



Lesotho Electricity Authority

**REPORT ON ANALYSIS OF LEC LOAD SHEDDING FOR  
PERIOD APRIL – JULY 2008**

## **1. Introduction**

The main interconnected grid of LEC which supplies power to eight (8) of the ten (10) districts of Lesotho is supplied with power from 'Muela hydropower plant (MHP) and Eskom Maseru Bulk intake point (Maseru Bulk). The rated or nominal capacity of MHP is 72 MW, whilst the maximum imports from Maseru Bulk are 24 MVA as given in the Electricity Import and Export Agreement between LEC and Eskom. The Letseng Diamond Mine and the district of Mokhotlong are supplied by an 88 kV line from Eskom Clarens intake point whilst Qacha's Nek is supplied at 22 kV from Eskom Kokstad intake point.

LEC carried out intense load shedding exercise from April to July 2008. This load shedding was carried without any schedules informing the affected customers of the times their power supply would be interrupted and the expected duration of such interruptions. LEC argued that it was not in a position to provide customers with load shedding schedules because it could not predict or forecast the system load thus it was not in a position to forecast which parts of the system would relieve the system by how much load if those parts were shed.

Reasons cited by LEC for the load shedding exercise were:

- a) MHP output generation did not meet the Lesotho winter electricity demand at peak times.
- b) Imports were curtailed as per Eskom requirement on LEC to restore the necessary demand and supply balance; as a result the top-up imported supply from Eskom could not meet the Lesotho load particularly during peak times.
- c) Implementation of reduction on imports based on 2007 imports made the situation worse as it did not cater for the system growth in 2008, from 2007 loads. In essence the total reduction was effectively more than 10%.

## **2. Information Request from LEC**

After LEC had carried out the exercise for four (4) months, LEA observed that there was some sequence that LEC followed in carrying out the load shedding. Some customers had also written to LEA complaining of the load shedding that always took place at almost the same times of the day and week. Based on the Authority's observation, customers' general outcry and the powers of the Authority to request information from licensees, LEA requested LEC to provide it with the load profile, load shedding schedule and amount of shed load since the beginning of the load shedding. LEA also requested LEC to provide it with a written confirmation of the import constraint by Eskom.

### 3. Objectives of the Analysis by LEA

One of the general duties of LEA as stipulated in the LEA Act is to “ensure the security of the supply of electricity in Lesotho.” The Authority’s aim in requesting information from LEC was to do an own analysis of the load shedding and load profile in order to **establish the base and peak loads of the LEC system** thus confirm or otherwise the claims of LEC, find out whether indeed load shedding was the right option at the time to address the shortage in power; and finally recommend possible solutions for the future to minimize or avoid the load shedding.

### 4. Analysis of Load Profile and Load Shedding Data

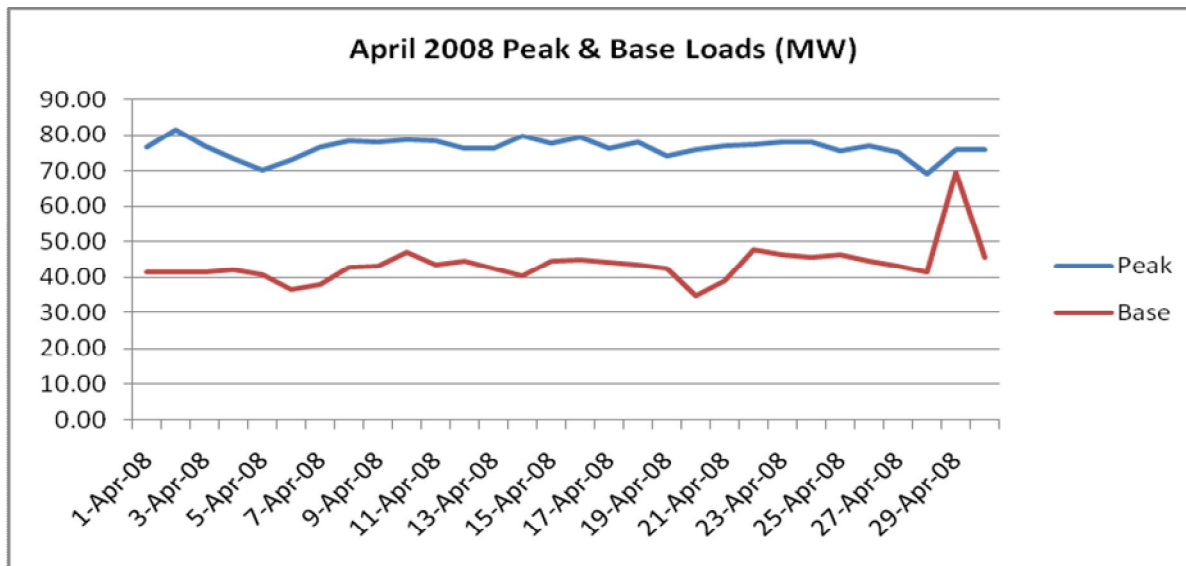
LEC supplied LEA with full **half-hourly load profiles** for January-July 2008. The areas affected by the load shedding at each instant and the corresponding estimated load shed were given for April-July 2008. The confirmation of the constraint on imports from Eskom was supplied by LEC and it revealed that the import constraint by Eskom allowed for a 4% annual load growth. Thus effectively the reduction on imported load was 6%.

The Authority has done an analysis on the data provided by LEC. LEA requested and duly received comments from LEC on the analysis report. The analysis was restricted to the four months of April-July 2008 during which load shedding was the order of the day in Lesotho. The data provided by LEC is for the main interconnected grid which is supplied by the ‘Muela power plant and the Eskom imports from the Maseru Bulk intake point. That is, the northern and eastern grids supplied respectively from the Eskom Clarens and Kokstad intake points are not covered in this analysis. The major findings of the analysis are highlighted below.

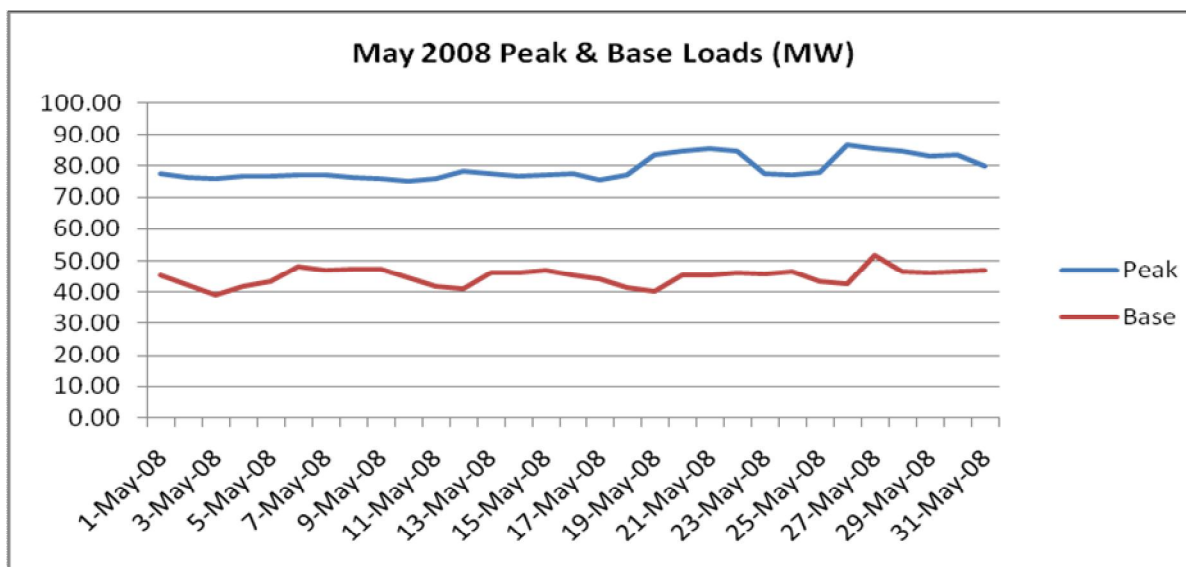
- 1) The base load for the period April-July 2008 was in the band 26-55.77 MW, far below the rated capacity of ‘Muela with an outlier of 69.37 MW in April.
- 2) The peak load for the period April – July 2008 was in the band 69 – 99.6 MW. The base and peak loads are depicted in Figures 1 to 4.
- 3) The percentage durations of time during which the load fell below or was equal to 70MW (approximately ‘Muela rating of 72 MW) are 69.31%, 55.49%, 41.67% and 39.31% for April, May, June and July respectively.
- 4) The number of hours in a day during which the load fell below or was equal to 70 MW range from 5-24, 7-22.5, 7-19 for April, May, June and July respectively. Table 1 shows the minimum, average and maximum of such times.
- 5) The daily and monthly load factors for the four months ranged above 70% with outliers of 35.54% and 51.72% on the 20<sup>th</sup> and 21<sup>st</sup> April 2008 when there was some missing load data. Table 2 shows the load factors.
- 6) Load was shed from as early as after 06h00 until as late as after 21h00. This reveals that demand could only be met during night hours. Table 3 depicts how the load was shed throughout the day. It is worth noting that some of the load shedding incidents have been counted more than once in the table. On the other hand there are a few incidents which have not been counted. The reason for multiple counting and non-counting is that the load shedding (switching off and on of the load) was itself overlapping.

- 7) On average, over the four months more than half of the load shedding incidents lasted for more than 3 hours with 49%, 60%, 55% and 45% recorded respectively for April, May, June and July. The longest incident took more than 5 hours in July, while 2.8 hours was the most common duration in all months.
- 8) A total of about 8 GWh of energy could not be supplied due to load shedding.

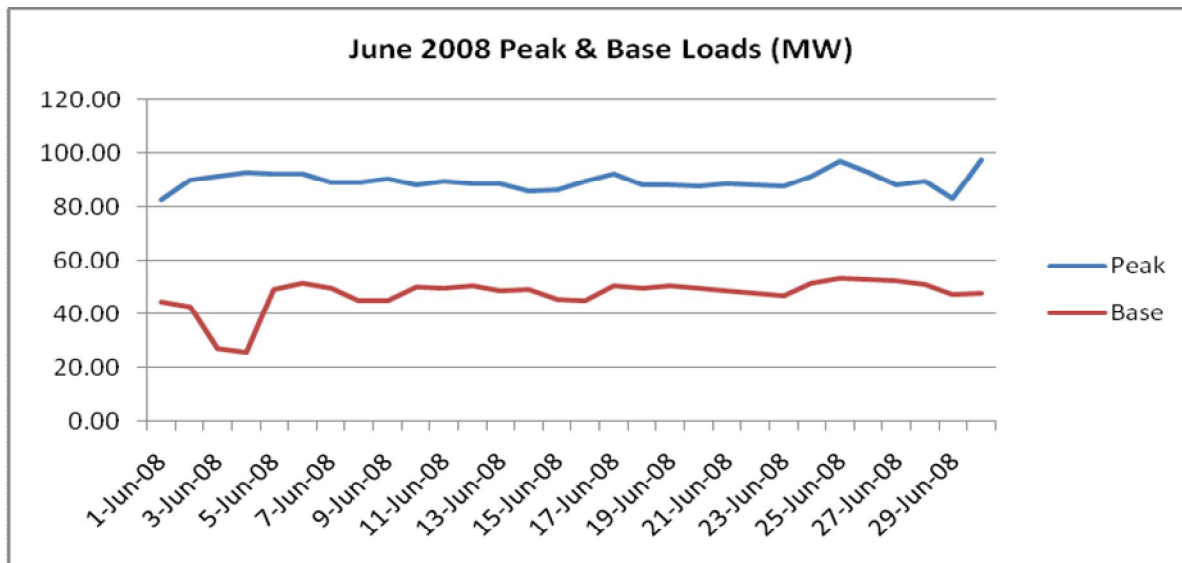
**Figure 1: April 2008 Peak and Base Loads**



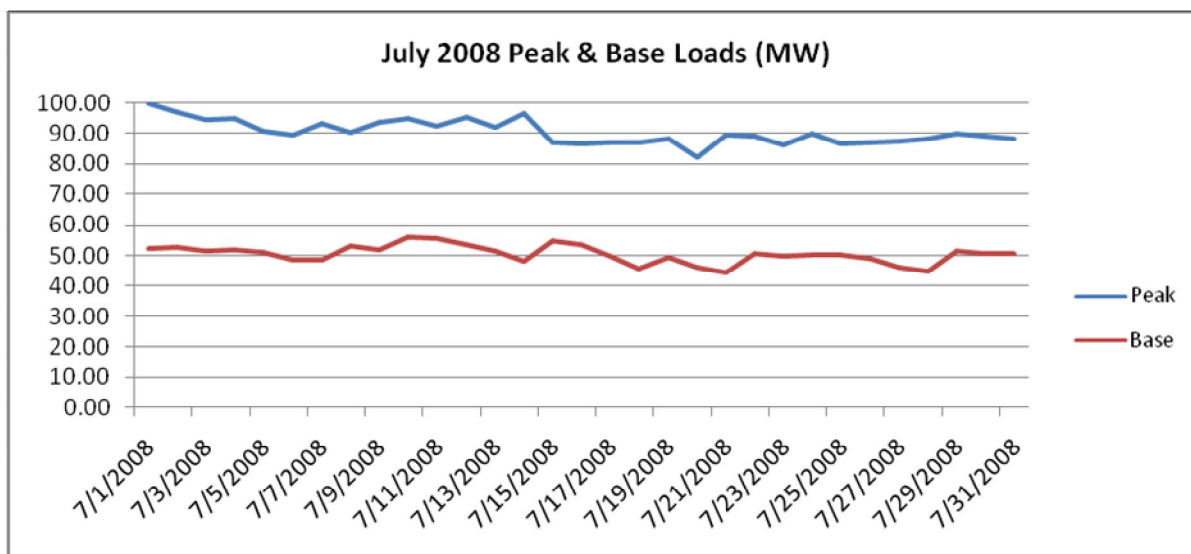
**Figure 2: May 2008 Peak and Base Loads**



**Figure 3: June 2008 Peak and Base Loads**



**Figure 4: July 2008 Peak and Base Loads**



**Table 1: Minimum, Average and Maximum Number of Hours in a Day when Load <=70 MW**

Month	Minimum	Average	Maximum
April	5	17.21	24
May	7	12.89	22.5
June	7	10	19
July	7	9,44	19

**Table 2: Minimum, Average and Maximum Daily Load Factor and Monthly Load Factor (in Percentage)**

Month	Daily Load Factor			Monthly Load Factor
	Minimum	Average	Maximum	
April	35.54 <sup>1</sup>	77.67 <sup>2</sup>	95.04	77.92
May	70.69	81.62	87.69	74.39
June	70.36	79.39	86.05	73.04
July	70.48	79.66	85.52	72.35

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<sup>1</sup>Missing data during some hours on 20 & 21 April 2008 resulted in lower values

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**Table 3: Load Shedding Incidents during Different Periods of the Day**

	Period of Day									
Month	06h00 - 11h00	08h00 - 12h30	09h45 - 15h30	13h00 - 18h00	17h45 - 21h00	18h00 - After 21h00	Actual Total	Total Counted	Incident Over Counted	Incident Not Counted
April	47	24	30	15	24	0	120	140	20	0
May	111	89	48	30	51	0	290	329	39	3
June	169	137	71	35	70	3	419	485	66	0
July	173	104	77	31	79	5	415	469	54	6

## 5. Conclusions

From the analysis and findings thereof, the following conclusions can be drawn.

- 1) The LEC system base load is still far below the rated capacity (72 MW) of 'Muela power plant. However, the system load at standard and peak periods exceeds the 'Muela capacity. This is supported by the percentage of time in a month during which the system load falls below the 'Muela rating. The monthly load factors which were just over 70% also show that the full capacity was not utilized throughout the period of a month.
- 2) Load shifting was possible during the four months under analysis as an alternative to the measure of last resort – load shedding. However, LEA notes that load shifting would not have been a straightforward strategy to implement particularly for the commercial and industry sectors due to labour code requirements and administrative logistics.
- 3) In view of the available capacity during the night, other solutions like rechargeable batteries of high capacity could have been employed and recharged during the night and supply the load during the peak periods. This would have however, required appropriate enabling tariffs.
- 4) If the envisaged installation of compact fluorescent lamps by LEC had taken place, which would “build” a virtual power plant estimated at around 15 MW; LEC could have reduced its shed energy by about 1,830,000 kWh (~2 GWh) from this virtual plant during the four months.



## 6. Recommendations

From the findings of the analysis and the subsequent conclusions drawn, the Authority would like to make the following recommendations.

- 1) To avoid load shedding during the 2009 winter, LEC should embark on:
  - a. Educating its customers on conserving and using electricity efficiently as a matter of urgency and the benefits thereof. LEA should also reinforce its role of education which it is already doing through newsletters and public gatherings. LEC would be better advised to prepare a code on efficient use of electricity urgently as this is its licensing condition which is long overdue.
  - b. Educating its customers about load shifting and advocate very strongly for it. Voluntary load shedding during peaks with accompanying monetary incentives should be considered before implementing the involuntary load shedding.
- 2) Demand side and electricity efficiency measures which have a short lead time and are less expensive relative to supply side measures should be the priority of LEC if load shedding is to be avoided (or at least minimized) in the coming and subsequent winters.
- 3) Government should consider establishing a generation entity as soon as possible. This will ensure proper generation planning and building of new plants in the long term.
- 4) A policy on renewable energy sources and accompanying tariffs should also be embarked upon to facilitate building of power plants fired by renewable energy sources.