Energy Management Consultation and Training Project
Demand Side Management Activities
(EMCAT-DSM)

DSM At Tamil Nadu State Electricity Board: DSM Cell Structure and Training Plan

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Executive Summary

The purpose of this plan is to outline how Demand Side Management (DSM) planning and training activities should be carried out at the Haryana State Electricity Board (TNEB). The Government of Haryana, with the active assistance of the World Bank, DFID, USAID, OECF, KFW and other financial institutions, has embarked upon a comprehensive program to restructure TNEB. Along with regulatory reforms, the program will foster a variety of operational efficiencies, including the introduction of DSM.

Experience in the United States has shown that a number of factors – from having an adequate technical infrastructure to behavioral changes - are needed if DSM efforts are to succeed. Our review of Haryana's system shows that voltage stability is so poor that many efficient technologies would not perform unless the distribution system is improved. In fact, equipment is overbuilt, sacrificing efficiency, to withstand the massive voltage swings. Some industries have postponed investing in better, more efficient equipment because voltage and frequency stabilizers would be needed. In addition, both commercial and technical power losses are substantial due to the poor distribution system, so improving the distribution system can provide speedy returns on investment. An improved distribution system will also create an environment conducive to end use efficiency.

Given these findings, the DSM planning process at TNEB must be integrated with distribution planning and loss reduction strategies. DSM programs should <u>not</u> be implemented <u>until</u> distribution efficiencies have been gained through line upgrades for loss reduction, capacitor installation, and improvement of power quality and voltage stability. These improvements will decrease costs, increase revenues, and set the stage for effective DSM efforts.

The need to improve the quality of distribution is consistent with other analyses of power sector restructuring and DSM in India, as well as TNEB's own efforts. The Ministry of Power's March 1998 *Report of the Committee on Private Sector Participation in Power Distribution*, states that "substantial up-gradation of the [distribution] system may be necessary to provide quality supply to consumers (p.75)." Roger Peters' report to the World Bank emphasizes the importance of making distribution system improvements before installing efficient technologies. And, to its credit, TNEB is aggressively pursuing distribution efficiencies.

Clearly, the need for distribution improvements to precede – and to be integrated with - DSM differs radically from the DSM environment in the United States, where high reliability and voltage stability are generally assumed. This, however, is not the only difference between the two DSM environments. In the U. S., planning processes for generation, transmission and distribution were already securely established when DSM came along. Energy and demand savings could thus be factored into those processes. Unfortunately, current planning processes at TNEB are mostly ad hoc, based on minimal information. Most of the basic utility planning data is absent. Accurate forecasts of demand and energy are needed to provide enough time to plan and construct power plants, and transmission and distribution systems. This same data is needed for planning DSM activities.

Thus, TNEB faces significant challenges – and heavy demands on its resources - as it moves toward DSM. Thus, we recommend that during the first year of operation the DSM Cell should set realistic and achievable goals that will benefit not only DSM but the utility as a whole. We recommend that TNEB hire one research analyst to accomplish the following goals:

- Develop the basic data needed for good utility planning and for regulatory reform (which can also be applied to DSM efforts)
- Develop an integrated communications plan to inform their customers about regulatory reform and energy usage
- Complete the feasibility studies for the DSM projects

Based on this DSM Cell scenario, training for TNEB in the first year should include:

- Basic utility planning processes and data requirements for Board members and Chief Engineers
- Specific forecasting and load research issues, at a general level for management and at a more specific level for the research analyst.
- An overview of DSM
- A visit to a regional or U.S. utility with best practice planning processes and successful DSM programs

In the second year, the DSM Cell should hire more staff to focus specifically on DSM issues. These staff would prepare specific DSM end use and market data, choose and design DSM programs, and potentially implement DSM programs. DSM training in the second year would address specific program designs, the role of market research and evaluation, and DSM financing, performance contracting and bidding.

1. Mission and Purpose of DSM at TNEB

Currently, Haryana faces severe power shortages with capacity and energy deficits as high as 40% and 20% respectively. Even with the rehabilitation of existing capacity and addition of new capacity, shortages will occur again within three years. In addition, the “real” uncontrolled and self-generated demand is not really known. Energy efficiency and load management on the customer side of the meter is an appropriate component of an efficient power supply system and an essential element to integrate into the future generation or power supply plans for TNEB.

In addition to postponing the need for generation or power purchases, Demand-side management can, under appropriate conditions, be targeted in areas requiring transmission and distribution upgrades. In this scenario, the demand reduction potential may provide an opportunity to postpone or change the nature of the planned system upgrade.

Energy efficient technologies, procedures and behavior changes can result in energy and demand savings. Large energy-saving potential exists in the agricultural and industrial sectors. Load management potential exists in the municipal sector. Also, the potential exists for using industrial self-generation as a load management tool.

In the short-term, DSM programs can provide emergency load relief, increase revenue from higher rate classes and extend service to more customers. In the medium-term, it can provide a lower cost alternative to new generation and power purchases and possibly postpone or alter T&D investments. It is essential, however, that before major investments are made in DSM, the distribution system must be upgraded to minimize losses on the utility side and to provide voltage stability for customers. Therefore, the development and implementation of DSM at Haryana should be integrated with distribution system upgrades.

2. Current Planning Processes at Haryana

Planning Processes

<u>2.1 Generation planning</u>

The TNEB currently has adequate but somewhat inaccurate information upon which to base its generation planning. The system is unable to satisfy customers' needs for an uninterrupted supply source. There is much self-generation by industry with diesel as the primary source. Anecdotal evidence indicates that many industries would prefer to have their electricity provided by the utility but the power is simply not available. A power requirements study was conducted by Price Waterhouse in 1997 for T&D. What that forecast was based on can not be determined until a copy of the report is received. It appears that Price Waterhouse completed a forecast and then inserted the Board's power supply plan, since the plan does not show the generation meeting the forecasted need plus reserves.

What is Known

Forecasted Demand - The recorded peak load was projected by Price Waterhouse to reach 2917 Mw in 1998 and 3772 Mw by 2002. The assumed unrestricted demand is currently estimated at 3200 Mw.

Power Supply Plan – The load factor of the current power plants is still very low, though it has increased from .4 to about .6. Current known capacity equals 2392 Mw. Additions of power plants, shares of plants and refurbishment of existing plants are planned for 1998 and 1999. The installation dates of these plants were moved up in time from 2001 and 2002 to 1998 and 1999. The share of one the Indian Oil plant, was also increased. These planned additions and refurbishments include:

- A 25 Mw liquid fuel plant commissioned by April, 1998
- Renovation of 4 110 Mw units to 270 Mw in 1998
- 210 Mw thermal plant at Panipat in 1998
- Two gas plants totaling 292 Mw by March 1999
- A 301 MW share of the Indian Oil plant (available in 1999?) – Increased from 240 MW

The additional capacity equals 875 Mw in 1998 and 593 MW in 1999, for a total capacity of 3792 in 1998 and 4385 MW in 1999.

The Ability of Generation to Meet Forecasted Demand – The Price Waterhouse report showed continued capacity deficits (including needed reserves) beginning in 1998. With the accelerated generation plan, based on the projected demand growth rate in the Price Waterhouse report, demand (including a 15% reserve) would outstrip supply again in 2001.

What is Not Known

The uncontrolled current and future load shape and unrestricted demand is not known since rolling power curtailments occur as a matter of course, especially in the summer. In order to determine the appropriate mix of generation, the "true" current and future load duration curves for the utility are needed.

2.2 Transmission and Distribution planning

The Transmission planning process was not transparent during the project team visit to TNEB. It appears that transmission planning would be based on the Price Waterhouse report forecast with transmission losses added. According to Paul Lavigne, the Electrical Engineer on the project, the Transmission system seems to be in good shape, and, if generation were adequate, would currently be able to deliver the power needed by the distribution system. How the need for future Transmission lines or upgrades is determined is unknown.

Distribution planning is based on virtually no information. No processes exist for the Circles to know what is driving the load. At the one distribution station which IRG staff visited, the TNEB Junior Engineer said he walks around town noticing the changes in electricity-using equipment in homes and on the farms and guesses what the growth will be.

The best evidence that load is greater than the lines can handle is the number of transformers which have failed. A detailed log is available in paper form at each distribution Circle. At Kurekshetra/Kaithal/Kanal, 7-8 transformers burned out in the last 2-3 months on domestic feeders with 100 transformers total failing in the entire division.

What is Known

Current restricted load at each substation is known.

What is Not Known

Though the central TNEB office commissioned the forecast by Price Waterhouse, projections by substation and for the distribution Circles and Zones were either not included in the report or not communicated to the distribution engineers.

2.3 Revenue Requirements planning

It is not clear how revenue requirements are forecasted at TNEB. It appears that requirements, though required to be directed by the provisions of Section 59 of Electricity (Supply) Act 1948, are based on the minimal amount needed to cover salaries and fuel costs with no projections made for future investments in the generation, transmission or distribution system. The rate tariffs which exist are different for domestic, industrial and agricultural sectors and are based on some knowledge of fixed and variable costs.

What is Known

The TNEB currently know what they need to recover in rates to cover salaries and fuel costs. Demand and load shape information is available for industrial loads on primary (HT) feeders.

What is Not Known

It is not known whether the rate tariffs which exist reflect the costs of serving those loads since sector load shapes are not available except for the largest customers. And though load data is available for industrial loads, cost of service studies have not been performed on this data.

<u>2.4</u> <u>Data Available for DSM Planning</u>

Since processes do not currently exist for DSM planning, the main issue examined here is availability of data required to conduct DSM planning. Data needs for DSM planning include sector load shapes, end-use load shapes, billing data to develop load shapes and conduct impact evaluations, forecasts of utilty load duration curves, avoided/marginal costs of future generation based on the generation plan to meet forecasted unrestricted requirements, and forecasts of revenue requirements.

What is Known

i). Billing Data

Billing data is available for domestic, industrial, commercial, municipal and some agricultural loads. At Kurekshetra, 56,000 out of 65,000 (86%) of the agricultural customers are on flat rates with no meters. Those customers on the metered rate run their equipment about 5 hours per day; those on the flat rate, about 12 hours per day.

Also at Kurekshetra, the only sector for which billing data is computerized is the domestic sector. For agriculture and industry, the billing data is written manually. Also, since only meters above 70 kw are electronic (tamper-proof) meters, the billing data for the meters below 70 kw is not completely reliable. Data available from the billing records includes a code, a meter#, consumer name, feeder type, meter reading date, due date and date paid.

ii) Sector Load Shape Data

Demand meters are available for the large industrial loads (served by HT - primary - lines). Therefore, this is the only sector for which load shape data is available on an individual unit level basis (ready consolidated picture for all the industries put together is not available, but will need to be developed). Since tamper-proof meters are installed on loads > 70 kw, and it is likely that all of the loads on HT lines are above 70 kw, this data could be considered good data.

iii) End-Use Saturations and Load Shapes

When people sign up for service, they must provide their connected load on the application form. This is verified by an inspector. When people add load, they are supposed to complete an extension of load application. If a meter reader discovers that the connected load is greater than what is on the records, this is reported. Sometimes, the application is denied because there is not enough power to supply it. Penalties often apply if the ratings are greater than what is on the original application form. The information from these forms is kept on computer. Because of this process, saturation data is easily available.

Typical equipment for agricultural customers includes either 3-15 hp tubewells. Some also have 15 hp threshers. Industrial customers include, in order of highest to lowest connected load: Iron and Steel, Textiles, Vehicles, Glass, Chemicals, Machine Tools, Pulp and Paper, Agro Processing, Rubber, Railway Workshop.

The following information, though anecdotal, can be compared to official connected load data and includes operating characteristics of equipment and consumer attitudes. This type of information is useful in prioritizing market research and load research needs:

> In a line of about 15 domestic consumers paying their bills a Kurukshetra there were basically two types of domestic customers: high income and low income. Lower income consumers typically possess 2 fans which run 24 hours and 3 bulbs which run from 6-10 p.m. Some of them also own a Television which runs from 6-9 pm and plug loads such as an iron. High income consumers typically own 3 bulbs, two fans, a small refrigerator and a geyser (electric water heater), although water heaters are less common. Water heaters are turned on only in the morning. One of the high income consumers said she would rather heat her water on the stovetop with gas than buy an electric geyser because they are too expensive to run.

What is Not Known

i) Billing Data

For industrial loads, it is unknown what the usage would be if there were a continuous supply. Since the meters are not tamper-proof, the billing data is not completely reliable. Since most of the agricultural load at Kurekshetra is unmetered, no billing data is available. And since supply is currently restricted to only 6-8 hours per day, it is unknown how the pumpsets and tubewells would run if there were continuous power available.

ii) Sector Load Shapes

With loads below 70 kw for which demand data is not available, load shapes are not available.

iii) End-Use Saturations and Load Shapes

No survey data exists which indicates the time of day that the home appliances or industrial loads operate or when the agricultural tubewells and pumpsets would operate if they were given power 24 hours per day rather than 6-8 hours per day. And because meters are easily tampered with, loads are often being served which are not on the utility's records.

iv) Avoided Cost Data

Avoided cost data does not currently exist for Haryana. A study was done by Hager Bailly Consulting for Ahmedabad Electric Company, as part of the AID Sustainable Cities program, which calculated avoided costs to analyze DSM. Although the methodology used may or may not be appropriate for TNEB, the categories of avoided costs are probably appropriate. These categories include avoided energy costs, avoided system demand and power purchase costs and avoided T&D costs. The future mix of generation as well as the operating characteristics in meeting unrestricted demand and energy forms the basis of avoided costs used to analyze cost-effectiveness of Demand-side Management alternatives. Without load shapes for unrestricted total demand and the impact on T&D, avoided costs for generation, transmission and distribution are not easily calculated.

3. Planning Processes in United States Utilities

The Genesis of DSM

Planning processes in the United States utilities for generation, transmission and distribution needs were well developed by the 1930's. The utilities have been successful at identifying the most economic generation plant options and the most economic investments in transmission and distribution to meet legal standards and provide quality, reliable power. A New Integrated Resource Planning process was put in place by regulators in the 1980's to improve planning processes to address economic efficiency and environmental policy issues.

The need for generation has changed since then, but utilities have continued to develop DSM programs to satisfy state regulatory requirements, to provide good customer service and to reduce costs. Through the years of developing and implementing IRP's, the utilities learned that DSM has value in building customer relationships. The regulators learned that it is important to let the market make decisions based on clear price signals, and that the market should drive the need for generation rather than the government.

Planning processes in U.S. utilities have become increasingly sophisticated since the 1930's. Forecasts are based on sophisticated econometric models, and computer models are used to evaluate multiple options for power plants and transmission/distribution system upgrades and additions. Processes are also in place for planning preventive maintenance.

In the 1980's, utilities began to include nuclear plants in their plans. At that time, many states were not allowed to recover the costs of plants through the rate-setting process until after the plants were built. For various reasons, the plants became extremely expensive between the time they were first planned and when they were installed. Regulators came to two conclusions relative to utility planning processes: 1) Demand-side management, which includes promoting energy efficiency on the customer side of the meter and controlling customer loads through load management, was a less expensive way to meet growing needs for demand and energy and 2) A new planning process was needed to compare power plants and demand-side management on an equal basis and allow for approval of plants before they were built. Economic efficiency as well as reduced environmental impacts were both policies which drove the requirements of utilities to implement energy-efficiency programs.

Many utilities had already been providing customer service energy efficiency programs and cost-reducing load management for many years. Many investor-owned utilities, especially integrated gas and electric utilities, provided informational brochures, energy audits and community presentations. Some of these activities, such as residential audits, were required by law. For many cooperatively owned electric-only utilities, load management has played a major role since the 1950's. These companies were seeking ways to reduce capacity costs and maintain or increase energy sales, with the goal of reducing electric rates.

Beginning in the early 1990's, some states passed legislation which required a pre-set level of spending on DSM activities or a specific level of savings to be achieved. Programs began to evolve from information-only programs to those which could be easily tracked as to their demand and energy-saving impacts. In addition to requiring evaluation of DSM against generation alternatives, some regulators required utilities to evaluate demand-side management in targeted areas to postpone or alter plans for specific T&D investments. Since T&D projects driven by load growth are most often built to serve peak demand and not energy, the most appropriate options are usually programs which control or shift peak load (load management).

In many areas of the United States, there was a reduced need for power plants at the same time that IRP was introduced. Although the need for generation was reduced, many state regulatory agencies still required utilities to achieve energy efficiency savings. The ability to meet the savings goals was a factor in allowing cost recovery in rate tariffs.

Initial DSM plans were technology driven as required by regulators. Since most utility employees first transferred to DSM planning were engineers, these technology-driven programs and processes were initially appealing. But there were many problems with the process which resulted in unsuccessful programs. With the advent of retail competition, extremely low load growth and low cost of generation, some utilities and state regulatory agencies have adopted more simplified approaches to IRP. Also, many utilities are now approaching DSM as a customer service to develop customer loyalty and attract new customers rather than as merely a way to meet the forecasted needs of serving a fixed service territory. This is seen as an important component of preparation for retail choice. With these changes, as well as the experience which comes from DSM successes and failures, more market and customer-driven processes and programs have emerged.

IRP and DSM Planning Processes

While DSM is one aspect of IRP, it includes more than DSM programs. An IRP will usually include many supply-side measures, ranging from traditional power plants to more innovative sources of electricity supply such as power purchases, independent power producers (IPP's), cogeneration and renewable energy sources.

IRP processes can be as simple as subtracting the demand and energy reductions of DSM programs from the original forecast (assuming a similar load shape) before making final generation plans. They can also be very complex, involving multiple scenarios designed to meet multiple criteria, where various generation resources and end-use customer programs compete to meet those criteria, resulting in a final "optimum" plan.

Figure # 3.1 shows the various inputs into an integrated resource plan. These inputs include a forecast, DSM programs (organized into one or more plans, or combinations of programs), generation plan scenarios, financial criteria and assumptions and utility rates. The computer models vary from simple spreadsheets to complex computer models designed specifically for integrated resource planning. Of course, not all strategic objectives of a utility can be quantified in a model. The actual decisions regarding which resource plan to choose involve a set of quantitative (from the modeling outputs) and qualitative criteria and involve senior management.

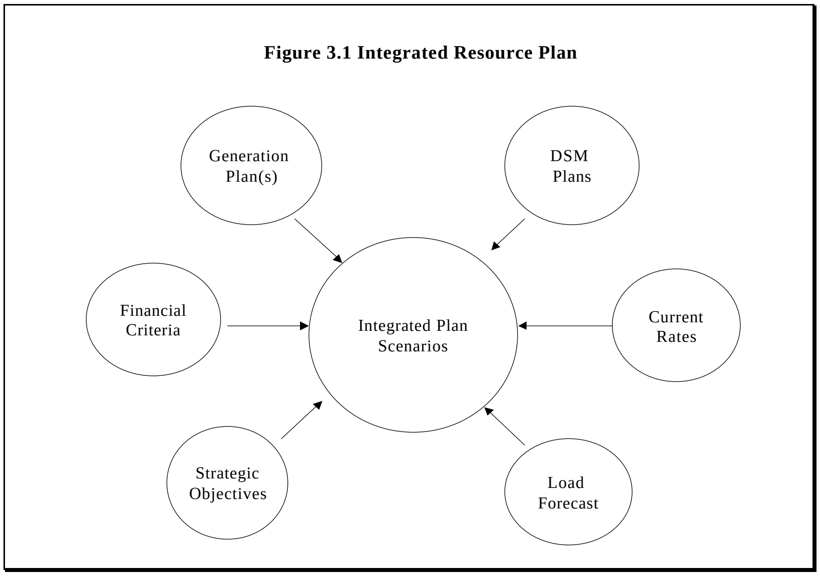


Figure # 3.2 shows the various inputs into the baseline and alternate generation plan scenarios. These inputs include the base load forecast, reliability and reserve margin requirements, capital and operating and maintenance cost forecasts for existing plants, refurbishing or repowering existing plants, renewable energy options, new traditional supply options, cogeneration options and independent power options.

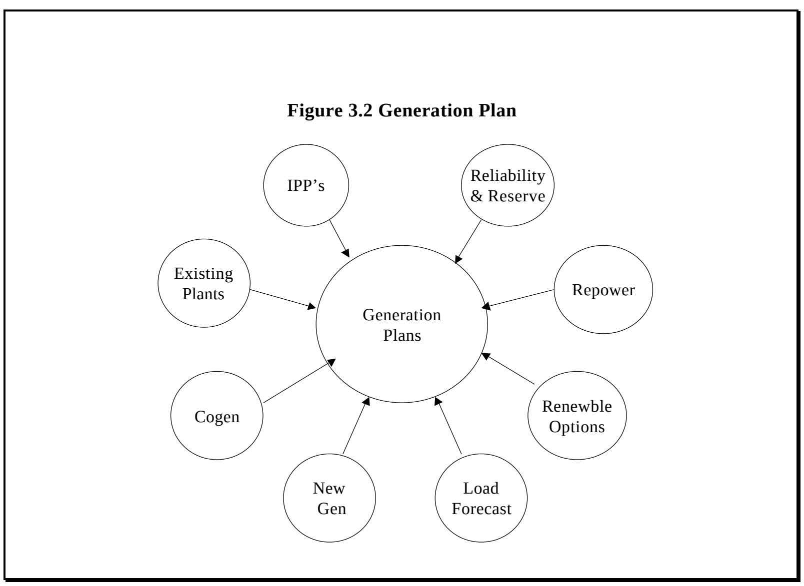
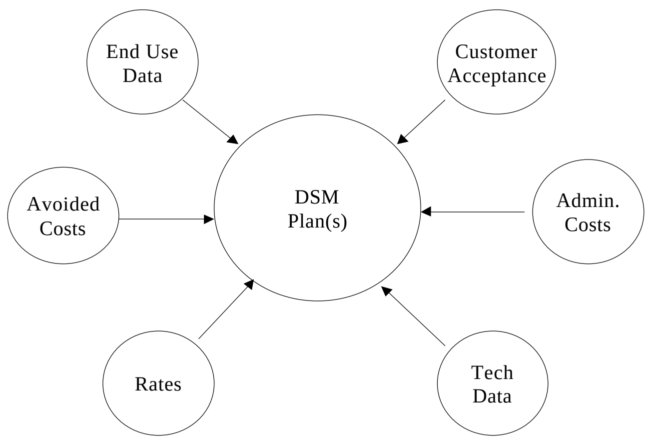


Figure # 3.3 shows the various inputs into the DSM plan scenarios which become part of the integrated resource plan. These inputs include end use load data (including saturations and load shapes), utility rates, technology data (costs and savings), administrative costs, customer acceptance information and avoided costs. Avoided costs are usually calculated based on the baseline generation or purchase power plan. An explanation of these inputs may be found in Appendix A.

Figure 3.3 DSM Plan



Because of the lack of detail in DSM plans incorporated into an IRP, an annual planning process is used to review the plan and add detail. Pilot programs may not have been implemented yet and, therefore, the implementability of the programs may be unknown. After pilot demonstrations are conducted, programs are actually implemented and evaluated.

A DSM planning process most often ordered by regulators as part of utility IRP's and short-term DSM plans is a technology-driven process. There are several flaws with a technology driven process. First, one is often ignorant of the market barriers to implementation until late in the process. Second, customer acceptance models are not very accurate in predicting consumer behavior. Third, priorities are often selected based on theoretical cost-effectiveness as opposed to being based on broad load shape or other utility objectives.

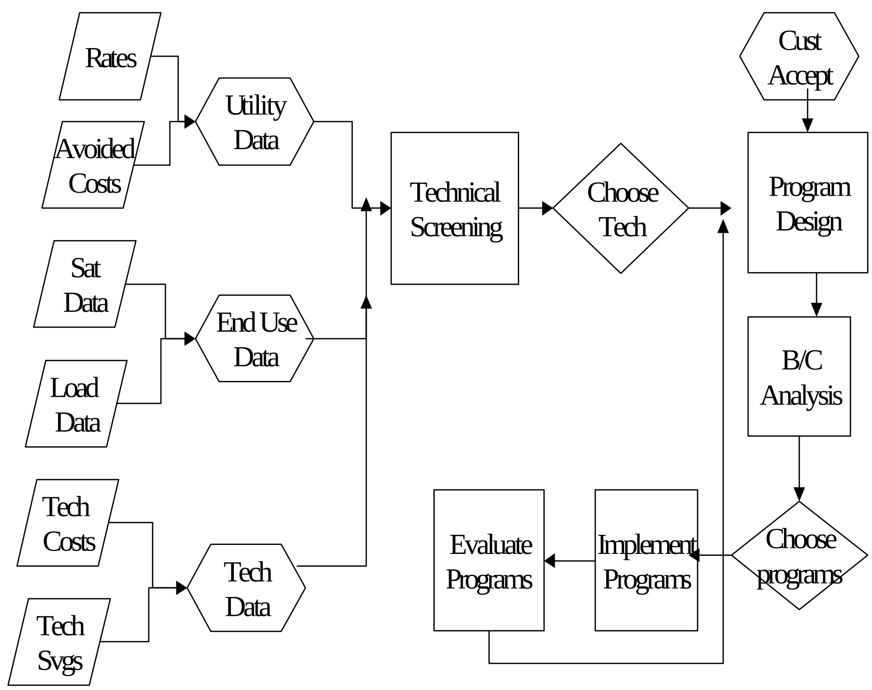
An example of a program designed under the technology-driven process is the following: In one U.S. utility, an opportunity for energy savings was identified through promotion of booster heaters for water heating in restaurants and lodging establishments. No initial research was conducted on the market for this technology. The program design included direct mail to customers pointing out the benefits of booster heaters and offering a low interest loan. When this program was implemented, it was discovered that

i) the customer required someone to explain the technology to him in person and

ii) the customers could not find any plumbers to service the equipment after installation. If these facts had been known before the program was implemented, the program could have been designed to achieve successful installations of booster heaters. As it was designed, it was not successful.

Figure # 3.4 shows a technology-driven process. A description of the process can be found in Appendix B.

Figure3.4
Technology-Driven DSM Planning



A preferred process is a market-driven process which begins with understanding various customer segments and their needs as well as opportunities for those customers to use energy more efficiently. Utilities have often adopted the market-driven process and somehow adapted the IRP process to this approach.

An example of a market-driven program is also provided: Another U.S. utility identified an opportunity for energy savings through promotion of Low Emitting

Diode (LED) exit lights in office and apartment buildings. Initial research revealed the following –

- Landlords of these buildings spent a great deal of money on maintenance of incandescent exit lights.
- Fire inspectors who visit these buildings spend a lot of time documenting the existence of burned out bulbs. They have a vested interest in reducing the time required for inspection.
- Availability of the LED exit lights was limited due to the high purchase cost for local retailers.

A program was designed which included development of a wholesale supplier for the LED exit lights. Fire inspectors were then trained to sell these lights during building inspections. Brochures were developed explaining the benefits of LED exit lights for building landlords. The result – a successful program.

Figure #3.5 shows a market-driven process. A description of the market-driven process may be found in Appendix C.

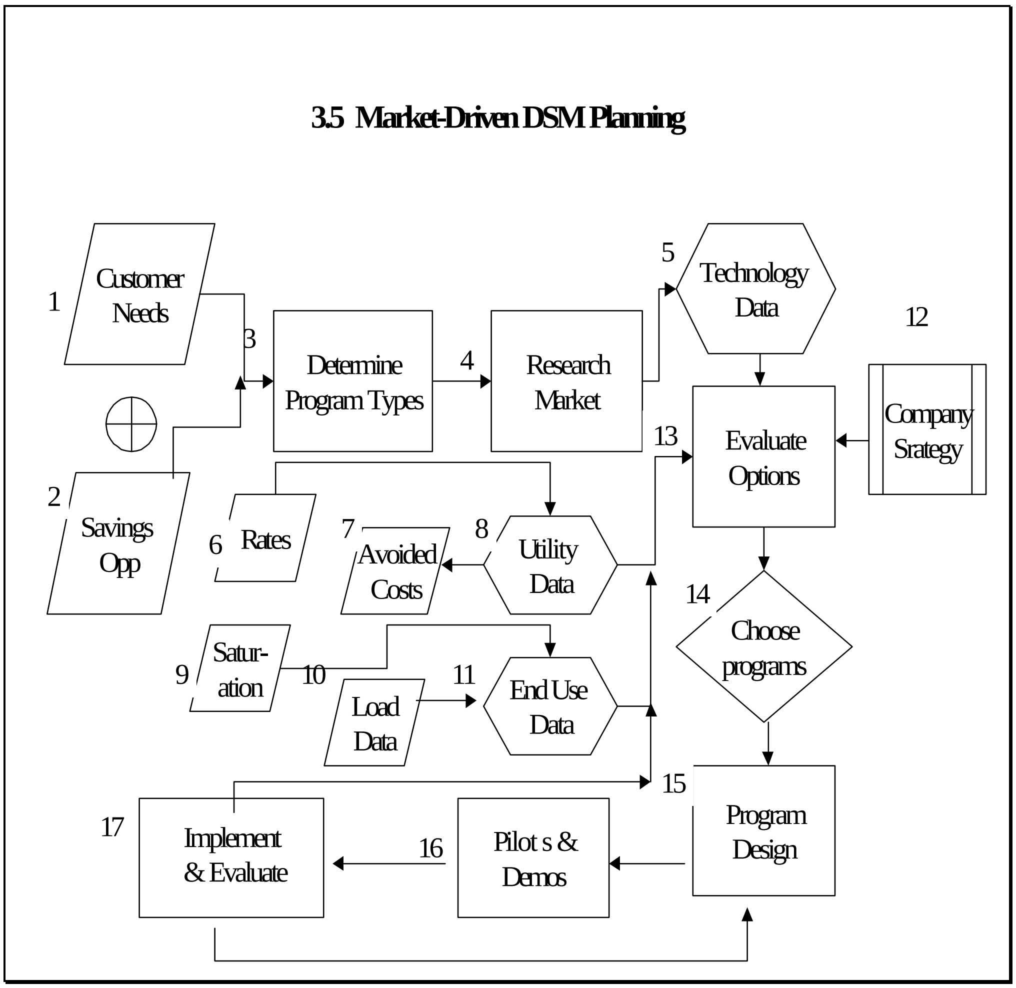
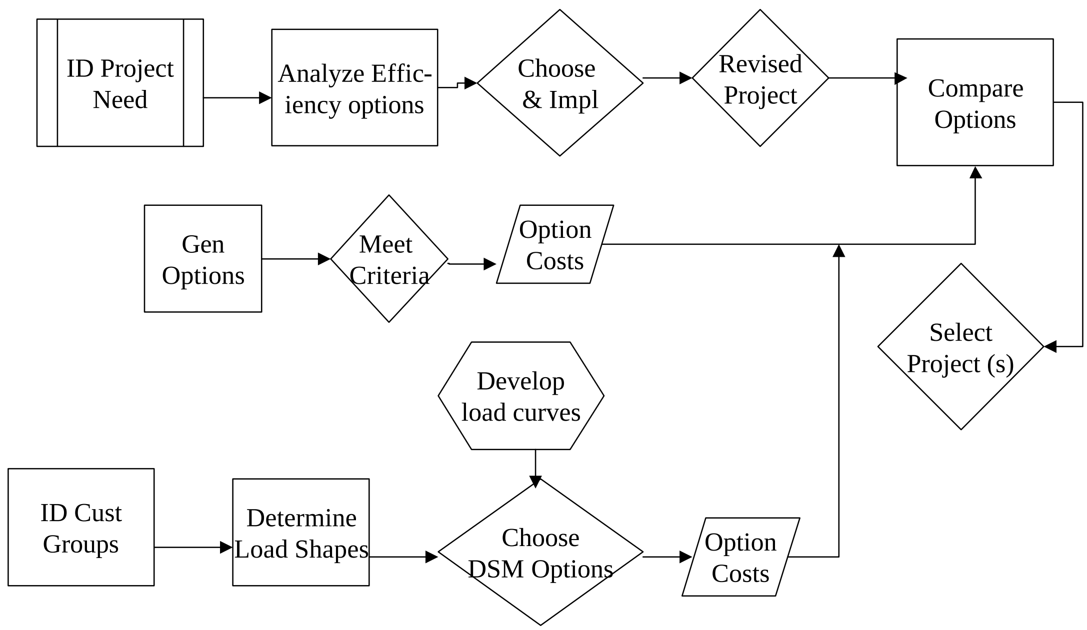


Figure # 3.6 shows a process for targeted area planning for T&D in the United States. An explanation of a targeted area planning may be found in Appendix D.

Figure 3.6 Targeted Area Planning and DSM



4. DSM Planning and Implementation Processes for TNEB

Experience in the United States has shown that a number of factors – from having an adequate technical infrastructure to behavioral changes – are needed if DSM efforts are to succeed. Our review of Haryana's system shows that voltage stability is so poor that many efficient technologies would not perform unless the distribution system is improved. In fact, equipment is overbuilt, sacrificing efficiency, to withstand the massive voltage swings. Some industries have postponed investing in better, more efficient equipment because voltage and frequency stabilizers would be needed. In addition, both commercial and technical power losses are substantial due to the poor distribution system, so improving the distribution system can provide speedy returns on investment. An improved distribution system will also create an environment conducive to end use efficiency.

Given these findings, the DSM planning process at TNEB must be integrated with distribution planning and loss reduction strategies. DSM programs should not be implemented until distribution efficiencies have been gained through line upgrades for loss reduction, capacitor installation, and improvement of power quality and voltage stability. These improvements will decrease costs, increase revenues, and set the stage for effective DSM efforts.

Recommended Purpose of DSM at TNEB

DSM Programs implemented by utilities in the United States have been designed to overcome barriers to the implementation of energy efficiency in the marketplace. Even though customers benefit from energy efficiency through reduced bills, barriers often exist which prevent them from investing in efficient technologies and processes. Load Management programs were driven by utilities' desire to reduce fixed costs and increase margins on power sold. Customers will consider receiving a lower level of service (interruption) for a lower rate.

In Haryana, where no customer is receiving power with a high level of quality and reliability, energy efficiency and load management programs may require a different approach. Increasing levels of reliability can be offered for higher tariffs. Investments in the distribution system benefit both the utility and the customer. As the distribution system is improved, not only are losses reduced, resulting in reduced power purchase costs and reduced costs to replace blown out transformers, but reliability is improved. Raising rates for customers who receive increasingly reliable service through upgrades to the distribution system could be a particularly valuable way to increase margins in the short term. These margins could be further invested in the distribution system, extending power to more customers and further improving power quality and reliability. Of course, customer research may or may not confirm customers' willingness to pay higher rates.

The Roger Peters report suggests that as emergency load relief is lifted, DSM programs should be in place to keep the load shape flat wherever possible. This may be neither valid nor achievable. As costs to serve various loads become better known through load research, increased generation or power purchases may be more or less expensive than certain demand-side options.

In addition to preparing for future regulatory requirements, there are several positive reasons for promoting DSM and establishing a DSM Cell at TNEB and its successors:

- Postponement of construction of expensive new power plants or purchases
- Increased system reliability
- Increased ability to meet any future environmental standards
- Movement of the utility staff towards viewing themselves as service providers as opposed to purely commodity providers
- Strengthening the communities served by the distribution company
- Gaining more control over the production and distribution of electricity

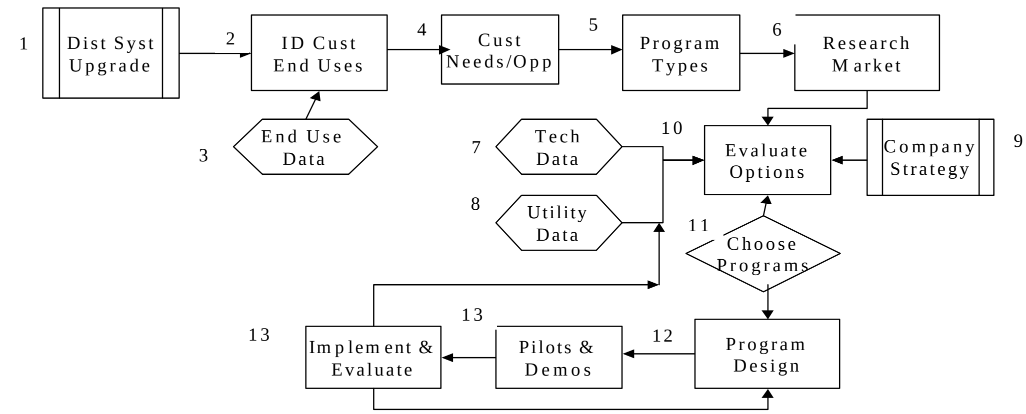
Recommended Planning Processes for Haryana

Clearly, the need for distribution improvements to precede – and to be integrated with - DSM differs radically from the DSM environment in the United States, where high reliability and voltage stability are generally assumed. This, however, is not the only difference between the two DSM environments. In the U. S., planning processes for generation, transmission and distribution were already securely established when DSM came along. Energy and demand savings could thus be factored into those processes. Unfortunately, current planning processes at TNEB are mostly ad hoc, based on minimal information. Most of the basic utility planning data is absent. Accurate forecasts of demand and energy are needed to provide enough time to plan and construct power plants, and transmission and distribution systems. This same data is needed for planning DSM activities.

Because of the potential for increased margins, the DSM planning process at TNEB must enable DSM for the purpose of increasing revenue for the same level of demand as well as decreasing costs for demand and energy. In addition, because of the large potential of distribution system investments to reduce costs, increase revenue and make customer energy efficiency investments possible, the process should be integrated with plans for distribution system upgrades.

In order to integrate the process of the distribution system upgrade and DSM planning the DSM planning process at Haryana should be a hybrid of the market-based DSM planning approach and the targeted area planning approach in the U.S. Figure # 4.1 shows a proposed DSM planning process for TNEB. This process requires first that a plan be developed to upgrade the distribution system. In those areas first targeted for line or other system upgrades, programs at customer sites which address power factor correction, voltage stabilization and power quality should be implemented. Additional programs to promote energy efficiency or load management should be evaluated for that area. The impact of any potential energy efficiency or load management programs should be considered when determining the final upgrade design. An explanation of this process may be found in Appendix E.

Figure 4.1 DSM Planning at HSEB



Integration of World Bank Projects with DSM Planning

A number of distribution system up-grade and DSM projects have been identified by the TNEB for possible funding by the World Bank for which feasibility studies will be conducted over the next few months. In addition, potential for energy and demand savings has been identified in the Roger Peters report. The following technologies have been recommended for study or implementation. Those projects which are being studied for inclusion in the World Bank APL-2 are indicated with a "*". Those which were NOT included in the Roger Peters report of recommendations are indicated with a "●".

∗1) Conversion of existing distribution system into L.T. Less System
*2) Remote Load Management System for six feeders
●*3) Load Management for Domestic Load through A/C ripple control
*4) Modification of municipal tube wells
*5) Modification of agricultural tube well installations
*6) Street Lighting
*7) Lift Irrigation
*8) Financing Mechanism for Energy Efficiency Projects
9) Residential Compact Fluorescent Lighting program
10) Promotion of efficient lighting and appliances in new home construction
11) Industrial technology programs
12) Commercial technology programs

Comments on Program Feasibility

Modification of Agricultural Tubewells

As suggested in the Peters report, pumpsets and tubewells should only be promoted on upgraded feeders due to the impact of voltage instability on the viability of efficient motors and on rewinding existing motors. It is not likely that an Energy Service Company would want to invest in agricultural pumps. Most ESCO's in the U.S. have invested in projects for industrial and commercial customers, especially (and sometimes exclusively) when they were able to obtain a service contract for managing customers' heating, ventilating and air conditioning (HVAC) equipment. Additional research is needed on potential manufacturers and distributors of equipment who could be potential partners in this program.

Remote load management for rural distribution feeders

Control of agricultural feeders is valid as an emergency relief option. Investigation should be made, however into less expensive methods of control than radio frequency. Ultimately, a more sustainable method of agricultural load control should be based on data regarding optimum watering times for irrigation. This research should have top priority with the new DSM Cell.

Industrial technology upgrades

At the December 1997 ESCO workshop, TNEB committed to providing assistance to individual companies interested in developing energy efficiency projects using performance contracting. National ESCO's should be contacted by the DSM Cell as to their interest in doing business in Haryana. Customers who attended the December workshops should be contacted now as to their interest in doing projects. Financing options investigated as part of #8 above should provide useful information for this activity. As with agricultural loads, the distribution system should be upgraded for those customers, where needed, in order to stabilize voltage. Otherwise, the investment in energy-saving equipment is not viable. Any further efforts, except those described below under additional programs, to promote efficiency to industrial customers should be postponed until load and market research is conducted to understand the amount of self-generation and opportunities for cogeneration.

Load Management for Domestic Loads

Ripple control for Domestic A/C is not a feasible project. In the U.S., utilities who promote control of domestic A/C loads often peak at 2 p.m. in summer. U.S. utilities' experiences with Central A/C has been that people who usually sign up are people who are either not at home when the interruption occurs (so they are not there to experience discomfort) or they leave their air conditioning on all the time so that, when control occurs, there is no discomfort. Others signed up because they are conservation minded and were told they would rarely experience interruption. When they were interrupted, many complained because they were interrupted at the time they needed and used their air conditioning the most.

The percentage of people with air conditioners in Haryana is very small so that the contribution to peak is likely a small percentage. Even if the A/C load is concentrated in a geographical area, the individuals who own Room A/C's are usually in higher income brackets and might not accept being interrupted. A better option might be to inform them of the benefits of pre-cooling their homes. A time of use rate could also be designed to support pre-cooling.

Compact Fluorescent Lighting Promotion

Domestic compact fluorescent lights have been difficult to sell in the U.S. Although lamps have improved and there is greater availability, the market has still not expanded much. In India, where per capita income is much lower, this is not really a viable option for most residential customers. Also, contribution to system peak is not really known. And, lastly, compact fluorescent would be severely impacted by the voltage instability which exists on the system. Until that is corrected, a program such as this should not be considered.

Lighting and Appliances in New Home Construction

While new construction is an opportune time to influence appliances and lighting installed in homes, the new construction market, at least in the U.S., is a complex one and requires further research in order to learn how best to intervene and influence appliance and lighting practices. This type of program would come much later in a utilities' DSM experience.

Additional Programs Suggested

Energy Efficiency Education campaign for domestic and small commercial sectors

The bill distribution system in Haryana provides an ideal avenue for an education program. Bills are distributed by utility employees. Currently, the backs of the bills are blank, providing a perfect opportunity for the communication of energy usage information. Only domestic bills are generated by computer. However, customers, both domestic and commercial, come to the office to pay their bills in person. The second phase of the education campaign should be a communication campaign through common media, including signs at bill-paying stations.

Those not educated in communications often confuse education, advertising and promotions and public relations. The purpose of education is to inform the customer. Advertising and promotions are one aspect of marketing and the main one employed in DSM programs. This usually includes methods used to sell a product or service. In the case of DSM, the utility is often selling customers an idea, convincing them to take a specific action. Public relations usually establishes a particular image or attitude towards the utility. All three of these aspects of communication are important and overlap.

TNEB should investigate the formulation a comprehensive communication plan. Information on tariff reform, DSM, enforcement of penalties for illegal connections and so on can all be communicated as part of one integrated plan designed to achieve the desired change in attitude and action on the part of customers. Such an effort would provide an important opportunity to initiate changes in attitude and behavior by customers.

Promotion of power systems upgrades in industrial feeders and industrial facilities including power quality, capacitors and HT Upgrades

After completion of the feasibility studies listed above, a demonstration project to upgrade Industrial power systems should be developed immediately. A survey of existing power factors and power quality in industries would be conducted along with a metered demonstration project to demonstrate the feasibility of a power systems program. This effort should coincide with investigation of feeder upgrade potential.

Impact of Restructuring/Regulatory Reform on DSM in Haryana

In a government owned system, the government's objectives govern the utility's actions, whether those objectives are rural electrification, full employment, industrial development or environmental improvement. A corporatized utility will be influenced by those objectives but will have independent business management. This management will have the incentive to make prudent investments in Generation and in the Transmission and Distribution System and charge rates which cover revenue requirements. Privatization introduces the element of earning profits for a set of investors. In this case, utilities will do whatever ensures them the targeted earnings, within regulatory guidelines.

There are three ways to ensure that a utility is responsive to customers' needs for reliable, quality power – legislation, regulation (at the local, state or national level) and competition. A nation or state can use any combination of the three to achieve its desired objectives. Since regulation has been chosen for India, there are certain regulations related to DSM, which are necessary to ensure service is provided as efficiently as possible and is widely available:

- Since DSM will be integrated so closely with and is largely dependent on Distribution Upgrades, standards for safety, reliability and power quality should be developed.

- Require utilities to develop accurate forecasts of revenue requirements for purposes of tariff design. Revenue requirements forecasts are also used in comparing integrated resource plan scenarios. Also, tariffs to encourage load management can not be designed unless there are accurate base tariffs to compare

- Ensure that all investments made to promote Demand-side Management are recoverable in rates, including information-based programs

- Reward, or conversely do not punish, the transmission and distribution companies for innovative programs. Even if planned savings are not achieved, it is important to learn from failures in designing DSM programs.

- If Integrated Resource Planning is instituted by TNEB, ensure that guidelines are flexible and allow load shifting and off-peak load building as well as peak-clipping and load reduction programs. This will ensure the long-term attractiveness of DSM for the Transmission and Distribution companies.

Plans for restructuring at TNEB include separation of the Transmission and Distribution companies from the Generation company and the eventual spin-off of the three distribution companies. Corporatization is planned for the Generation, Transmission and Distribution companies. Privatization and competition is possible for Generation. In addition, TNEB , in response to national requirements, is planning as a first task, tariff reform to recover at least 50% of the cost of serving all loads except agricultural loads. This effort in itself will require much more detailed knowledge of load shapes than is currently known.

It has been suggested that DSM programs will be a shared responsibility of the Transmission Company and the Distribution companies in the restructured environment. The closest model in the U.S. is the Generation and Transmission (G&T) electric cooperatives and their member distribution cooperatives or Joint Action agencies for municipal utilities. In this model, planning occurs jointly between generation and distribution companies but implementation is completely in the hands of the distribution companies (except in cases of third party implementation).

In the interim period after T&D are spun off at TNEB, DSM planning can indeed be planned by the Transmission company with assistance from the distribution companies. In order to ensure success, the regulations should require the Distribution Companies to share load and billing data with the Transmission Company and the distribution companies should be required to support the market research plans and implementation plans of the Transmission company, as appropriate.

When the distribution companies are spun off from Transmission, potentially creating wholesale competition, the Transmission company could become a mere wheeler of electricity. When this occurs, DSM requirements should be transferred to the distribution companies. If IRP is implemented, the form should be somewhat different than in the U.S., since these distribution companies will not be building generation but merely purchasing power. Demand-side options can still be compared to power purchases but the process is not as complex as it is for a company which owns generation. Demand-side management can still be, and should be, integrated with targeted planning for Distribution system upgrades. DSM can play a role in Transmission company system investment decisions, but probably a minor one.

5. DSM Cell Structure at TNEB

TNEB faces significant challenges – and heavy demands on its resources - as it moves toward DSM. Thus, we recommend that during the first year of operation the DSM Cell should set realistic and achievable goals that will benefit not only DSM but the utility as a whole. We recommend that TNEB hire one research analyst to accomplish the following goals:

- Develop the basic data needed for good utility planning and for regulatory reform (which can also be applied to DSM efforts)

- Develop an integrated communications plan to inform their customers about regulatory reform and energy usage

- Complete the feasibility studies for the DSM projects

In the second year, the DSM Cell should hire more staff to focus specifically on DSM issues. These staff would prepare specific DSM end use and market data, choose and design DSM programs, and potentially implement DSM programs. DSM training in the second year would address specific program designs, the role of market research and evaluation, and DSM financing, performance contracting and bidding.

Most of the foundational data and information required for utility planning is absent at Haryana. This includes accurate forecasts of demand and energy and load duration curves for enough years into the future to provide lead time for planning and constructing generation, transmission and distribution to meet the unrestricted load.

The time and effort required of TNEB to prepare for and participate in the restructuring and reform process is monumental. The first step, the requirement to develop new tariffs will require significant effort by itself, not the least of which is the need to understand current costs (revenue requirements).

In order to forecast revenue requirements, capital costs for new generation, transmission and distribution, and future operating and maintenance costs are needed. These future costs need to be based on an accurate forecast of load duration curves which provide the future energy and demand needs. The forecast of energy and demand based on a simple trend may or may not be accurate. Even if future load shapes are no different than today, the fact remains that today's load shape for unrestricted demand is not even available. But if the composition of the load is changing, even if the load shape were known, it might not be a good predictor of future load shapes even 2-3 years from now.

With all the data needed for regulatory reform and the decisions to be made, TNEB is likely to be overwhelmed with this task. Any DSM Cell established should concentrate on development of the basic data needed for good utility planning and for regulatory reform during the initial year/(s) of its existence, as well as basic market research. In addition, educational and information programs can be implemented and the programs found feasible for funding by the World Bank can be implemented. The second or third year, the Cell can focus on gathering additional information on end use and technology data, understanding the markets and determining what additional programs can be piloted.

In the United States, there are as many configurations of DSM staff as there are utilities. The number of staff and degree of specialization depend on the regulatory requirements, the size of the utility and the governing structure of the utility company. Larger utilities tend to have more in-house staff. Smaller utilities tend to outsource major projects and play largely a project management role.

The types of activities which need to be conducted to plan and implement DSM include:

1. Foundational work – Load research and Forecasting
2. Statistical Analysis – Load Shape Development, Market Research, Impact Evaluation
3. Data preparation for planning (customer research, load data, technology data)
4. Economic analysis
5. Program Design and Implementation
6. Development of overall plan to meet company criteria and objectives
7. Relationship building with customer groups, industry associations, and other trade allies
8. Development of partnerships with ESCO's and Financial Institutions
9. Liaison with Generation/Power purchase Cell
10. Liaison with metering and billing Cells
11. Liaison with transmission and distribution planning Cells

At Haryana, because of the tremendous effort required of regulatory reform, as mentioned in the previous section, the DSM Cell should concentrate on #'s 1,2 & 3 above during the first/second year. The second or third year should focus on the remaining points, with emphasis given to conducting pilot programs in areas where the distribution system has been upgraded and losses reduced through power systems upgrades.

Figure #5.1 (on next page) shows the ongoing tasks which support the complete DSM planning process as outlined in Figure # 4.1. This figure outlines the individual(s) with responsibility for the task, duration of the task over time, actual time to accomplish task in days and equipment needed to accomplish the task. Additional activities which need to be done include communication with Senior Management, understanding the reform and restructuring activities which impact the DSM Cell, obtaining necessary support and resources for the Cell, acting as liaison with generation, transmission and distribution planning and Distribution Reform Cells, and developing partnerships with ESCO's and Financing companies. These duties fall within the purview of the DSM Cell Director. The DSM Cell Director should report to the Chief Engineer of Distribution Reforms, who reports to Mr. Verma, the Board Member responsible for all T&D Plans and Operations. In the initial years when emphasis will be on up-gradation of distribution system, DSM Cell would need extensive assistance/support and co-ordination with the Planning Cell. A mechanism will have to be in place for effecting close cooperation between the office of the Engineer-in-Chief of Planning and the DSM Cell.

Figure 5.1 DSM PLANNING AT HARYANA STATE ELECTRICITY BOARD

Task #	Task Description	Responsibility	Duration	Time Requirement	Equipment Needed/Comments
1	Distribution Efficiency Upgrade Plan	Distribution Planners	1-11/2 years	3 –5 months per project	Computer, software
2	End Use Data Research and Preparation	Field Engineer/Research Analyst	1-11/2 years	1-2 month per project	Computer, software, metering equipment
3	ID Customers and End Uses	Research Analyst/Distribution Planner	2 months	15-30 days each	Computer, statistical software
4	ID Customer needs and Opportunities	Research Analyst/DSM Designer	4-6 months	1 –2 months each	Based on market research
5	Determine program types	DSM Designer	4-5 weeks	2 –3 weeks	
6	Research market	Research Analyst/DSM Designer	2-4 months	1-2 month each	
7	Prepare technology data	DSM Designer	5-7 months	2-3 months	Depends on number of technologies
8	Prepare utility data	DSM Designer	4-6 months	1-2 month	
9	Understand company strategy	DSM Cell Director	Ongoing	.25 -.5 FTE	
10	Evaluate DSM options	Director, Analyst, Designer	4-6 weeks	5 –10 days each	
11	Choose programs	Director, Analyst, Designer	4-6 weeks	5 –10 days each	
12	Program Design	DSM Designer	4-6 months per program	3-4 months per program	Most time-consuming process
13	Pilots and Demonstrations	DSM Designer and Research Analyst	1—12 months	3-4 months per project	
14	Implementation and Evaluation	DSM Designer, Research Analyst,	Launch - 2 - 4months	2-3 months each	Launch time-consuming
		Distribution Engineers			

The following recommendations are made for staffing the DSM Cell and providing the input data necessary for following the recommended planning process:

Inputs to DSM Planning

Forecasting energy and demand requirements – Outsource

Many small utility companies in the United States outsource their energy and demand forecasting, just as TNEB did by hiring Price Waterhouse. Forecasts are needed not only for generation and transmission but for each distribution company and each substation. An updated forecast for generation, transmission and distribution needs to be completed in 1998-99.

Forecasting revenue requirements and designing rates

This will be addressed through Restructuring Technical Assistance activities

Transmission and Distribution Plans - Develop capability internally.

This activity is usually performed by engineers and sometimes out-sourced by small distribution companies. Currently, based on whatever forecast is available, planners can examine limited options for system upgrades. If safety, reliability and power quality standards are developed by regulation, there will be an increased need for this activity and for computer software to model options. Development of a plan for upgrading the distribution system and developing the T&D planning capacity should be done in 1998-99. Updated forecasts are needed to provide an accurate determination of projects needed due to growth on the system.

Avoided/Marginal Costs – Outsource

Until there is a regulatory requirement for IRP, and processes and models are in place, there is no need to train internal staff to develop these numbers. They are developed based on the utility's current generation investment/power purchase plan. An outside firm should be hired in 1999 to develop avoided costs based on an accurate forecast and revised generation, transmission and distribution plans.

DSM Planning and Implementation Process

The following positions are required to maintain a functioning DSM Cell at Haryana. The second position, the Research Analyst, should be hired in 1998 and report to the new Chief Engineer of planning. The DSM Cell Director and Program Designer/ Implementation Manager should not be hired until 1999.

DSM Cell Director

Tasks

- Communication with Senior Management (Board members) r.e. DSM
- Obtaining necessary support and resources for the DSM Cell
- Understanding of Corporate Objectives/Strategy
- Evaluating and Choosing DSM Programs
- Liaison with Generation/Power purchase planning, transmission and distribution
- Determining impact on restructuring activities which impact the DSM Cell
- Developing partnerships with ESCO's and Financing Companies
- Relationship building with customer groups, industry associations and trade groups

Skills Required

CORE Skills:

- Leadership Skills
- Communication Skills
- Knowledge of business planning
- Understanding of Generation, Transmission and Distribution Planning processes and data needs
- High level understanding of DSM and its role in all aspects of utility planning
- Knowledge of Utility Accounting and Economics
- Customer Service and Marketing Skills
- Negotiation Skills
- Project management skills

SECONDARY Skills:

- Use of market research in the DSM planning process
- Concepts of load shapes and diversity

- Value of load research and market research in utility planning
- Understanding of utility revenue requirements and rate design concepts

Equipment and Software Requirements

- Word Processing , Spreadsheet and project management software (Preferably Microsoft Word, Excel and Project), Windows 95

- Pentium Computer with at least 1GB of Hard Disk and 32 MB of RAM

Suggested Specific Training
It is assumed that the Director will already possess core skills of leadership, communication, business planning, utility accounting, customer service, marketing and negotiation skills.
- General concepts regarding what is DSM
- Concepts of load shape and diversity
- Purposes for load research
- DSM Financing Options
- Performance contracting and vendor financing methods
- Designing and managing bidding programs
- Integrated Resource Planning principles
- Forecasting, generation planning, T&D planning processes
- Project management

<u>Research Analyst – 1 FTE</u>

Tasks

- Load Research
- Load Shape Analysis
- Market Research (Primary and Secondary)
- Design and Implement program evaluations
- Participate in Choosing program options and designing DSM Programs
- Conduct pilot program evaluations

Skills & Knowledge Required

CORE Skills -
- Quantitative analysis/sampling design skills
- Computer skills
- Understanding concepts of load shape and diversity
- Knowledge of DSM program evaluation methods
- Survey design
- Knowledge of secondary research sources
- Ability to design program evaluations

•Research design methods
•Database skills

SECONDARY Skills:
•Understanding purposes for load research
•Knowledge of DSM program evaluation methods
•Use of market research in the DSM planning process
•Understanding of utility billing process and systems
•Knowledge of existing utility application process and databases
• Forecasting methods

Equipment and Software Required

•Simple statistical analysis can be done with spreadsheet software but the preferred tools are SAS and SPSS. For those inexperienced with data analysis tools, SPSS is the preferred product since it is menu-driven. The integration of the chosen software with current and future billing systems and customer databases should be considered when making a final software choice.

•For Load Shape development from metered sector and end use load research, an excellent product is Load Data Analysis Workstation (LDAW) available from. Load Shapes can also be graphed in spreadsheet software. End Use load shapes can also be created directly in software developed specifically for Demand-side analysis based on knowledge of rated kW of the technology, operating hours and usage patterns from survey data.

• Database software tool , word processing , spreadsheet and project management software (preferably Microsoft Access, Word, Excel and Project), Windows 95

•A Pentium personal computer with 1 GB of hard drive and 32 MB of RAM

Suggested Specific Training
It is assumed that this individual will already have the core skills of Quantitative analysis, sampling design , Computer skills, Survey design, knowledge of secondary research sources, research design methods, and database analysis skills

•General concepts regarding DSM
•Concepts of load shape and diversity
•Purposes for load research
• Specific techniques for load research
• Metering technologies for load research and evaluation
•Applying statistical methods to load research and evaluation
•Methods of DSM program evaluation

- Appropriate applications of market research in DSM planning
- Forecasting methods
- Tools for load research and evaluation

Program Designer/Implementation Manager – 2 FTE's

1 FTE for Industrial/Commercial/Municipal
1 FTE for Agricultural/Residential

Tasks

- Understand customer needs relative to energy use
- Identify opportunities for DSM programs based on customer knowledge/market research
- Determine program types to meet customer needs/achieve load shape objectives
- Assist researcher in conducting secondary research
- Prepare utility, technology, and customer data for DSM analysis
- Evaluate options and choose programs for further design
- Design programs, including delivery channel, partnership development, administrative procedures, promotion plan and evaluation plan
- Monitor pilot and demonstration programs
- Manage program implementation
- Manage any bid development, selection and contract management

Skills & Knowledge Required

CORE Skills:

- Specific understanding of DSM principles
- Knowledge of customer service principles
- Understanding concepts of load shape and diversity
- Understanding purposes for load research
- Appropriate applications of market research in DSM planning
- Understanding of DSM program types
- Knowledge of Advertising and Promotion
- Knowledge of equipment and processes for appropriate sector(s)
- Knowledge of methods to calculate energy use in buildings, processes, appliances, lighting and other equipment in appropriate sectors
- Knowledge of energy use and energy efficient technologies appropriate for sector

SECONDARY Skills:

- Understand concepts of market research
- Ability to conduct secondary research
- Knowledge of various methods of DSM program evaluation

- Understanding of utility billing process and systems
- Knowledge of existing utility application process and databases
- Computer Skills
- Understanding of financing methods for DSM

Equipment and Software Required

- Spreadsheet, Word processing and project management software (preferably Microsoft Excel, Microsoft Word and Microsoft Project), Windows 95

- Demand-Side Management analysis software – The software most widely used in DSM analysis today at U.S. utilities is DSManager (Windows version is called RetailManager). This software is highly data intensive, however, requiring either 8760 hourly load data or on peak and offpeak energy and demand. Avoided costs need to be developed for the same level of detail as the load shape data. Spreadsheet programs exist which may be easier to use and require less detailed end use and technology data.

- A Pentium personal computer with 1 GB of hard drive and 32 MB of RAM

Suggested Specific Training

It is assumed the individual will possess the core skills of customer service, advertising and promotion and knowledge of the appropriate sector.

- General concepts of DSM
- Concepts of load shape and diversity
- Purposes for load research
- Methods of DSM program evaluation
- Appropriate applications of market research in DSM planning
- Cost-effectiveness criteria and economic analysis of DSM
- Modeling DSM Cost-effectiveness (DSManager or spreadsheet)
- DSM Financing Options
- Performance contracting and vendor financing methods
- Designing and managing bidding programs
- Integrated Resource Planning principles

6. Training Plan for TNEB

Based on this DSM Cell scenario, training for TNEB in the first year should include:

- Basic utility planning processes and data requirements for Board members and Chief Engineers
- A visit to a regional utility with best practice planning processes and successful DSM programs
- Specific forecasting and load research issues, at a general level for management and at a more specific level for the research analyst.
- An overview of DSM

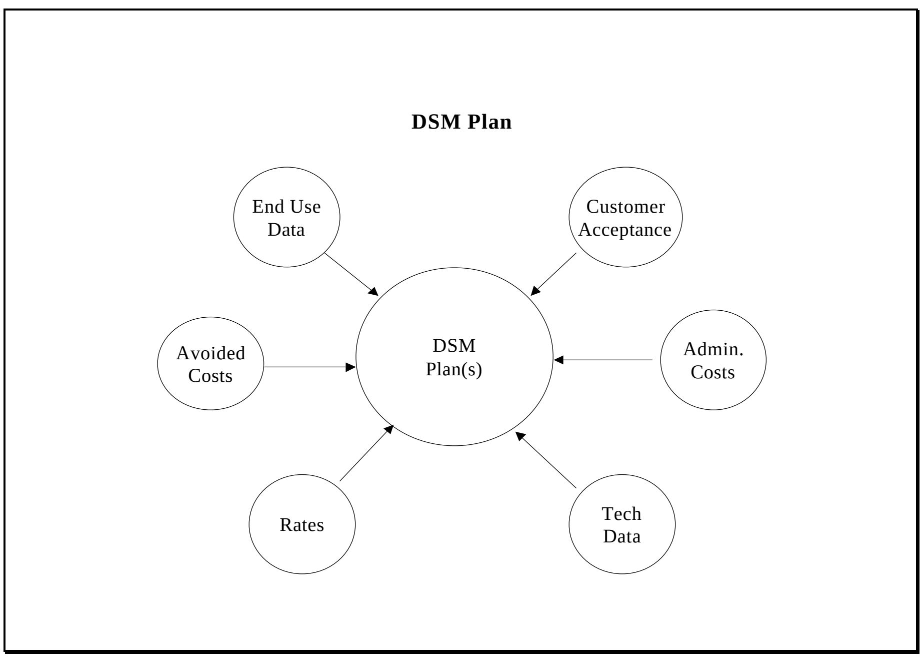
In the second year, the DSM Cell should hire more staff to focus specifically on DSM issues. These staff would prepare specific DSM end use and market data, choose and design DSM programs, and potentially implement DSM programs. DSM training in the second year would address specific program designs, the role of market research and evaluation, and DSM financing, performance contracting and bidding.

It was assumed that the individuals in the DSM Cell would possess certain core skills upon selection. If these skills are not available at TNEB and a decision is made not to add staff, certain foundational training will need to be done. Also, when the individuals are chosen, a Needs assessment should be done to aid in training design as well as to determine additional training needs beyond what is outlined in the following training plan.

Appendix A - Inputs to DSM Planning

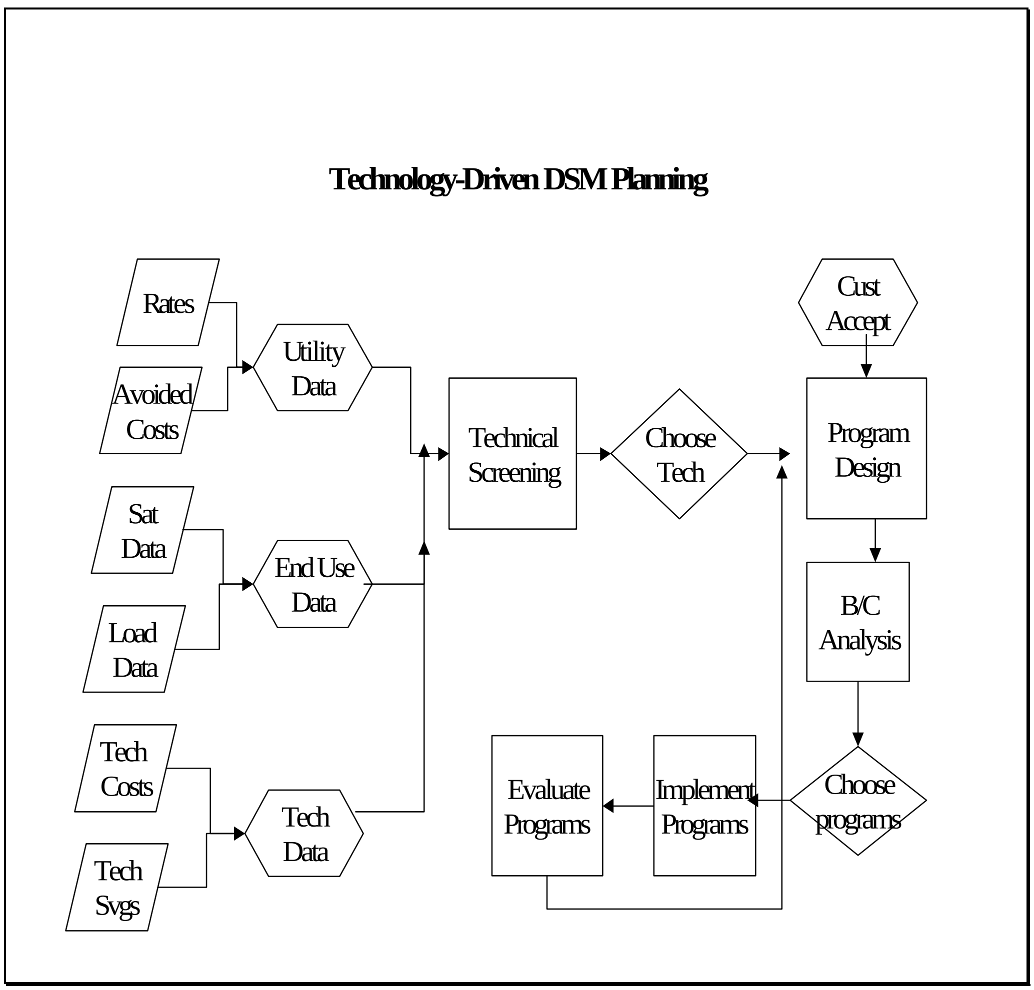
End use load data includes saturation percentages as well as energy and demand usage attributable to each end use. The energy and demand usage and savings can exist as discrete numbers or as 8760 hour load data. The 8760 hour load data can be derived from pure metering studies or from combinations of data from metering, survey data and computer models through statistical analysis. In U.S. utilities, basic load research for different sectors and sub-sectors usually already exists for the purpose of rate tariff design. End-use load research is usually geared towards sectors which contribute significantly to peak demand and end-uses identified through saturation surveys as potentially contributing a high percentage of the peak demand in a particular sector.

Technology data for efficient technologies, procedures and processes can be constructed from simple engineering calculations based on manufacturers' data, from other utilities' program evaluation results or from pilot studies.



Appendix B – Technology Driven DSM Planning Process

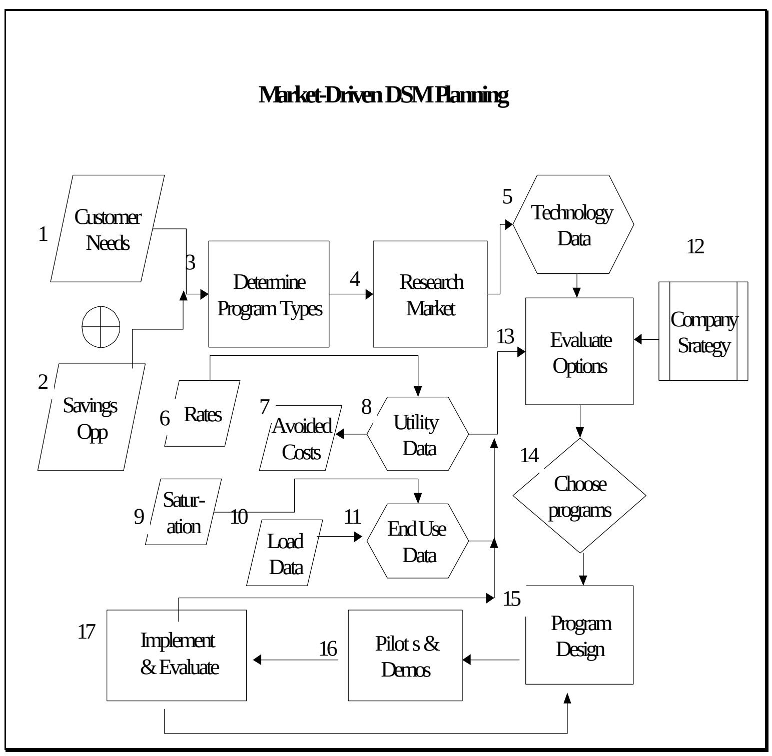
In this process, the data mentioned previously (utility, end use and technology data) is prepared for analysis. The first step in DSM analysis is a technical screening, which means that the technology costs and demand and energy savings are compared with the cost of building capacity/purchasing power or generating electricity, respectively. After technologies or rates are chosen, programs are designed. An optimum program design is sought which maximizes the "net benefits" (benefits minus costs) of the program. Costs and savings are interdependent, since higher costs may increase participation and, therefore, savings, but also reduce the "net" benefits per participant.



Appendix C – Market-Driven DSM Planning Process

The first step is to assess customer needs. This information can be obtained from either primary or secondary research. If information is not known about customer needs relative to energy use and costs, then program opportunities can be listed for customers which contribute significantly to peak demand and for end-uses which contribute significantly to the customers' energy costs. Next, program types which address those needs or end-uses are considered. Program types include information, financing methods, audits and studies, technical assistance and consulting, procurement and equipment installation services, cooperative programs with trades and associations, rate designs, and turn-key programs. Research is conducted next to understand something of what customer interest may be in the programs, barriers in the marketplace, delivery channels for the products or services involved and technical issues.

Next, evaluation of program concepts is done from an economic standpoint as well as from a qualitative standpoint. Criteria include benefit/cost ratios (using avoided costs or other criteria), ability to meet other utility objectives, customer response and interest, stakeholder views, government policies, replicability and load impact. Some programs may be delayed. Others will be chosen for immediate implementation (such as information programs) and others will be designed as pilots. The design phase includes the delivery approach, development of needed partnerships, a promotion plan, an administration plan, and a data collection and post-implementation evaluation plan.

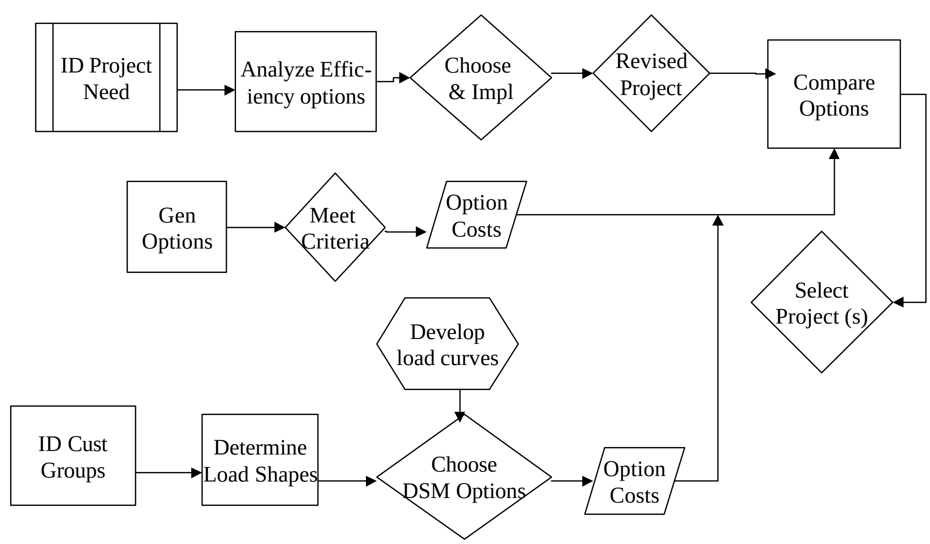


Appendix D – Targeted Area Planning for T&D

The impetus for a transmission or distribution upgrade can be reliability, voltage quality, unserved energy, environmental impacts, safety or growth. Once a project is identified, options for improving the efficiency of the area should be evaluated. These include installation of capacitor banks, power factor correction, conservation voltage reduction, amorphous core transformers or voltage upgrades. Then the transmission or distribution option to meet that reduced load should be determined. It is assumed that those options which are cost-effective will be implemented.

Simultaneously, data should be collected on the generation and DSM (customer efficiency and load management) options which could meet the criteria driving the upgrade. The generation alternatives begin with data collection on generation options and continue with evaluating them based on the criteria. The demand-side evaluation is a longer process. First, customers in the study area must be organized by groups. Load data for those groups should be evaluated based on saturation data and other end use data available for the study area. Next, load curves for the study area (current and projected future) and the contribution of each end use to the peak should be evaluated. A final determination is made as to DSM options appropriate for the study area. Demand and energy savings and costs of these options are established. Then these options are evaluated as to whether they meet the criteria which are driving the project. Lastly, all T or D, generation and demand-side options are evaluated based on their ability to meet the criteria and cost (both capital and O&M). A final plan is chosen which includes any additional generation planned, DSM planned and a final T&D project design which best meets the desired criteria at a reasonable cost.

Targeted Area Planning and DSM



Appendix E – Recommended DSM Planning Process for TNEB

In this process, the first step is upgrading the distribution system in a cost-effective manner including capacitor banks, power factor correction, voltage correction and, where appropriate, upgrading lines from LT to HT. Minimum reliability and quality standards would be established. The second step is to identify customer groups and end-uses in the upgraded area. End use saturation data and any load shape data available would be utilized in this step. Next, customer needs and/or program opportunities would be identified and then program types determined which meet those needs or provide those opportunities. The market for the program is then researched to determine delivery channels, market potential and barriers to implementation.

Next, options are evaluated using the load data already established as well as technology and utility data. Even though the DSM is being implemented only on certain distribution feeders, the value of postponing additional generation/purchases and transmission investments is still included in the avoided costs used for the economic analysis. Company strategy/objectives relative to load shapes, plans for improved reliability, power quality and revenue are also inputs into the evaluation of options.

Once program concepts are chosen, the programs are designed, pilots implemented where appropriate and programs finally implemented and evaluated. Evaluations in the U.S. pre-competition were often used to "true-up" savings which utilities achieved to meet regulatory goals. The methods used were expensive and not usable to improve program savings estimates. These impact evaluations were often not integrated with process evaluations. If they were, both evaluations were not useful for improving programs because of the time delay. A real-time approach to process and impact evaluation which is used to improve programs during the year of implementation is the approach recommended for Haryana.

DSM Planning at HSEB