

8.1 INTRODUCTION

The Electricity Act 2003 envisaged providing reliable, quality and affordable power to all the electricity users through a market driven mechanism. Under the guidance of India's Ministry of Power, substantial resources and efforts have been spent on improvement of underperforming infrastructure, adoption of new technologies, creating an accountable and introducing competition.

Thus the adoption of a generally accepted and measured set of indicators for monitoring performance will enable to improve the performance of companies and assist in reforms. Here, we propose a set of indicators as a first step which should enable the utility to have more insight into their performance relative to other utilities.

The overall aim is to propose a set of key performance indicators in two stages for the electricity sector which should be measurable and capable of bringing the service quality, financial improvement, better consumer service and helping in overall socio-economic and industrial development. This involves using both quantitative and qualitative indicators.

The objective of setting up of KPIs is to establish the relationship between various business functions, and creating platform on which Balance Business Score Card can be built. KPIs help to understand complex issues and to create a business model. Most importantly KPIs can not and should not exist in Isolation. The purpose of determination and subsequent measurement is to provide the information to all the stake holders in regard of state of affairs.

The company has to decide and select the appropriate KPIs for implementation. It should be decided on performance criterion and keeping in mind the benchmarking competition. In performance benchmarking section, we have seen that there are different Indicators methodologies to be adopted for effective monitoring and to achieve the desired goal.

The KPI accordingly can be classified as partial, specific or overall but the moot question remains which KPIs to be selected in the beginning and which to add on subsequently particularly for a Distribution company where hundreds of KPIs can be defined. Keeping in view this dilemma, we are suggesting that KPIs should be implemented in two stages.

It is also imperative that KPIs should be decided considering local geographical conditions, current state of available infrastructure, resources. However different set of parameters and/or target can be set amongst different user groups' viz. industrial, urban sector, rural sector etc.

8.2 PROPERTIES OF KEY PERFORMANCE INDICATORS

For electricity sector, a variety of measurable KPIs should be identified; defined with a Vision of transforming the Distribution segment so that the wholesome objective of electricity sector reform is achieved. The main properties of these KPIs are stipulated in this section.

8.2.1 Measurability and Measurement Unit

The KPIs can be useful if it is clearly defined and it is measurable. It can be expressed in physical, monetary or qualitative terms. However the properties of some issues make them inherently difficult to measure, e.g. the degree of a regulator's independence, so in the beginning to select KPIs, these Indicators should be avoided and introduced at a later stage, when the system becomes more mature.

Technical aspects should be measured in generally acceptable convention of measurement unit e.g. Voltage in kV. The system level should be defined without any ambiguity in the beginning and responsibilities assigned particularly at cut-off points or where the responsibility changes e.g. Voltage cut-off points in between transmission and distribution. Qualitative aspects of the steps are, however, often the crucial factor in determining the success or failure of reform, but representation of qualitative indicators tends to involve a degree of subjective evaluation and judgement.

8.2.2 Comparability and Consistency

The KPIs should be consistent in definition, measurement method and data assembly. When KPIs are measured over a period of time, they should reveal the progress of the program and brought some insight of the system for MIS purpose so that corrective action can be initiated the management.

The monetary indicators can be compared cross-sectoral but for the consistency purpose, care has to be taken that accounting system should be same across all utilities. The consistency means that all the data of all the units under consideration are available at a predefined interval in the desired format.

8.2.3 Data Collection and Data Analysis

The data source should be reliable and preferably cross checked. For data collection, it should be available at reasonable cost and in minimum efforts. Data should be available consistently and continuously. For data analysis purpose, the data should be disaggregated as per the question being asked.

SAQ 1

a) Explain the importance of KPIs in Power Sector.

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b) Explain the properties of KPIs.

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8.3 CLASSIFICATION AND SELECTION OF BASIC KPIs

All the KPIs should be determined keeping in mind the consumer in the centre. For a business to remain successful and profitable, it is essential to earn a reasonable profit. However it is bound to come if the customer is satisfied and delighted.

For an electricity distribution company, the customer interaction starts from the time when an applicant wants to have an electrical connection. Upon the energisation of connection, consumer requires uninterrupted pure sine wave electricity and quick restoration of supply upon occurrence of a fault. To pay his electricity consumption bill, he requires an error free bill and facilities to pay this bill without standing in queue.

From the DISCOM's perspective, to serve its customer and to keep its promises, it is a mammoth task and it requires adequate infrastructure, resources, availability of quality & reliable power, customer friendly employees, finance, monitoring and control system, a mechanism to address varying degree of issues etc. Most of the factors are controllable by the utility but few factors are beyond its control e.g. availability of reliable and quality power etc. therefore, it becomes even more important to determine, devise and define the KPIs keeping in view the practical aspects and measure only those attributes which are controllable by the utility.

The entire KPI exercise is presented keeping the above mentioned philosophy in helm of affairs.

8.4 ESTABLISH KPIs

Key Performance Indicators

KPIs are a critical tool used in measuring and monitoring operational performance. KPIs are both used to inform those with oversight as well as to help run day-to-day operations of the utility. They allow a utility to track progress of improvement programs and also serve as a flag for areas where service might be deteriorating and is in need of extra attention. They also allow the utility to set targets for improvement within a given year or over the course of an improvement program. In many jurisdictions, utility performance against KPIs is a key evaluation criteria used by regulators in setting tariffs. KPIs can be defined per an internal operating standard, by international standards or a mix, as is appropriate and realistic for the utility. While there is an endless array of potential KPIs that can be established, it is best to focus at first on a small, high level, high impact set of measures. This philosophy matches the approach we take with operational reforms: focus on those areas that have the highest potential for improvement, generating the highest value over the shortest period of time.

In general, there are three main categories of KPIs against which performance is measured: kilowatt-hours, people, and time.

Examples of KPIs that are useful in initiating and sustaining operational improvements are shown in Figure 8.1. While this is not an exhaustive list, it does provide an indication of the type of measures that can be used to keep track of performance improvement progress.

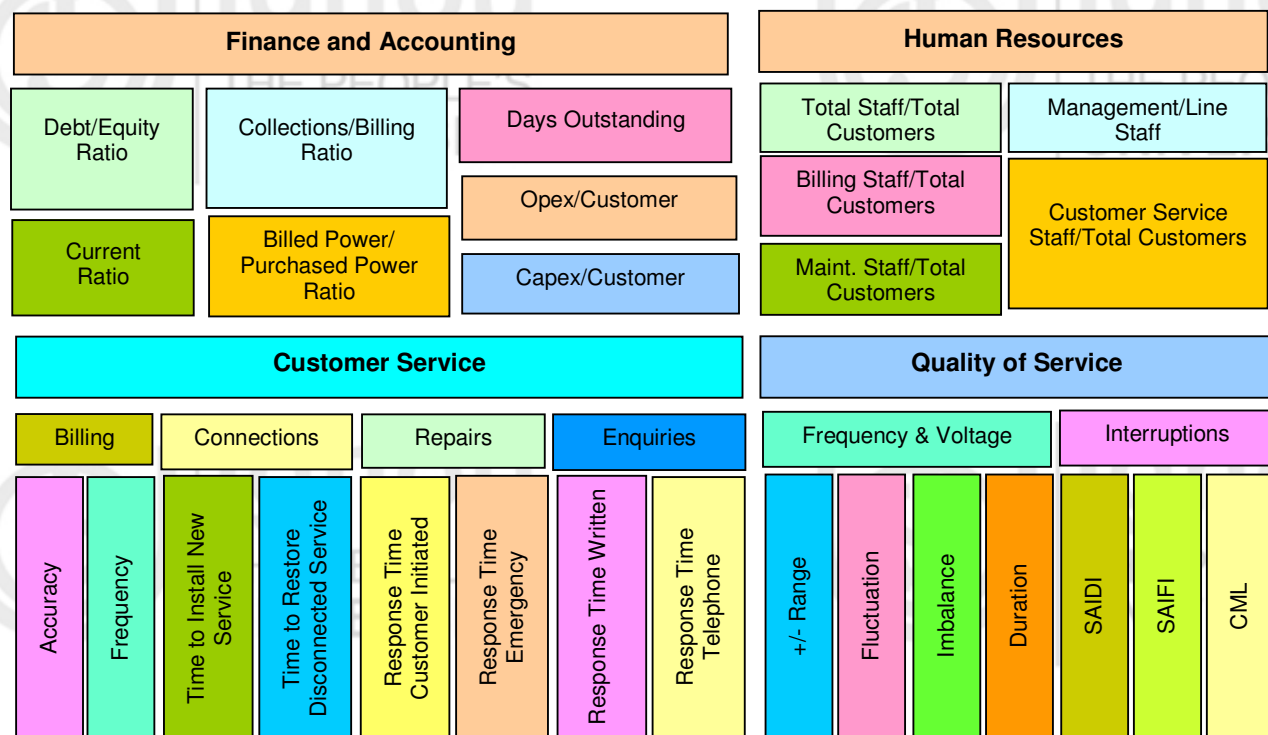


Figure 8.1 : Sample Key Performance Indicators

It is up to the utility to select the appropriate KPIs and add further KPIs as it gains experience and progress. There are certain basic KPIs and other advanced KPIs. Accordingly it is proposed to select and implement the KPIs in two stages.

8.5 KPIs FOR FIRST STAGE IMPLEMENTATION

The KPIs which are to be selected for first stage implementation should be simple, easily measurable and easy to implement. At the same time they should address the qualitative aspects, customer needs and requirements, Business needs and requirements and Human resources. It would help to develop an enabling atmosphere to adopt the changes and involvement of all the concern stakeholders. Accordingly the KPIs are selected in four categories viz. Supply availability & reliability, Cost & profitability, Consumer service and Capacity building.

8.5.1 Supply Availability and Reliability

Reliability is one of the core KPI factor that shape customer satisfaction. Customers' perceptions of reliability are actually shaped by a combination of factors, including voltage characteristics. However, the most visible of these are the continuity of supply factors that manifest themselves in outages, be they momentary or extended. Thus, they may be the most important of the customer service KPIs under the control of the management of distribution companies.

Main Features

The main points related to measuring and regulating continuity of supply are:

- The type of interruption: Planned or unplanned interruptions. Planned interruptions that are not notified may be recorded as unplanned interruptions.
- The duration of each interruption: Short or long interruptions. For example, any interruption that lasts more than ten minutes as a long interruption.
- The voltage levels of faults and other causes of interruptions : Low/ medium/high voltage. The interruption of supply to final customers can originate at any voltage level in the system. Customers connected to low voltage networks (i.e., ≤ 1 kV) are affected by interruptions due to faults in low voltage, medium voltage (MV) and high voltage (HV) networks and transmission networks, while users connected to MV networks are not affected by interruptions due to faults in the LV network. In HV and transmission networks, not all faults cause interruptions to final customers, due to network design.
- The type of continuity indicators i.e., number or duration of outages. The cumulative yearly duration of interruption per customer, generally referred

to as the System Average Interruption Duration Index (SAIDI) indicates how long during the year energy is not supplied (average per customer).

The number of outages per customer in a year, termed System Average Interruption Frequency Index (SAIFI), indicates how many times in a year energy is not supplied. Some customers are more sensitive to the cumulative duration whereas others are more sensitive to the frequency of outages.

Key Performance Indicators

8.5.2 Supply Availability and Reliability – Proposed KPIs

KPI	UOM	Measures	Representative Standards
SAIDI- System Average Interruption Duration Index	Hours	$\frac{\Sigma (\text{Duration of outage}) \times (\text{Number of Customers affected})}{(\text{Total Number of Customers})}$	2 Hours
Distribution Transformer (DTR) failure	%	$\frac{(\text{Number of DTR failure during a year}) \times 100}{(\text{Average Number of DTRs during the year})}$	0.5%
CAIDI – Customer Average Interruption Duration Index	Minutes per Occasion	$\frac{\Sigma (\text{Customer Interruption Durations})}{(\text{Total Number of Customer Interruptions})}$ = SAIDI/SAIFI	90 Minutes
OH/Cable failure rate	Faults per 100 ckt-km of 11 kV line	$\frac{\text{Number of Faults during a year} \times 100}{(\text{Total 11 kV circuit kilometer})}$	2 Numbers
SAIFI- System Average Interruption Duration Index	Number	$\frac{\Sigma (\text{Number of interruptions}) \times (\text{Number of Customers affected})}{(\text{Total Number of Customers})}$	1.3 Instances

SAQ 2

(a) What should be the basis of selection of KPIs in your Power Business Organization?

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(b) List the KPIs for supply availability and reliability. How relevant these KPIs in the context of your organization?

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8.5.3 Cost and Profitability

The cost of per unit of energy is a very vital ingredient to determine the customer satisfaction. Though the consumer is ready to pay little higher tariff but he sees the value for every penny spent on that. Moreover Regulator does not allow any untoward cost and it eats the profit. The cost and profitability are actually shaped by a combination of factors, including O&M expenses, Technical and Commercial losses, and Collection efficiency.

Main Features

The main points related to measuring and regulating cost and profitability are:

- **The present loss level and trajectory to reduce the loss:** The per unit of cost delivered to the consumer is delivered by the quantum of prevalent loss level and the losses allowed by the regulator for that year. It is very important to constantly monitor the loss and take corrective actions immediately by technological and/or administrative mechanism.
- **Unaccounted Energy:** The health of the metering system to be monitored constantly. Any meter out of circuit meaning not recording the correct energy should be replaced/rectified immediately or within the stipulated turn around time. The meters are not available across many utilities particularly for Rural, Domestic, Agriculture and Street Light connections. It becomes more necessary to define a path to achieve the 100% metering status and till such time access the quantum of energy consumed in terms of the per unit connected load through sample study.

- **Collection Efficiency:** In this era of Information revolution, consumer wants better avenues for payment and their billing related complaint redressal. The efforts should be directed towards facilitation to the consumer so that they are motivated to make the payment and not harassed by standing in long queues. The collection efficiency ultimately decides both – the cost and profitability.
- **Operating Expenses:** i.e., the cost incurred by the Utility towards Operation and Maintenance to supply the energy. It is generally expressed in per unit. This cost should be benchmarked against the international standards and efforts to be put to reduce it.

Cost and Profitability – Proposed KPIs

KPI	UOM	Measures	Representative Standards
Aggregate Technical & Commercial Losses	%	$\frac{\text{Energy Realized}}{\text{Energy Import}}$	8%
End to end Money Flow Efficiency	%	$\frac{\text{Collection Deposited In Bank}}{\text{Energy Delivered to the Division (Monetised)}}$	92%
ROCE – Return on capital employed	%	$\frac{(\text{Profit before Interest \& Tax})}{(\text{Long term loan + Equity})}$	16%
O&M Expenses per unit of energy Input	Paisa per Unit	$\frac{\text{Total O \& M expenses}}{\text{Total energy imported}}$	10 Paisa per Unit

8.5.4 Consumer Service

The consumers are becoming more and more demanding on each passing day. The Regulators have started imposing the minimum service standard levels with penalty. For the business to be successful and to remain successful, the satisfaction through better consumer service is of paramount importance. The satisfied and delighted consumer is a great asset for any company and has direct bearing on the bottom line of the company's balance sheet. The list of consumer services is endless particularly for a DISCOM, however to begin with it is shaped by a combination of factors viz. Response time, Staff Attitude, Willingness of the staff, Customer Satisfaction Index etc.

Main Features

The main points related to measuring and regulating consumer service are:

- Response Time:** The consumer wants that the intended service should be provided by their service provider within the stipulated time. For a consumer or a prospective consumer, he wants that the new service connection to be provided at a minimum possible time, if there is any supply outage complaint, it should be resolved as early as possible. Similarly he wants that he bill delivered to him should be error free and in case of any error/dispute it should be resolved amicably and as fast as possible. It becomes imperative for DISCOM to define the minimum stipulated time frame for each kind of service, monitor the outcome on daily basis, generate exception reports and take corrective actions. If necessitates, bring he changes in the processes and adopt new technologies.
- Customer Satisfaction:** The periodic customer satisfaction survey should be a part and parcel of every DISCOM. It provides a valuable insight about the present capabilities and the consumer expectations. A roadmap can be formulated to address the issues which are in control of the management.
- Staff Attitude:** It plays a very vital role in any service industry. A proper training plan and calendar can be prepared to address this vital aspect. Human resource is very important gradient for any business and it determines the success or failure of the business. It is invaluable asset. The attitudinal training should be provided for each employee irrespective of his/her hierarchical position.

Consumer Service – Proposed KPIs

KPI	UOM	Measures	Representative Standards
Customer satisfaction index	% of customers, somewhat or very satisfied	$\frac{\text{(Number of customers expressed satisfaction)}}{\text{(Sample size of customers interviewed)}}$	100%
Number of voltage complaints	No	Number of complaints received in a month	Nil
% billing complaints resolved within regulatory time limits	%	$\frac{\text{(Number of complaints resolved within regulatory time limits)} \times 100}{\text{(Total Number of complaints)}}$	100%
% of new services provided within three days	%	$\frac{\text{(Number of new service connections provided within 3 days)} \times 100}{\text{(Total Number of applications received)}}$	100%

8.5.5 Capacity Building

DISCOMs have to not only manage the day to day operations but also manage the explosive growth, so it is dual task. At the top of it, consumers are becoming more and more demanding, resulting which DISCOMs require additional capabilities. The capacity building may be creation of assets, performance improvement or human resources skill upgradation. In this section, we are concentrating only on Human resources skill upgradation aspects.

Main Features

The main points related to measuring and regulating consumer service are:

- Business Function:** The consumer is the fulcrum for today's business; every strategy needs to be built keeping in view this fulcrum. Consumer does not know about the departments, roles and responsibilities of any individual, internal processes impediments etc. within the company, he wants a superior qualitative product/service at a low cost within the shortest possible time frame. It creates the need for the organization to work in a cross functional team rising above the cage of traditional thinking and produce versatile managers conversant with different functions and ready to take extra burden on their shoulder to meet the customer requirement. It does not obviously come through as a God gift, neither as learning provided in academics nor by virtue of simply doing the job with full honesty and versatility. It has to be created and developed by imparting the training.
- Training Plan and Calendar:** Nothing can be achieved if not properly planned and executed. Every organization should prepare a training plan, allocate resources as per the plan and maintain a calendar for its implementation and monitoring.

Capacity Building – Proposed KPIs

KPI	UOM	Measures	Representative Standards
Percentage of Employees having attended Electricity Distribution Business – Operation/Engineering Aspect Related Training	%	Planned versus Actual	100% (For that segment of employees)
Percentage of Employees having attended Electricity Distribution Business – Commercial/ Finance aspects Related Training	%	Planned versus Actual	100% (For that segment of employees)
Percentage of Employees having attended Electricity Distribution Business – Management Aspect Related Training	%	Planned versus Actual	100% (For that segment of employees)

SAQ 3

How you are going to apply KPIs related to cost, consumer service and capacity building in your organization? Explain.

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8.6 OTHER ASSOCIATED KPIs FOR SECOND STAGE IMPLEMENTATION

8.6.1 Commercial Quality Standards

These KPIs deal with the quality of the relationship between a supplier and a user (customer). They are important to potential customers when they request information or ask to be connected to the network. Commercial transactions between a company and a customer may be classified as follows:

- Connection to the network – time frame;
- Price associated with the supply – tariff schedule;
- Customer query response – turn around time to pick up the phone call;
- Meter reading;
- Accuracy of estimated bills;
- Accuracy and timeliness of actual bills;
- Meter testing;
- Billing anomaly reduction and rectification; and
- Payment arrangement.

Commercial Quality Standards – Proposed KPIs

Key Performance Indicators

KPI	UOM	Measures	Representative Standards
Number or actual meter readings within a year	%	Planned versus Actual	Say 99% of meters will be read at least six times each year on bi-monthly billing cycle
Cutoff at customer's request	%	Number of Cut-offs executed within 10 working days/ Total cut-off request received	Say 99% compliance within 10 working days
Voltage complaints	%	Number of complaints attended to within 10 working days/ Total voltage complaints received	Say 99% compliance within 10 working days
Outage Response Time	%	Number of complaints attended to within 8 hours in rural area / Total complaints received in that segment	Say 99% complaint attended to within 8 hours in rural areas
Estimating Charges	%	Number of estimates provided subsequent to inspection within 7 working days / Total Estimates request received	Say 99% compliant within 7 Days from the date of survey for simple requests
Meter Problem response Time	%	Number of meter complains attended to within 15 working days / Total meter complaints received	Say 99% complaint within 15 working days

8.6.2 Consumer Interaction and Service Standards

These KPIs deal with the customer, internal business processes and change management. These are important to provide the desired services at predefined standards and to monitor the quality. These indicators also give insight about the consumer satisfaction level.

KPI	UOM	Measures	Representative Standards
Queries on Charges and Payments	Time	Number of occurrences	Say Reply within 10 working days
Reconnection after disconnection for non-payment	%	No. of reconnections effected by 5 p.m. the day following payment / N. of reconnections request received	Say 100% compliance by 5 p.m. the day following payment
Maximum waiting time in a Customer Service Center	%	No. of customers served within 30 minutes / Total number of customer served	Say 90% of customers served within 30 minutes
Time to Answer Customer Service Telephone	%	No. of times customer telephone calls attended to within 60 seconds / Total no. of customers call received	Say 75% within 60 seconds
Notice of Supply Interruption	%	Planned Versus Actual	Minimum 24 hours before planned interruption
Response to Customer Letters	%	Planned Versus Actual	100% within 10 days

8.6.3 Voltage Quality Standards

The term voltage quality (or power quality) is an umbrella concept for a variety of disturbances in a power system. The quality of delivered electricity is difficult to define and quantify. The quality is mainly determined by the quality of the voltage waveform as it is impossible to control the currents drawn by customer loads. Voltage quality is not only the responsibility of the network operator but also, in certain respects, depends on producers and customers. Generally, voltage quality covers a range of factors including interruptions.

There are several technical standards for voltage quality criteria, but in the end the quality is directly and indirectly determined by the ability of customer equipment to perform properly. However customer awareness about power quality is highly subjective. A good definition of voltage quality should

therefore incorporate the impact of the (lack of) quality on the customer. In practice technical parameters like frequency, voltage level or harmonics are used to indicate the voltage quality. Although definitions are not fully consistent in standards, the most relevant quality phenomena are the same.

For power systems these phenomena are:

- Frequency variations;
- Fluctuations of voltage magnitude;
- Short-duration voltage variations (dips, swells and short interruptions);
- Long-duration voltage variations (over- or under-voltages);
- Transients (temporarily transient over voltages);
- Unbalance; and
- Interruptions.

Importance of Voltage Quality

The voltage quality has a growing economic impact on the customer and the network operators. The costs associated with “lack of quality” can be large, especially for industrial customers.

Usually voltage quality is considered at the customer’s connection point. However, the reasons for the growing importance of voltage quality lie not within the power system itself but are closely related to the developments in customers’ equipment. Some important examples are:

- customer equipment contains more microprocessor controls and power electronic devices which can be sensitive to variations in voltage quality;
- the growing importance of higher energy efficiency has led to an increase in the number of adjustable motor drives and shunt capacitors which generate harmonics on the power system;
- processes and equipment have become more interconnected and interrelated which can make them more vulnerable to failure of one component;
- customers are becoming more aware about the issue of voltage quality and becoming more demanding in that respect.

Utilities want to meet customer demands and expectations. With the introduction of competition between them it is important for a utility to maintain its customers’ confidence. Where the financial consequences of solving voltage quality problems affect the economic position of the network operator, voltage quality becomes an issue for the regulator.

KPI	Representative Standard for Low Voltage	Representative Standard for Medium Voltage
Frequency	49.5-50.5 Hz (99.5% of the year) or 47-52 Hz (all year).	49.5-50.5 Hz (99.5% of the year) or 47-52 Hz (all year).
Magnitude	Un +/- 10% (95% of the week, 10 min. RMS) Un + 10% to – 15% (100% of the week, 10 min. RMS).	Un +/-10% (95% of the week, 10 min. RMS).
Fluctuations of Voltage Magnitude	+ 5% up to + 10% some times per day Flicker: Plt ≤ 1 (95% of the week).	+ 4% up to + 6% some times per day Flicker: Plt ≤ 1 (95% of the week).
Voltage Unbalance	U – ≤ 2% (95% of the week. 10 RMS); 3% in some areas.	U -≤ 2% (95% of the week. 10 RMS); 3% in some areas.
Voltage Dips	Indicative : up to a few tens to up to one thousand.	Indicative : up to a few tens to up to one thousand.
Short Interruptions	Indicative : up to a few tens to up to a few hundred.	Indicative : up to a few tens.
Long Interruptions	Indicative : (interruptions > 3 min) annual frequency 10 up to 50, depending on area	Indicative : (interruptions > 3 min) annual frequency 10 up to 50, depending on area.

8.6.4 Finance and Accounting

Every business is done to earn some profit and it is the underline concept. The major tasks is to maintain the finances effectively to meet the future requirement, to earn profit and to incur the cost prudently. It also provides a trigger whenever any expense goes out of gear. These are expressed in ratios, expenses per unit of output etc.

Finance and Accounting – Proposed KPIs

Key Performance Indicators

KPI	UOM	Measures	Representative Standards
Debt/Equity Ratio	%	Ratio	Say 2:1
Collection/Billing Ratio	%	Total Collection Amount / Total Billed Amount	Say 98%
Days Outstanding	Days	Time	Say 55 days for monthly billing cycle
Operating Expenses / Energy (kWh)	Paisa per unit	Planned versus Actual	Say 10 paisa per Unit

8.6.5 Human Resources

It is the responsibility of management to have the lean, efficient, customer friendly organization which strives for catering to diversified need of all the stakeholders. The productivity should be measured with respect to each employee and it should be benchmarked with respect to past performance and with the industry best.

Human Resources – Proposed KPIs

KPI	UOM	Measures	Representative Standards
Total Staff / Total Customers	%	Planned versus Actual	99%
Billing Staff / Total Customers	%	Planned versus Actual	99%
Maintenance Staff / Total Customers	%	Planned versus Actual	99%
Customer service Staff / Total Customers	%	Planned versus Actual	99%

SAQ 4

a) Explain the inter-relationship between first and second stage of KPIs.

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b) Explain the process of implementation of KPIs related to finance, accounting and human resources in any DISCOMs.

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8.7 SUMMARY

This unit attempts to explain the importance of Key Performance Indicators (KPIs) in the business of power specially in a change environment due to partial deregulation. The KPIs must possess certain characteristics to be effective in reality.

A framework of two-stage model has been suggested for the successful implementation of KPIs in the organization. The KPIs related to supply availability, reliability, cost, profitability and consumer service are to be implemented at the first stage. In the second stage, the KPIs for commercial quality standard, voltage quality standard, service standard, finance and human resources can be implemented.

In other words, the KPIs are trying to standardize performance of the organization in power business through various parameters. This process of performance measurement will not only ensure the economic viability of the power utility organizations but also helps to enhance the satisfaction of power consumers.

8.8 TERMINAL QUESTIONS

Key Performance Indicators

1. Elaborate the important properties require for key performance indicators.
2. Explain the KPIs for supply availability and reliability.
3. What are the main features expected for KPIs related cost and profitability?
4. Explain the KPIs for commercial quality standards.
5. Elaborate your understanding about voltage quality standards.
6. Briefly explain KPIs for finance and accounting and human resources.