the electrical energy requirements for South Africa?
- By when is the capacity needed to provide for the electrical energy requirements?
- What is the appropriate mix of technologies to meet these needs that meet the required policy objectives?

The Electricity Regulations on New Generation Capacity states that the process for developing the integrated resource plan shall include:

a) Adoption of the planning assumptions;
b) Determination of the electricity load forecast;
c) Modelling and scenario planning based on the planning assumptions;
d) Determination of the base plan derived from a least cost generation investment requirement;

e) Risk adjustment of the base plan, which shall be based on:
   i. The most probable scenarios; and
   ii. Government policy objectives for a diverse generation mix, including renewable and alternative energies, demand side management and energy efficiency.

f) Approval and gazetting of the integrated resource plan.

The objective of the IRP should be to minimise the total cost of electricity (supplied and not supplied) to the consumer, given the constraints inherent in the technical aspects of the supply and non-technical considerations brought into the planning model. The technical aspects flow directly from the planning assumptions, where as the non-technical considerations follow from a policy, scenarios or externalities.

The planning algorithm considers inputs such as the load forecast and generation performance information, which are uncertain. The adequacy criterion provides the basis to determine whether the plans are adequate given these uncertainties.

The plan will be described in three time periods as follows:

a) **Short Term:** The plan describes the choices that have already been made and the projects that will begin within the next four years.
b) **Medium Term:** The plan develops options that are likely to be needed in the next period, i.e., five to ten years from now.
c) **Long Term:** The plan will develop a long term picture considering potential risks and opportunities and identifies and scopes a set of broad options.

3. Adoption of the Planning Assumptions and Deriving the Input Data Set

There are a number of assumptions that need to be confirmed before the plan is developed. Additionally, the input data set that the plan will use will also need to be confirmed. The following are some of the important input factors:

a) Discount rate (net discount rate before tax);
b) Future inflation figures (PPI);
c) Exchange rate;
d) Existing generator performance expectations;
e) Costs and characteristics of existing generation plant (life cycle refurbishment, decommission);
f) Existing fuel supply availability, costs and parameters;
g) Future technology options, costs and characteristics;
h) Future fuel supply availability, costs and parameters;

i) Water and sorbent requirement, availability, costs and parameters;
j) Demand forecasts (both energy and peak demand);
k) Anticipated demand side management (DSM) (including dispatchable DSM).

***Note**:*
The cost and characteristics of the future supply options will be based on benchmark information and not actual options. This is done because future options are not yet developed to the extent that they are accurate enough to be used in an expansion study. Also, because of the participation of private investors, it is not necessarily known which location will be specifically chosen for different technologies.

a) Determination of the electricity load forecast

Two forecasting methodologies will be utilised to determine the annual energy requirements and which can briefly be defined as:

1. A time series analysis of historic trends at individual customer and/or sector level, adjusted for non-repeatable events. This adjustment is made through expert knowledge and judgement for known and assumed parameters that will impact future electricity consumption.
2. An econometrics model utilising economic and demographic parameters has been constructed that calculates the forecast based on algorithms that utilise these parameters in the input function.

In order to compare the forecasts that will arise from the two methodologies, the same assumptions must be used in both forecasts, where applicable. In addition to the energy forecast it is also required to do an hourly demand forecast. Two methods will be used to forecast this hourly profile:

- A method using the system profile.
- A method using sectoral profiles.

b) Policy environment

The DOE is responsible for setting the policy guidelines for the energy industry. The policy environment has significant impact on long term planning.

4. The Planning Models

The Base Plan and selected scenarios are modelled on an expansion planning software tool named PLEXOS@R.

a) Base Plan and Scenario Development

The Base Plan is taken as the least cost plan considering only the direct costs of the options considered. It does not consider any externalities.

The additional scenarios for the risk-adjusted plans may consider externalities either as limits or explicitly modelled as additional costs for the affected technologies. The primary externality factor that will be considered in this IRP is carbon emissions.

The risk adjustment of the Base Plan shall be based on the most probable scenarios, Government policy objectives for a diverse generation mix, including renewable and alternative energies, demand side management and energy efficiency forecasts.

Some of the important policies (or strategies) that should be considered in scenarios for the risk adjusted plans are those that give direction to:

- Nuclear;
- Renewable Energy mix and size;
- Climate Change;
- Imports (Regional Development);
- Diversity of energy sources; and
- Energy Efficiency Policy/Strategy and
- Technology Solutions.

Since the planning process deals with degrees of uncertainty, the developed scenarios will also have sensitivity scenarios using different demand forecasts.

b) Results

Once developed, the outputs of the planning process should be reviewed and interpreted to ensure that the preferred options are identified, and there is a common understanding of the implications of the decisions, which need to be made. The outputs need to be scrutinised to:

- Identify unrealistic expansion options;
- Review reserve margin impacts, (Reliability Criteria);
- Ensure limits imposed by the IEP such as load factor on gas turbines or other energy limits are not violated.

The identified draft plans are then subjected to production studies to ensure the reliability of each of the plans developed. This is done because the expansion plan is not as precise as a production study but a simplified model. The production study is a more precise model of the problem and is a further assessment that the reliability criteria can be met by the draft plans.

Each plan that passes the reliability tests must then undergo further scrutiny. Firstly, the plan must be costed and estimation of the tariff impact made. These can only be broad indications since the costs are mostly benchmark costs. In addition, the review must identify whether other policy objectives not considered specifically in the scenarios, are met; such as competitiveness, social development issues, localisation etc. Furthermore, the broader picture of other infrastructure development such as water, roads and transmission must be considered for each plan to identify potential implementation issues.

A decision-making framework is then used to decide between the different plans (scenarios) and on what plans get recommended to the Minister of Energy.

5. Implementation of the selected IRP

The development of the IRP as proposed in the Regulation, results basically in a high level plan, identifying the required capacity, the capacity mix and the requisite timing for the capacity.

The Regulations require that feasibility studies be done to identify the potential developer of the different supply options.