

SYSTEM LOSSES: THE JAMAICAN EXPERIENCE

OVERVIEW

System losses have been a major operational challenge and focus for the Jamaica Public Service Company for well over a decade. Sustained programmes to upgrade the primary and secondary networks have yielded notable improvement in the level of technical losses. While continued innovation in technology will yield further efficiency gains, that end of the loss spectrum is now within the tolerance band generally considered by the energy industry as acceptable for a utility within an operating environment such as JPSCo's.

Despite several initiatives and sustained campaigns, the Company has had only marginal and modest success against pervasive and pernicious non-technical losses. Electricity theft has had a profound impact on the cost and quality of service that the JPSCo has been able to deliver to its customers. Financially, the cost has been staggering. Based on projected net generation of 3,650,000 MWh for 2003, non-technical losses of 9.5% equates to 346,750 MWh of "lost" energy. Assuming a bus bar cost of US\$0.11/kWh, this "lost" energy will carry a price tag of US\$38,142,500.00.

The regulatory framework within which JPSCo operates allows for a maximum system loss of 15.8%. Losses above this value directly impair the Company's bottom line. While the cost of fuel is generally a direct pass through to the customer, fuel costs incurred in producing incremental electricity above the 15.8% value are not recoverable. Based on a fuel rate of US\$0.035/kWh and 18.5% system loss, the Company's bottom line will be impaired US\$3,450,000.00, during 2003.

While the effect of this increased fuel cost clearly demonstrates the severity of impact on the Company's financial performance, it does not fully capture the cost of these losses. For example, the Company is exposed to increased operational costs, consequential liability and loss of customer goodwill from the degradation in power quality and reliability caused by network intrusion. Neither does the figure tell the story of the tragic cost in human lives and property that often results from attempts at illegal abstraction of electricity in Jamaica.

In presenting the Jamaican experience, this paper will only briefly discuss the technical side of the losses. The focus will rest heavily on non-technical losses which not only has the greatest scope for impact on the Company and its customers but, as shall be outlined later, continues to be a formidable challenge in JPSCo's drive to become a world-class energy supplier.

THE LOSS SPECTRUM

At the end of August 2003, total system losses (technical and non-technical) within the Jamaica Public Service Company (JPSCo) network stood at 18.5%. The technical component of losses was 9.0% with a 9.5% non-technical component. The figure is deterioration on the trend of the past few years.

Overall losses have remained stubbornly high, ranging from a high of 21.38% in 1992 to a low of 16.03% in 1996 in spite of significant revenue protection/loss reduction efforts over more than ten years. Over the past eighteen months losses have risen relatively sharply. The average system loss for 2002 was 17.2%. At year-end 2002 the figure was 17.8%. A marked increase in losses was seen during the latter half of 2002. This has continued well through the first eight months of 2003.

Appendix 1 graphically illustrates system losses from 1993-2002.

While the Company's analysis of the factors behind this negative trend is ongoing, a number of economic factors as well as Company initiatives during the period lend suggestion as to possible causes.

1. The effective cost of electricity rose appreciably commencing in 2001 due to a rate increase coupled with adverse economic conditions resulting in major currency devaluation. More specifically,
 - The economic backlash from the September 11, 2001 strike on the US was only fully manifested in 2002 and Jamaica, like other countries experienced a significant reduction in economic activity for much of the year.
 - Electricity rates went up in 2001 after being constant for over seven years.

2. The Company implemented two major initiatives in mid-2002:
 - Commissioning of additional generation at the Bogue Power Station
 - Launching of a new Customer Information System.

Both Company initiatives are being carefully reviewed to determine whether they have had a negative impact on losses.

(I) Technical losses

While the primary thrust of this presentation is on the efforts to reduce non-technical losses, there have been several ongoing initiatives aimed at trimming technical losses.

Within the past five (5) years, seventeen (17) feeders were upgraded from 13.8 kV to 24 kV, simultaneously increasing feeder capacity while reducing technical losses by 0.80%. Service to a 10,000-kVA customer was upgraded to 69 kV from 24 kV, yielding a 0.38% loss reduction. Distribution transformers added to the system during the period have been of a low-loss design

with some 3000 high-loss distribution transformers being replaced at failure by low-loss units over the period.

Installation of a number of bulk capacitor banks within substations and feeder capacitors, aimed at boosting voltage and reducing technical losses was also implemented.

Insulated secondary conductors (duplex, triplex and quadruplex) are now used almost exclusively. A number of old open secondary circuits have also recently been rehabilitated being replaced with insulated conductor. At the same time, the length of secondary runs has been reduced; the size of distribution transformers was commensurately reduced.

The Company's technical loss spectrum is presently disaggregated as follows:

Generator Step Up Transformers.....	0.3%
Transmission Lines (138/69 kV).....	1.5%
Substation Transformers.....	0.4%
Medium voltage Distribution (24/13.8 kV).....	2.2%
Distribution Transformers.....	1.6%
Low Voltage Distribution.....	3.0%
Total:	9.0%

(II) Non-technical losses

At 9.5% of total system losses, non-technical losses is comparable to that of a number of countries within the development strata in which Jamaica is ranked by the World Bank. Nevertheless, by the industry best standards to which JPSCo has been benchmarked, this level of losses is high.

The contributory factors to losses of this nature are many and complex. Jamaica's less than robust social and economic environment over the past two decades have fostered conditions conducive and encouraging to electricity theft. Simultaneously, weak state law enforcement and several deficiencies in JPSCo's business operations have created opportunities for such losses that have been increasingly exploited.

Contributory factors include:

(a) Social & economic

- Ten-year economic depression
- High rate of unemployment
- Generally high crime rate
- Weak law enforcement
- Relatively low penalty/fine for electricity theft
- Garrison communities phenomenon

(b) Business Deficiencies

- Past unavailability of meters resulting in direct connections
- Collusion by field operatives (Company and contractor)
- Weak internal controls over adjustments to accounts
- Deficient record keeping
- Weak audit procedures
- Improper accounts set-up

(c) Network access

- Large stretches of un-insulated secondary network offering easy access
- Unsealed Meters
- Exposed, energised terminals when meters are withdrawn from service.

INITIATIVES TO DATE

For the vast majority of electric utilities, the non-technical component of system losses is generally due to factors fully within the utility's control, for example:

- Polarity reversal of a current transformer (CT) in a three phase system during installation will result in only 30% of energy consumed being recorded on the customers' meter.
- Improper set up of accounts contribute to significant losses, e.g. a multiplier entered as 60 instead of 600, will result in an account being billed for only one-tenth the actual demand\consumption.
- Potential transformers (PT's), CT's and meters which become defective while in service are also major non-technical loss contributors.

Within Jamaica, the largest components of non-technical losses are due to factors outside of the utility's control.

An analysis of the Company's non-technical loss profile yields the following:

Throw-ups.....	5.2%
Other theft.....	0.8%
Defective equipment.....	3.0%
Incorrect Installations.....	0.3%
Improper account set up.....	0.2%
	9.5%

Disaggregation into the above categories is based on prior analysis of the throw-up phenomenon and statistical data arising from various audits.

In recent years the Company has pursued a “carrot and stick” strategy in its effort to control and reduce commercial losses. These initiatives have distilled to focus on three primary areas:

- Removal of illegal connections (throw ups)
- Tightening of internal controls (including audits of large accounts)
- Conversion of illegal users to legitimate consumers

In 1999, JPSCo established an integrated Loss Reduction Division (comprising up to 72 persons) in an effort to reduce system losses from the then prevailing level. In spite of the Division’s valiant efforts, the anticipated reduction in losses was not realised.

A further reorganisation of the loss reduction effort was implemented at the beginning of 2002 consequent upon the privatisation of the Company. The primary objective of this latest reorganisation is to place greater emphasis on the removal of throw ups, the greater part of the overall problem, and, at the same time, again make core business units more accountable for activities closely aligned with their respective activities.

(i) Removal of throw-ups

Illegal “throw-ups” (wires thrown up and hooked onto the Company’s open, low voltage, secondary conductors) remain the most visible, obvious and public manifestation of non-technical losses. They are also the most prevalent form of electricity theft. In terms of individual energy use this mode of electricity theft ranks a distant second to other more sophisticated versions of illicit abstraction, such as meter bypasses by commercial enterprises and large residential customers in its impact on energy losses. Nevertheless, as can be seen from the analysis, cumulatively throw-ups account for the lion’s share of non-technical losses and the Company has historically placed great emphasis on this mode of electricity theft in its system loss reduction initiatives.

In excess of 30,000 illegal connections were removed from the system allowing for a theoretical, monthly reduction of 4,500,000 kWh of monthly electricity production.

This figure is derived from past efforts which identified and quantified the extent of non-technical losses within inner city “garrison” communities. Master meters were installed at the entrance of several of these communities that were devoid of any legitimate consumer. The number of “throw-ups” within the communities being used to steal electricity was counted yielding an average consumption of just more than 100 kWh per month per “throw-up”.

(ii) Tightening of internal controls

One of the clear weaknesses identified in an early management audit consequent on the change of ownership of JPSCo was the porosity of its internal controls. This presented abundant potential for revenue leakage. Such leakage would be most readily obvious, verifiable and of greatest revenue impact in the large customer rate categories. Audit of these accounts was therefore considered an effective strategy for loss reduction.

The effort resulted in more than 90,000 accounts investigated and close to 30,000 defects corrected yielding more than 2,000,000 kWh of incremental, monthly billing.

(iii) **Gentle persuasion**

The third axis of the Company's strategy was a campaign to convert illegal consumers into customers. This, it attempted to do through a community outreach programme working in conjunction with local political leaders. Inner-city communities, and in particular those identified as "garrison" communities were offered assistance in regularizing their electricity supply in exchange for a minimum number of residents signing on.

In an effort to reduce losses, recover some revenue from these consumers and transition to the normal applicable residential rates a flat rate tariff was introduced in several communities. The flat rate was set at an effective level approximately one-half that of the normal residential rate.

While this effort succeeded in legitimising about 1,600 consumers, it has not been particularly successful as only a handful of these consumers have consistently honoured their commitments.

Given the extremely volatile nature of many of these communities, the normal enforcement mechanism (disconnection of delinquent accounts) cannot be routinely employed, thus weakening the "stick" element of the strategy.

SITUATION ANALYSIS

The most recent organisational refinements are aimed at ensuring past deficiencies are more aggressively addressed.

Audits

Audit of large (R50, R40 and select R20) accounts has been assigned to the audit department. Their mandate is to ensure all R50 and R40 accounts are audited within three (3) months of being set up and annually thereafter. The purpose is to identify and correct record keeping deficiencies (incorrect billing multipliers), meter defects, etc.

Audit of R20 accounts is to be accomplished every five (5) years. Audits not only ensure meters accurately record energy consumed but also that correct potential and current transformer data are used for billing.

These audits have already identified a number of issues that had not been previously noted. In several instances, defects issued for correction had not been acted upon due to a deficiency in the communication protocol. Although this deficiency has now been addressed, some of the outstanding issues are still being corrected.

Meters

The meter ordering process has improved avoiding the need to direct connect customers. Improvement in the meter control process, particularly at customer service centres, is being implemented to minimise the risk of meters being withdrawn from stock and installed without proper authorisation. Particular attention is being given to the timely return of meters to the Meter Department after withdrawal from service.

A large number of installed meters are unsealed. Most disconnections by the Company are performed through contractors but they have not previously been trusted with disconnection seals. The Customer Service Department has undertaken to issue seals to contractors and ensure such issues are strictly accounted for. Implementation is in progress.

A two-month project will shortly be undertaken by the Customer Service Department to ensure all in service meters are resealed. A similar effort attempted some years back was not successful. At that time, withdrawal of each meter, inspection of meter socket internals for shunts and meter testing prior to reinstallation and resealing was required. The process proved extremely lengthy and the effort was aborted without being concluded. Conditions have deteriorated further since that effort.

While sealing of meters without inspection risks the possibility of some by-passes being 'legitimised' behind a company seal, leaving meters unsealed facilitates meter removal and reinstallation without detection with far greater potential for theft. The Customer Service Department will also more rigorously review field inspections and corrections to advancing meters reflecting significant (>100 kWh) monthly consumption etc.

Persistence & Prosecution

While just less than half of the non-technical loss component of system losses is due to the conditions mentioned earlier, the remainder is due to approximately 150,000 highly visible 'throw-ups' providing service to structures primarily within informal, inner city communities. Because of a perception of lack of consequences associated with this practice, the phenomenon has infiltrated into many formal middle-income communities. A much higher profile is now being given to the removal of the throw ups. Several of these raids have received coverage by both the electronic and print media. Arrest and imprisonment of persons responsible, are being pursued to remove the perception of lack of consequences. Additionally, in past times, areas were likely to escape being raided more than once a year. Individuals therefore restored throw-ups shortly after a raid with little chance of being disturbed for another year. The present focus is to not only arrest and prosecute individuals for theft, but also conduct repeated raids into areas to remove the feeling of comfort.

Several individuals, including commercial customers, have already been arrested, convicted and fined under this new thrust.

In some areas the "throw-up" phenomenon appears largely due to less than satisfactory socio-economic conditions. In others the problem appears to be primarily due to prevailing attitudes of lawlessness.

FUTURE INITIATIVES

In addition to continued vigilance and enforcement of the measures outlined earlier, one of the primary strategies now being pursued by the Company is to forge a broader coalition of forces for a renewed thrust at reducing commercial losses. At the centre of this renewed effort is an acknowledgement that many of the factors driving the growth of non-technical losses are outside the ability of the Company to control or influence. JPSCo has therefore initiated a multi-sector, multi-prong approach canvassing support from the regulator, civic society, the political directorate, commerce and the media.

Specific initiatives planned include:

- Enhanced collaboration is planned between the Company's senior management and a number of senior government officials, viz Minister of National Security, Attorney General, and Opposition Leader to secure support of the political leadership for the Company's effort to reduce, if not eliminate, this aspect of lawlessness which is presently prevalent in the country.
- The Securing of a Parliamentary commitment to introducing tougher penalties for electricity theft in new electricity laws being drafted.
- Closer ties will be forged with law enforcement agencies to ensure adequate security protection is available to afford safe passage into and out of garrison communities to address theft problems. These measures are expected to reduce system losses by 2.0%, i.e. from 18.5% to 16.5%, within twelve (12) months.
- Further reduction of about 0.2% will be achieved by further addressing the technical loss component. This will be secured by installing 44,000 kVAR of additional feeder capacitors (22,000 kVAR of which is presently on order) and relocating 18,000 kVAR of substation capacitors to corporate area substations (to be used on a contingency basis during major plant outages), boosting system voltage, hence reducing technical losses. Three feeders, presently operating at 13.8kV, will be upgraded to 24kV, increasing feeder capacity, reducing losses and enhancing load transfer flexibility within the corporate area where most feeders now operate at 24kV.
- Beyond the next few months, it is anticipated that the stigma associated with the risk of arrest, fines, imprisonment, etc., will cause individuals involved in more sophisticated means of illegal abstraction of electrical energy to desist. Progressive audits of more R20 installations and audits of select apartment complexes, comparing cumulative, billed energy consumption to consumption recorded by a temporary, master meter will aid in detecting concealed by-passes and yield further system loss reductions.

- Preliminary investigations indicate that the increase in system losses seen since mid-2002 is partially associated with the Bogue Generation Expansion Project. This has arisen due to lack of appropriate metering of electricity consumed by various station services and units auxiliaries leading to overstatement of net generation. Notwithstanding the absence of metering, an effort was made to take account of electricity consumed. The average consumption by auxiliaries of the Companys' simple cycle combustion turbines is 0.5% of gross generation. The Bogue units' gross production was similarly impaired to yield a net generation figure. Against a background that auxiliaries on CT10 consumes 1.3% of gross generation, the 0.5% impairment is likely significantly understated. Appropriate metering should be in place by end of September.
- A thorough examination of the new Customer Information System is at an advanced stage. The review focused on ensuring that all accounts on the system prior to changeover remained on the system and that billing multipliers, etc were not inadvertently altered.



Appendix 1

Jamaica Public Service Co. Ltd.
System Losses
1993-2002

