Integrated Resource Planning Training for Decision Makers

Day 5, Session 10 – Criteria for generation planning 10 March 2021





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Reliability / security of supply of electricity

- Power sector investments are very large in every economy – getting power sector investments 'wrong' potentially very costly in terms of lost output and reduced economic growth
 - Over-investment in electricity will reduce the resources available for investment in the productive sectors of the economy
 - Under-investment will result in shortages leading to load shedding and blackouts.
 Productive sectors have to sacrifice production or buy and run expensive stand-by generators
- Planning safety valve is to be integrated into the regional grid – this will be discussed in Topic 17 next Thursday

- Utilities would like to have plenty of spare capacity to call on to make sure they can provide security of supply
- Ministries of Finance are concerned about the macro-economic consequences of excessive investment in the power sector: many other urgent needs in a developing country
- In OECD countries loss of supply is treated as a calamity, in many SADC countries it is a frequent event (with costs being curtailed by pre-announcing load shedding schedules)
- There is a balance to be found that is appropriate to a country's level of development

Houston and Harare



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HOUSTONCHRONICLE

POLITICS // TEXAS POLITICS

'Your government failed you': Texas lawmakers, mayors sound off on power outages

Cayla Harris, Austin Bureau Feb. 16, 2021 | Updated: Feb. 16, 2021 1:82 p.m.



 Mayor Sylvester Turner speaks along side of other elected officials in Houston, Saturday, Feb. 6. Karen Warren, Houston Chronicle / Staff photographer

Texas lawmakers on both sides of the aisle expressed outrage as the state's power grid collapsed amid severe winter weather, leaving millions without electricity.

"A state that prides itself on energy production left millions of its citizens to freeze in the dark. It's not just incompetent; it's criminal," State Rep. James Talarico, a Round Rock Democrat, said on Twitter.

Era of power cuts is over — Magombo

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Dr Magombo

Mukudzei Chingwere and Elita Chikwati

The era of load-shedding in Zimbabwe is over and the current power outages being experienced in some areas are a result of faults and vandalism, a senior Government official has said.

Permanent Secretary in the Ministry of Energy and Power Development Dr Gloria Magombo said the country had enough electricity supply and was working on further increasing its power generation capacity.

Delays by residents in reporting faults and cases of vandalism and damage to infrastructure were resulting in prolonged outages.

Security / reliability of supply concepts and measures

- SAPP: the objective of power supply planning is to satisfy demand at a specified level of reliability
- Reliability level can be specified as a maximum LOLP (eg, 1%) or as a reserve margin (eg, 15% for a standalone system), but consideration also needs to be given to the largest single generation unit on the system
- Alternative approach is to assess the cost of unserved energy and include this alongside capital and O&M costs in analysing the system expansion options.
- Strictly cost depends on when the energy is not provided, but normally an average value is calculated using an economy-wide VoLL

Loss of load probability (LOLP)

A measure of the probability that a system's load will exceed the generation and firm power contracts available to meet that load

Reserve margin

Amount of capacity over and above the expected peak demand (usually expressed as a percentage of peak demand).

Cost of unserved energy

Economic cost arising from customers being denied access to electricity

Value of Lost Load (VoLL)

measure of the economic cost arising from demand for electricity not being met.

Reliability criteria in an IRP set system reliability levels that have to be respected by generation and transmission

Generation planning criteria

- Reserves margin how much more capacity is needed to support the reliable operation of the system
- Accepted LOLP/EENS what is the accepted level of the system not being able to meet the demand
- Networks planning criteria
 - *'N-1' reliability level* the system shall be able to meet peak demand even with one transmission line, main power transformer or unit for reactive power compensation out of service.
 - Voltage levels Minimum and maximum voltage levels during normal and contingency operation.
 - **Capacity** Maximum thermal loading of equipment.



Indicative planning criteria for SAPP member countries

Country	LOLP (days per year)	Min Reserve margin (% of available capacity)		
Botswana	-	20%		
Eswatini	-	10%		
Mauritius	-	10%		
Namibia	2 to 55	-		
South Africa	-	19%		
Tanzania	5			
Zambia	-	50% or 20% (in dry years)		
Zimbabwe	-	10.6% for thermal-based power and 7.6% for hydropower		
SAPP	-	10.6% for thermal-based power and 7.6% for hydropower		

SAPP generation planning criteria

- Agreement in 2011 to a set of minimum standards 'but utilities may choose to apply more stringent criteria'
- Reserve Capacity Obligation of a Member for any given period shall be equal to
 - 10.6% of the Annual System Peak Obligation of such Member when the generating plant is thermal
 - 7.6 % when the generating plant is hydro.
 - a weighed average shall apply to Members who have a mixed system.
 - Members are permitted to contract reserve auxiliary services from others (or in future from AS market)
- Security Criterion: minimum level of internal generation shall have as a long term objective capacity equal to or greater than 100% of demand. Internal generation shall be committed when existing reserve levels drop below that specified in the reliability criteria.



SAPP GENERATION PLANNING CRITERIA

NOVEMBER 2011



Generation planning design features and reliability approach

- In order to maintain a balanced design of the power system, excessive concentration of generating capacity in one unit, at one location or in one area shall be avoided.
- Auxiliary power sources shall be provided in each major generating station to provide for the safe shutdown of all units in the event of loss of external power.
- Each member shall have a unit capable of black start so as to restart other units in the member's area.
- Boiler controls and other essential automation of major generating units shall be designed to withstand voltage dips caused by system short circuits.

- Traditional reliability approach is to use reliability criteria (such as LOLP) as a constraint
- Including the cost of unserved energy in the optimisation is a superior approach because it makes explicit the trade-off between reliability and capacity expansion
- "When another criterion such as reserve margin is also applied, in some circumstances it could be the limiting factor. It could require more generation or transmission than the least-cost optimum. In that the resource plan would not achieve the ideal least-cost balance of cost and reliability"



SAPP generation planning criteria discussion

Questions on SAPP criteria

- What gives security of supply assurance in an inter-connected power system?
 - Is the so-called 'Security Criterion' aptly named?
 - If a country has installed capacity sufficient to meet its maximum demand, why might it nonetheless import electricity?
- Do you agree that analysing the cost of unserved energy is superior to specifying a reliability criterion?
- Should least cost be the main / sole focus of generation planning?

Other generation planning criteria

Other criteria may be specified related to different policies

- **Self-sufficiency**: installed capacity must be sufficient to meet x% of peak demand and/or domestic generation must supply y% of energy requirements
- Renewable energy: renewable energy sources must supply z% of energy requirements by a specified date

Questions on national planning criteria

- How are reliability criteria dealt with in your country?
- What value of lost load (VoLL) is used in your country?
 - Has it been imputed from data about the economy, or have customers been surveyed about their willingness to pay to avoid a disruption in electricity supply?
- What if any self-sufficiency and RE constraints are imposed?
- Any other generation planning criteria specified?



Review session – first week

- Open Q&A session on topics covered during the first week of the course
- A look ahead to the second week

Peter Robinson, peter.robinson@eca-uk.com



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