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

Final Report

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1. Introduction

The Energy Management Consultation and Training Project (EMCAT) was initiated in 1992 for a five-year period. The project's original funding level was $20 million, later increased to $27 million. The EMCAT DSM Phase II objective is to address the entire range of potential activities for improving electricity system efficiency, from power plant efficiency improvement to end-use efficiency improvement. EMCAT DSM Phase II has two major components: (a) a supply-side component aimed at modernizing, rehabilitating, and improving management of existing energy systems; and (b) a demand-side component aimed at promoting investments by electricity end-users in technologies that enhance energy efficiency. The second component is broken into two phases, the first from April 1994 through September 1997, and the second from June 1997 through December 1999. EMCAT DSM Phase II is one of several complimentary programs USAID/India has instituted to address its fourth Strategic Objective; the others include the India Private Power Initiative (IPPI), India Private Power Development (IPPD/EMCAT), Sustainable Cities, and the Asia Sustainable Energy Initiative (ASEI). EMCAT DSM Phase II was evaluated in early 1996, after which the project was extended through the end of 1999. The evaluation was used to design the scope of work for the project's second phase.

The objectives of EMCAT-DSM's first phase were to promote end-use efficiency in selected energy-intensive Indian industries and to promote conservation and related policy reforms. The primary Government of India (GOI) counterpart for EMCAT's DSM activities is the Industrial Development Bank of India. The project was charged with addressing the main constraints on improved efficiency, which were assumed to be: (1) widespread dependence on outdated end-use technology, (2) inadequate domestic supply of energy efficiency devices and equipment, (3) shortage of energy efficiency related technical capabilities (consultancy, design, and engineering), and (4) inappropriate prices and a lack of other financial incentives for energy efficiency investments. The first phase resulted in significant achievement in all four of these areas. Phase II will build on the efforts of Phase I, and will run through September 30, 1999, with funding of $2.75 million. The project was extended until 31 March 2000 due to sanctions, see below in project modification.

EMCAT's Demand-Side Technical and Management Activities (EMCAT-DSM) will contribute to the achievement of USAID/India's fourth strategic objective: "increased environmental protection in energy, industry, and cities," and to achieving the strategic objective's first and second Outcomes -- "increased efficiency and decreased pollution in energy supply and use" and "pollution per unit of output reduced in companies in key industrial sectors" -- by improving the efficiency of systems providing energy services in India, because system-wide efficiency improvements are one of the most promising avenues to reduce the ratio of CO_2 emitted (and other environmental emissions) to electricity services provided. More specifically, two of the intended results of USAID/India programs are to create an improved policy, legal, and regulatory framework for increased power sector efficiency (Activity 4.1.3), and to increase use of environmental technologies as a percentage of total industrial investment (Activity 4.2.1). The second phase of EMCAT-DSM will contribute to realizing these goals by addressing the end-use efficiency improvement challenge from two directions: (a) top-down initiatives by governments and utilities; and (b) encouragement of bottom-up responses by key industrial sectors. Government initiatives will

be coordinated with the EMCAT DSM Phase II Regulatory Reform and Restructuring component (EMCAT-R^3), which will be conducted concurrently with EMCAT-DSM.

Objectives

EMCAT-DSM's second phase will help meet USAID/India's strategic objectives by emphasizing four activity areas: (a) Standards and labeling; (b) Utility DSM programs; (c) Building DSM infrastructure; and (d) Industrial energy efficiency investments. These activity areas were derived from USAID/India's strategic objectives and results framework, the lessons learned from EMCAT-DSM experience to date, and analysis conducted in 1995 and 1996.

EMCAT-DSM's second phase has four goals, each of which is associated with one of the activity areas. At the present time, it is anticipated that higher priority will be given to the first three goals than to the fourth, but the prioritization is subject to change as the project progresses. Activity-specific goals for EMCAT-DSM's second phase are:

> **Standards and labeling:** Expand the use of energy efficiency standards and labels for major household end-uses and industrial electric motors and drives. Revision and use of voluntary efficiency standards and product quality labels.
>
> **Utility DSM programs:** Expand implementation of utility DSM programs beyond the EMCAT DSM Phase II pilot program with Ahmedabad Electric Company (AEC), in the context of IRP as a key component of utility restructuring. Identify and address barriers to DSM investment and implementation. Relate DSM initiatives to IRP and restructuring initiatives under EMCAT-R^3.
>
> **Build DSM infrastructure:** Building the infrastructure to support energy efficiency activities, including domestic energy audit training and efficient motor systems.
>
> **Industrial energy efficiency investments:** Bring to closure industrial efficiency projects for which pre-investment studies have been conducted (either during EMCAT-DSM Phase other or I studies conducted to date), and leverage additional funds from multilateral development banks and other financial institutions for efficiency improvement and DSM.

1.1 EMCAT-DSM concept

Capacity Building in the area of Energy Efficiency in India The main thrust areas of progress were in appliance labeling and standards, utility DSM and providing institutional support for Ministry of Power (MOP) and Bureau of Indian Standards (BIS).

1.2 Task Order Award

USAID/India awarded International Resources Group, Ltd.(IRG), a Task Order(Contract No. PCE-I-00-96-0002-00) in May 2, 1997 to implement EMCAT-DSM under IRG's Environmental Policy and Institutional Strengthening Indefinite Quantity Contract (EPIQ) with USAID's Global Bureau. The original work period extended from June 1, 1997 through

September 30, 1999. This was later extended through a no cost extension until March 31, 2000, see section 1.3 project modification.

1.3 Project Modification

Political events nearly derailed EMCAT-DSM less than a year after it began, and not more than 8 months after operation at full strength. Following India's test of a nuclear device on May 13, 1998, USAID gave a "go slow" work order to EMCAT-DSM for approximately six weeks as it determined the effect of mandatory US (Glenn Amendment) legislative sanctions. IRG's staff remained in New Delhi and the project was reoriented slightly to accommodate the late start of the Energy Commercialization project (ECO). This mainly incorporated more work with the central government at the Ministry of Power (MOP).

2. Background

2.1 The Situation at EMCAT-DSM Phase II Beginning

This project was the first USAID energy efficiency project in India to incorporate a resident advisor into the project design. Drawing on the excellent work done under EMCAT Phase I and other USAID sponsored projects, Phase II was in an excellent position to make an impact in the energy efficiency area in India. India has a long tradition of engineering and provides ample scope and opportunity to promote energy efficiency within the India context. Unfortunately, energy efficiency in India was still viewed as a subject for the shop floor and the line engineers. This is very common in many countries and still to this day, holds back the promotion of energy efficiency as a viable financial exercise.

USAID's efforts in the energy efficiency are accompanied by many donor agencies most notably DFID of the United Kingdom. It was clear from the beginning that USAID would need to carve a niche for itself since its funding levels are much lower than other agencies. One of the main areas where USAID clearly had opportunities was in the policy areas with the central government and in the DSM areas especially Load research.

2.2 The Challenge to EMCAT-DSM

The challenge of the EMCAT-DSM Phase II project was to clearly demonstrate that Energy efficiency both in the factories and in the policy making bodies of the Government of India was a valid developmental field within the Indian context. The condition of the Indian power sector, from generation right down to domestic distribution, makes promoting energy efficiency a challenge. The instability of the voltage and the lack of reliability are the two greatest psychological factors holding back the progress of energy efficiency in India. Companies and people are unwilling to part with money that will be lost with one 30% voltage spike or surge. In fact, refrigerators in India are 2 to 3 times more inefficient than in Thailand due to the over building of compressors. How should we promote energy efficiency within this environment?

Policy. Obviously working at the center is an excellent place to start with policy. It is also important to engage the states. A large responsibility in India lies with the states to provide an environment to promote Energy Efficiency. The reward of a policy initiative, even in the best environments, is years and even decades away. However, this is a great tool to "push" the society at large to incorporate Energy Efficiency into their planning processes. The one big opportunity for USAID was Energy Efficiency standards and labeling and to support GOI to establish the Bureau for Energy Efficiency (BEE).

DSM/Energy Efficiency. After Ahmedabad where will DSM/Energy Efficiency succeed? Within the Amedabad Electric Company (AEC) the climate was favorable for an Energy Efficiency project. The company is private and the individual charged with DSM was an evangelical supporter of Energy Efficiency and the role it could play within an electrical utility. However, the main question was, would this concept work within a bankrupt organization run by bureaucrats and political appointees, and not businessmen? USAID wanted to expand DSM work with the State Electricity Boards that are the key to solving the problems within India's electric sector.

2.3 Deliverable and Reports

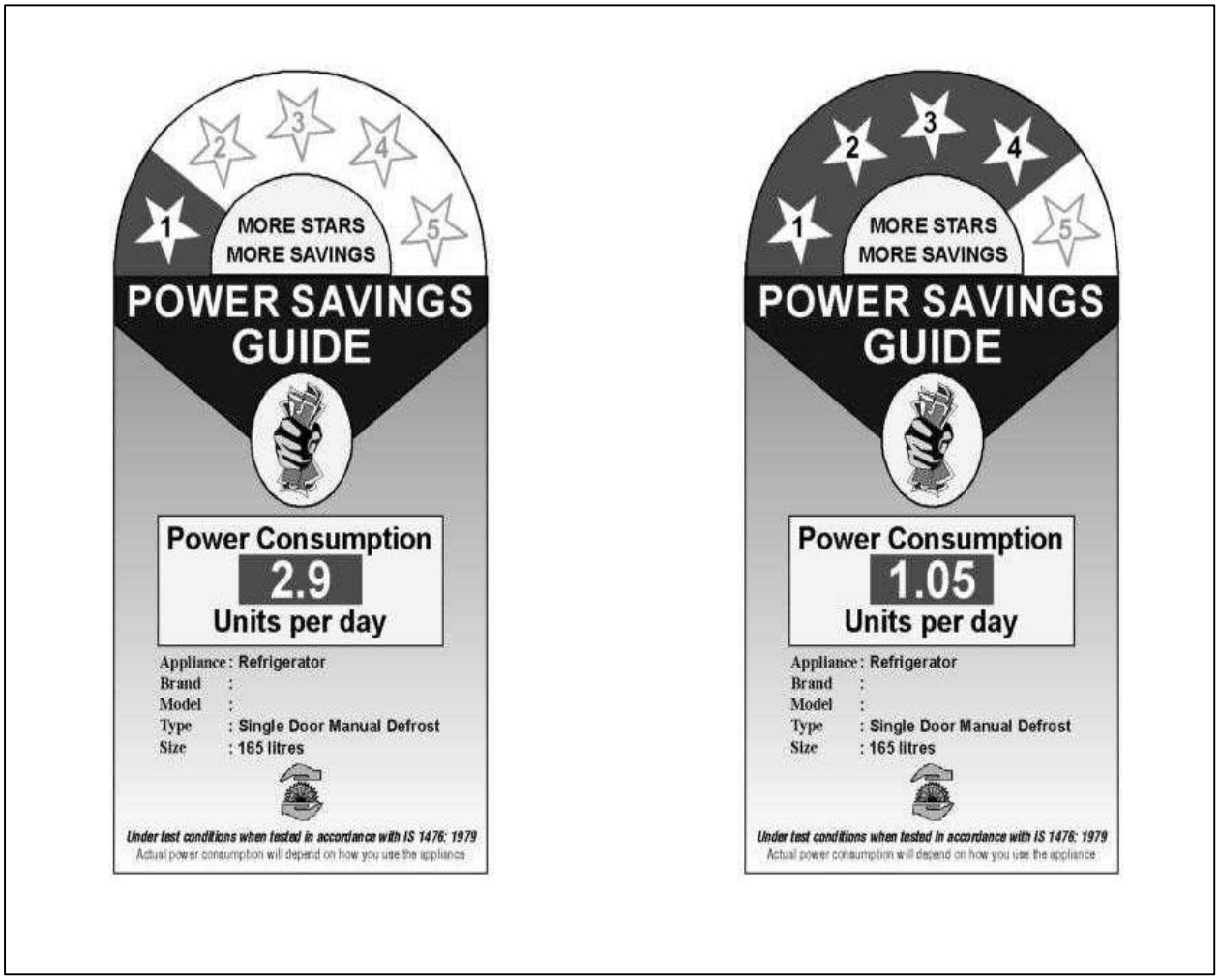
Included with this final report is a CD ROM which has the reports which were generated under the project. Due the sheer volume generated by the project a comprehensive list is included in Appendix A.

3. EMCAT-DSM Accomplishments: The Situation Today

Policy. By the end of EMCAT DSM Phase II, and 34 months of effort, there has been substantial achievements in the policy area with the introduction of the energy efficiency label designed with the assistance of USAID. Below is the label design depicted in Black and White. However, the label was designed in color and this is only a representation. By the close of EMCAT DSM Phase II, the label design below had been included in the standards for refrigerators, air conditioners and water heaters. Although, the BIS is in the process of making some minor alterations to the label, the basic design will remain intact.

This label should not be viewed as a simple design job. The process of getting the label approved through BIS allowed USAID to participate at the policy level within a standards making body, in India. This initiative should be used to work in other policy areas pertaining to Energy Efficiency, such as procurement.

The other main policy effort at the central level has been to support the passage of the Energy Efficiency Bill and the pending Bureau of Energy Efficiency. Unfortunately for EMCAT, due



to three different governments and sanctions, the project was unable to help assist the establishment of the Bureau since the EE Bill was not passed before 31 March 2000.

DSM/Energy Efficiency. The EMCAT DSM Phase II project worked in three different states in Gujurat, Haryana and Tamil Nadu. All of these sates are at different points in the reform process. The work in Gujarat involved evaluating the very successful DSM project at the private Ahmedabad Electric Company (AECo) and implementing it under EMCAT DSM Phase II. The work was completed and the dissemination of information was widespread and well received. The situation at AECo changed dramatically during the first year of EMCAT DSM Phase II, due to a change of AECo ownership. The DSM cell is still functioning and is

used heavily by senior management as a customer service tool. However, a full-blown Energy Efficiency training center as originally conceived, was not in the strategic plans of the new owners.

The old Haryana State Electricity Board (HSEB) undertook reform and restructuring with the help of a loan from the World Bank. Within the context of this loan EMCAT DSM Phase II established a DSM/EE cell and provided funding for distribution loss studies, combined with agriculture pump rectification. These studies resulted in the commitment of $40 million in loans, to reduce energy losses, both in the distribution system and the agriculture pumps.

In Faridabad, an industrial town on the border of New Delhi, in the state of Haryana a pilot Energy Efficiency project was completed with minimal Technical assistance. The Faridabad commission invested their own money in the Energy Efficiency project, that would result in savings of 35%. The aim of the project was to demonstrate to the reforming SEB that good DSM/Energy Efficiency projects could be found within their service territory. At the time of the completion of the EMCAT DSM Phase II project the World Bank and other lending institutions are evaluating the success of Faridabad and the wider implications for investments in municipal pumping infrastructure. USAID is also incorporating this work into a new project that is combining water, energy and health.

In Tamil Nadu, which is not considered a reform state, the EMCAT DSM Phase II project helped establish a DSM/Energy Efficiency cell at their request and undertook a large Load research project. In the process of establishing the cell USAID donated both computers and equipment to assist in the implementation of the pilot project at the board. Currently the cell has 5 employees and has just completed a pilot project involving capacitors and power factor correction.

The Tamilnadu Electricity Board is a Statutory Body formed in 1957 under the Electricity supply Act, 1948 as a successor to the erstwhile Electricity Department of the Government of Chennai. The main task of the electricity board is to generate, transmit and distribute electricity within the state.

The Generating capacity of the Board as on 31/3/1998 was 6916 MW comprising 2970 MW from four Thermal Stations, 130 MW from two Gas turbine Stations, 1956 MW from 29 Hydro Stations, 19 MW from wind farms and 1841 MW as Tamilnadu's share from Central Generating stations. The gross amount of energy supplied during 1997-1998 was 34065 Million Units and the total sale was 26943 MU involving 11.9 million consumers The system loss estimated by the TNEB is16.9%. The peak demand of the state during 1999 was 4918 MW and the board has difficulties in meeting the peak demand. The board has set itself a target of peak demand reduction by 300 MW over a period of five years. Several measures like HT Capacitor installations, Peak hour tariff for industries, statutory energy audits for HT consumers have been introduced to curtail the evening peak.

In order to give an impetus to the peak load management efforts TNEB invited US Agency for International Development (USAID) for assistance and USAID have provided technical assistance to TNEB, to conduct a pilot Demand Side Management study at Chennai city comprising the following activities:

- Load survey and Research

- Guidance on end use measures for peak load reduction
- Proposals to reduce technical losses
- Tariff review
- Consumer awareness
- Assistance with establishment of DSM Cell within TNEB

The IRG (International Resources Group and Energy Economy and Environmental Consultants (3EC) have provided assistance for the first of the above mentioned tasks. This report summarizes the methodology, tasks undertaken and the results achieved on pilot load survey and research.

Definition. *Load Research is the accumulation of customer usage and demand data, data analysis and the deduction of the usage pattern by customer classification. It is intended to provide usage patterns relative to the contribution of consumer classes to the utility system's usage and demand. Load Research is an important tool to design and evaluate Demand Side Management program, design and evaluate Time of Day Tariffs, allocate cost of service to various classes of customers.*

Chennai City Power Distribution Scenario. TNEB does not have a demand curve for Chennai City and even in case of Tamilnadu the composition of the peak load is unknown. Since a demand curve is essential for the successful design and implementation of DSM programs, development of the same was taken as the first task. Significant efforts were made to develop a Chennai system load curve and to segregate the system load curve for each major category of consumers.
A description of Chennai City distribution system is appropriate at this stage. The city receives power essentially from four power stations namely, North Chennai Thermal Power Station, Ennore Thermal power Station, GMR Vasavi and Basin bridge thermal power plant, the last mentioned one being a peaking station. Power is received and transmitted from these stations at a voltage of 230 kV and power is also received at the same voltage from Sriperumbudur. Minor quantum of power is received at 110 kV. Seven major substations located at Tondiarpet, Kadaperi, Koyambedu, Tharamani, Korattur, Mylapore and Gummidipoondi step down the voltage level to 110 kV for distribution. Further voltage reduction and distribution is carried out by 83 substations located within the city. The 230/110/33 kV network of the Chennai city is furnished in Appendix 1. The city distribution system is divided into four circles namely North, Central, South and West. Minor quantity of power is exported out of the city at 11 kV from peripheral substations.

The consumers are categorized essentially into two groups depending on the voltage of supply as HT and LT consumers. The Railways falls under the category of industrial and bulk power is supplied to them at 110 kV. A few continuous process industries receive power at 110 kV and power at 33 kV is supplied to a handful of old industries. For billing purposes TNEB has divided the HT and LT consumers into five categories each, based upon the activity performed (Ref. Appendix-2).
Essentially the city load encompasses industrial, commercial and domestic consumers. The connected load for agriculture sector is about 85 MW.

LOAD RESEARCH PROCESS. The various components involved in the load research are summarized below:

- Financial Commitment

- Determination of Statistically sound survey groups
- Procurement of computer, hardware and software
- Addition and training of staff
- Procurement of statistical meters
- Random selection of consumers for study
- Customer Interviews
- Statistical metering Installation
- On going accumulation of data
- Program maintenance
- User studies

Generally speaking load research is an on going process, carried out over several months. However for Chennai City a snap shot has taken for a period of 3 days to build up an indicative load curve understanding the limitations of accuracy. The overall purposes of the load research conducted for Chennai City were three folds

- To develop load curve information – particularly demand curve- and estimate the contribution of various consumer categories to the evening peak in order to define the DSM programs.
- To develop supply curve and carry out reconciliation between supply and billing
- To help establish the needed infrastructure and staff capability to support systematic data collection and analysis of the load related data.

The Methodology adopted was:

- Collect total city load data and draw demand & supply curves
- Develop load curve for different categories of consumers namely domestic, commercial and industrial, based upon data collected from typical installations. Scale up the typical load curves to arrive at the category wise load shapes
- Superimpose category wise curves on total Chennai city demand curve

Analyze the load curve for contribution of demand by category and suggest appropriate DSM programs.

Summary of Recommendations. The following action plan is suggested for DSM activities in TNEB:

1. Continue load research
   - Verification of load surveys
   - Customer load studies and data base building
   - Extension to other cities
   - Energy reconciliation
   - Improve metering on EHT side
   - Continue loss reduction study
   - Establish linkage with all circles / Divisions
   - Commercialize, the PF demonstration program
2. Energy labeling, performance assessment and promotion of energy efficient domestic, commercial equipment like lighting, Refrigerators and Air conditioners.
3. Extension of the use of Electronic/Static meters.
4. Consider and introduce tariff modification particularly for LT commercial
5. Develop methods for bringing awareness
6. Detailed study of metro water pumping system

4. EMCAT-DSM Activities

4.1 Standards and Labeling

Original Objective. *Expand the use of energy efficiency standards and labels for major household end- uses and industrial electric motors and drives. Revision and use of voluntary efficiency standards and product quality labels.*

4.1.1 Project Activities

Please see quarterly reports and project reports included in the CD ROM for a comprehensive list.

4.1.2 End of Project Status:

- White Paper on Proposed Energy Efficiency Legislation
- Extensive Consumer Research on Label Design
- Recommended Label Design to MOP
- 2 Workshops on Labeling and Standards
- Training of BIS & MOP Personnel on the technical basis of the label
- 1 Working Group Formed (CII)
- Marketing Plan for the Energy Efficiency Label
- Procurement Policies: Tamil Nadu State Electricity Board with recommendations for wider implementation
- Continuos Support to BIS and MOP
- Support CERC in lab development

4.1.3 Lessons Learned

1) **Persistence and long term commitment with the Government** and the policy making bodies such as Bureau of Indian Standards (BIS).
   a) Continual contact was needed with concerned Bureaucrats in the relevant agencies and ministries by the EMCAT DSM Phase II project staff including resident advisors time. **Do not leave in the hands of consultants only**.
   b) Attend rule-making meetings when invited. Don't rely on written communication.

c) Do not overtly advertise the involvement of a foreign agency in the rule making process. This is very important.

2) **Do not alienate any part of the community involved the standard making procedure**. This includes businesses, consumers and all nodal government agencies. Include all of the parties in the decision making process. Document their involvement for later validation of the process.
3) Writing standards outside the Indian process and delivering them cold for incorporation into their existing system WILL NOT work. India has a well established process and are reluctant to incorporate out side views unless their is due process
4) India needs testing laboratory infrastructure to support the standards and labeling initiatives.

4.2 Utility DSM Programs

Original Objective. *Expand implementation of utility DSM programs beyond the EMCAT DSM Phase II pilot program with Ahmedabad Electric Company (AEC), in the context of IRP as a key component of utility restructuring. Identify and address barriers to DSM investment and implementation. Relate DSM initiatives to IRP and restructuring initiatives under EMCAT-R*[3].

4.2.1 Project Activities

Please see quarterly reports and all project reports included in the CD ROM for a comprehensive list.

4.2.2 End of project Status

- Ahmedabad Electric Company's Pilot program Evaluated
- AECos DSM Program Results disseminated throughout India and Abroad
- Published in Major Utility Publication, "The Electricity Journal"
- DSM at HVPNL(HSEB)
  - ♦ DSM Cell
  - ♦ Pre feasibility Study(Lt less/Pumps Agriculture)
  - ♦ Held Three Training Programs
- DSM at TNEB
  - ♦ DSM Cell
  - ♦ Load research
  - ♦ Loss reduction
  - ♦ Tariff review
  - ♦ Capacitor Pilot project

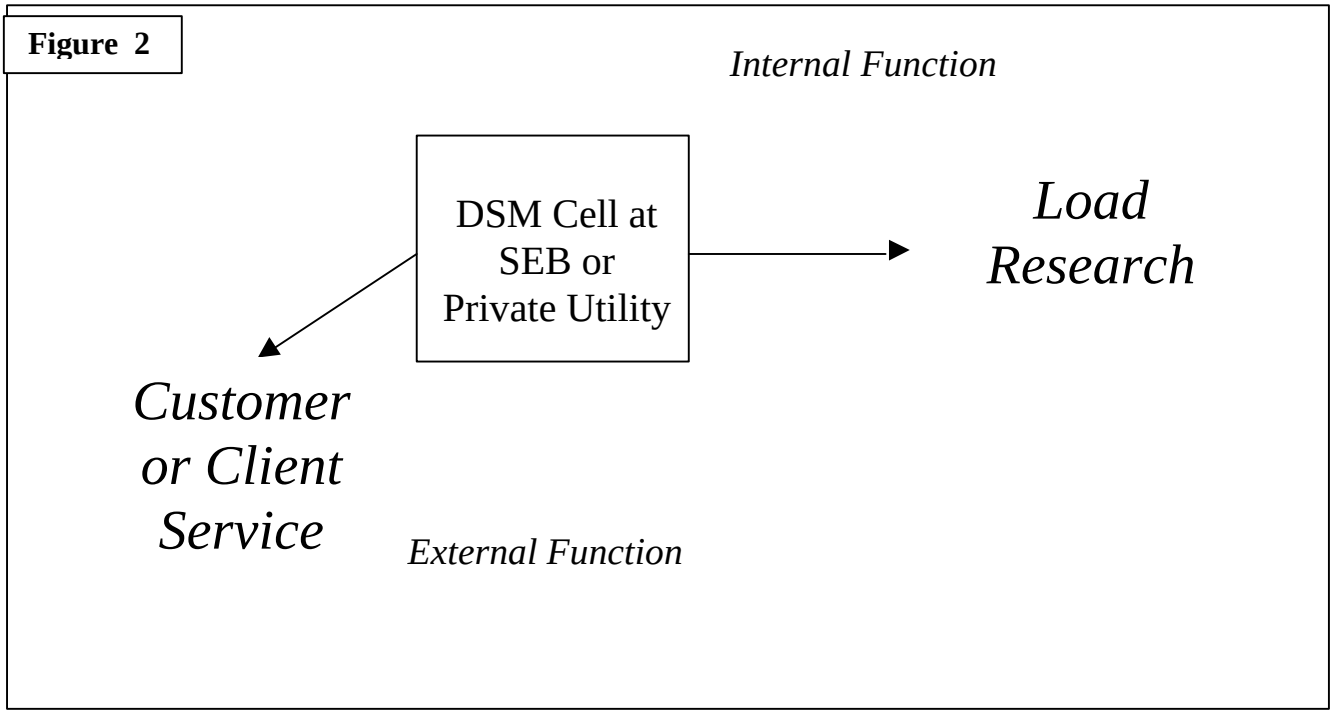
4.2.3 Lessons learned

1) Unlike the US, where management of the distribution side of the business is extremely efficient, Power utilities in India, whether SEBs or the newly privatized distribution entities, suffer from major inefficiencies and deficiencies at all levels and in all areas of their distribution business, Under the circumstances, greater gains will accrue if emphasis is put on involving the utilities improving their distribution management rather than on improving end use efficacy with consumers***. Need of the hour! Therefore, is to take up***

DSM emphasizing efficient distribution management. Promotion of US style DSM can follow only after the utilities have achieved reasonably high levels of distribution efficiency and some progress has been made on the tariff rationalization.

2) **Pick a SEB that shows interest in the project**. A reform state is a better choice if there is some certainty that the project will not get lost in the overall context of the reform process and due priority is given to DSM activities. For a state level DSM program to be successful it requires an absolute minimum of 2 years. However, 3 to 5 years is more suitable for the SEB working environment. Within this time frame sizable energy savings can be achieved.
3) **Senior management support is essential.** This support must come from a member of the board such as Member Distribution. Without this support the DSM/Energy Efficiency cell will not succeed.
   a) Demand at least 3 to 5 employees to be assigned to the cell fulltime. With this many employees the project will have some continuity even with a high transfer rate.
   b) The working cell must have contacts with the field engineers.
   c) If the SEB cannot procure the required equipment these should be furnished to insure a higher level of productivity and provide the necessary TA to give the cell status with the SEB.
   d) Do not underestimate the power of Indian SEB bureaucracy.
4) **Insist on load research as part of the project.** Load research is the internal function of the cell (see Figure 2 below) Load research will:
   a) Encourage the involvement of all the employees in the cell.
   b) Provide data to fully understand the end uses and their impact on the system.

Figure 2



Currently the average domestic user in India uses a light bulb and a fan. Load

research can start with industrial and commercial consumers where some data already exist.
   c) Provide information on technical losses, preferably for each of the distribution circles.
   d) Provide information o commercial losses. However this area of losses should be treated with care due to the political nature of the SEB and all involved.
5) **Highlight and encourage quick success projects.**
   a) Projects with long gestation periods will discourage staff within the cell. These staff members are already fighting with the SEB to be credible and projects that seem intangible will only erode confidence within the cell and with senior staff.
   b) A quick success, like the capacitor project at TNEB, will give credibility to the cell. This type of project will also allow them to market their success both inside and outside the SEB.
   c) If the SEB seems to favor some projects then it means they have a better working relationship with the customer and the chances of success for the project will increase.
6) **The commercial relationship between SEBs and customer is non existent.**
   a) The existing relationship, which is acrimonious, will only impede projects.
   b) The cell will need to learn to work with customers. This is the external function of the cell (see Figure 2).
7) The two thrust areas with the cells should be **Load research and Customer Service (see Figure 2)**. Both of these functions are nonexistent in most electric utilities in India. These are badly needed if the utility is going to engage in American style DSM or ever consider privatization.

4.3 Build DSM Infrastructure

Original Objective. *Building the infrastructure to support energy efficiency activities, including domestic energy audit training and efficient motor systems.*

4.3.1 Project Activities

This part of the project was always intended to give flexibility to the project so that USAID could go where the opportunities presented themselves. As can be seen in the outline in section 4.3.2 there have been a variety of activities undertaken. This list is by no means comprehensive but representative of the activities undertaken. The resident advisor spoke widely at conferences all over India and they are too numerous to list. Please see quarterly reports and project reports included in the CD ROM for a comprehensive list.

Savings Potential

Bore well Pumps	5.4 Million kWh
Booster Pumps	.47 Million
Sewage Pumps	.27 Mill
Load reduction	
Bore well Pumps	750 kW
Booster Pumps	250 kW
Sewage Pumps	40 kW

Fardidabad. Under The EMCAT Project a comprehensive energy audit was conducted, of the whole MCF water system. The audit included not only engineering measurements and verification of all pumps, but it also included an audit of the energy bills received by MCF from HVPNL. Using the results of these exercises, a comprehensive energy management program was recommended to FMC. However, given the budgetary restraints, MCF decided to implement a pilot project using their own resources with

technical assistance from USAID, through the EMCAT-DSM program.

The city's water supply and drainage system consumes the maximum electrical energy (as compared to any municipal function) it accounts for over 70% of the total municipal electricity bill. Since the water table has been falling substantially every year the energy bills related to recovering this water have been increasing steadily year after year. The average depth of the water is 35-40 meters and it is steadily declining. Obviously, this is a cause of concern for MCF officials, since there is an embedded energy cost in every liter of water pumped and, for that matter, lost through distribution leakage. Since the EMCAT-DSM project is primarily concerned with promoting efficiency, through the more efficient operation of the pumping and recovery system, the project did not expound on the water issues, but primarily on the energy associated with providing water for the citizens of FMC.

The disrepair of the pumping station reflects a high level of inefficiency. The IRG team in conjunction with MCF identified several sites for the potential pilot project. After careful analysis and scrutiny by both parties, the ESI Booster Station was chosen. This site was chosen to maximize the resources available to MCF and because of its potential for efficiency gains. A complete renovation including major efficiency improvements was planned for the pumping station. The pilot project represented a start in the operational changes at MCF and also the start of an ambitious program to modernize their pumping stations in order to maximize efficiency gains. The renovation has been completed and the pilot project will yield approximately 40% in Savings. The pilot project exploited the unfortunate fact that the pumps and motors were oversized for the required pumping load. Once the proper piping was designed for the pumping station the correct pump size was ascertained. In the end the total horsepower need for the pumping requirements was reduced from 150 to 90. This resulted in demand savings of approximately 40%. The average measured power consumption was 107.33 kW with the target installed motor capacity to be 67.00 kW, which represents a substantial reduction. The reduction was a result of both more efficient pumps and proper piping. Capacitors were also utilized to reduce the losses on the pumping station cable and distribution losses. The payback for the pilot project was just over 3 years.

Financial Savings for Pilot Project

Reduction in Penalty	Rs. 262,000
Estimated yearly Savings	Rs. 398,273
Project Cost	Rs. 1,420,000
Simple Payback	**3.6 years**

Also included in the revamping of the pumping station were operational issues. One of the major changes in the operation of the pumping station was the creation of a provision for pumping the water directly into the system and bypassing the overhead tank. Pumping into the overhead tank from the ground tanks had been the traditional method, but this didn't create any efficiency gains. This practice was abandoned which resulted in more water for the system at lower energy usage.

Another major problem for MCF was distribution losses through their HVPNL transformer. As part of the project HVPNL revamped their transformer and provided new conductors and proper terminations. The renovation of this transformer improved the voltage delivered to the pumps. Not only does this result in a greater working efficiency of the pumps but it lowers the maintenance cost of the pumps and motors

4.3.2 End of project Status

- Pilot Demonstration Project at FMC
  - ♦ Capacitors
  - ♦ Distribution Efficiency
  - ♦ Pumping Improvement (Both Operational and Mechanical)
- Participated in Maharashtra Water Pumping Seminar
- Performed Pumping Audit of Kholapur Municipal System
- Promoted USAID/EMCAT-DSM at more than 30 Workshops and Seminars throughout India and Overseas.
- More than 20 Newspaper Articles Devoted to EMCAT Phase II Work

- Power Factor Improvement Demonstration Project
  - ♦ Collectorate Building
  - ♦ Ranganathan Street

4.3.3 Lessons learned.

1) Workshops and seminars are good for promoting the work but do little to implement projects. They are also very good networking tolls for putting teams together and disseminating information on Energy Efficiency.
2) To promote EE/DSM there needs to be success stories. These success stories, such as the Faridabad pilot project, will help promote Energy Efficiency by demonstrating the cost-effective nature of viable Energy Efficiency projects.
3) This part of the project demonstrated the overwhelming cost effective nature of the municipal pumping projects in India. The Faridabad pilot project demonstrated the endless Energy Efficiency opportunity in the municipal sector.

4.4 Industrial Energy Efficiency Investments

Original Objective. *Bring to closure industrial efficiency projects for which pre-investment studies have been conducted (either during EMCAT-DSM Phase other or I studies conducted to date), and leverage additional funds from multilateral development banks and other financial institutions for efficiency improvement and DSM.*

4.4.1 Project Activities

Please see quarterly reports and project reports included in the CD ROM for a comprehensive list.

4.4.2 End of Project Status

- Report on the Status of the Indian Financial Sector
- Provided DSM Project for $40 Million World Bank Loan at HVPNL
- Provide Project Water Pumping Project at FMC for Financing. Project was financed with internal funding

4.4.3 Lessons Learned

1) **There is no Shortage of Capital in India for viable projects,** whether they are energy efficiency projects or more line oriented projects.
2) Industrial companies will finance viable projects with money from internal sources or external if the bottom line is approved within the company. **As will all companies there is competition for capital.**
3) Indian companies, like companies worldwide, want projects with paybacks of 2 to 4 years. The industrial uncertainty in India in the last few years has not helped this mentality.
4) With the extreme voltage fluctuations and the unreliable many companies are not willing to invest in technology that cannot withstand the poor power supply. Variable frequency drives are one such technology that needs a reliable supply.
5) Unless power quality and reliability issues are sorted out within the distribution companies major investments in industrial energy efficiency will remain low.

5. Conclusions and Recommendations

Recommended continuing activities under the ECO project and other relevant USAID activities:

- ✓ **Expand Faridabad Pilot Project.** This project has met with tremendous success and should be expanded within Faridabad, if the new commissioner would like to work with USAID. Due to the close proximity to Delhi this project can continue to be used as a success story.

- ✓ **Implement Full DSM Program at TNEB.** Tamil Nadu State Electricity Board (TNEB) has been extremely cooperative in the establishment of the DSM/Energy Efficiency cell with the board. All the ingredients are present including a supportive management and eager and willing staff. A tremendous amount of Load research has already been performed and the cell has computers, donated by USAID, to work with the data. The work at TNEB should continue and expanded. This board is cooperative and even though they are not "reforming" they are willing to work with donor agencies. The absence of other agencies and multilateral donors allows better access to the senior management, as well as their attention.

  Like any other SEB, TNEB does provide free or highly subsidized power to its farmers and this has caused some problems for lending institutions as well as Aid agencies. However, given that all the boards who sell power to farmers are most likely not to meter it. **The states that do not meter the agriculture load, but charge a horsepower tariff suffer from the same problems as TNEB. Grossly inappropriately priced power to farmers, inability to calculate the appropriate load to the farmers, rampant commercial and technical losses throughout the system and chronic lack of coordination throughout the system between generation and distribution which leads to an unstable supply to all consumers.** The only way to assist in solving these problems is to meter all load and account for all electricity sold within the system. Load research within the context of DSM will help the all boards to develop the tools to solve these problems

- ✓ **Assist in the Establishment of BEE at MOP.** USAID's role with the central government is essential to continue the EMCAT Phase-II policy successes with labeling and standards. Working with BEE continues the relationship that has been strengthened through the EMCAT DSM Phase II project. **The BEE needs to start strong and it is essential that BEE secure credibility from the beginning.** USAID can provide that early strong start by providing TA and also to procure computers and other infrastructure items.

- ✓ **Implement India's Energy Efficiency Labeling Program.** EMCAT-DSM Phase II gave rise to the Indian labeling program. With the unequivocal success of the design of the label USAID through its contractor was able to get the label design accepted in the BIS standards. USAID should seize this policy success and use the ECO project to continue this work and also continue to modernize the BIS energy efficiency standards.

  The implementation of the label will be a long process that will need ample technical assistance and continued consensus between the various stake holders if it is to be a success. At the close of the EMCAT Phase II project a certain level of inertia had been

reached with the GOI labeling program. A senior member of the BIS staff even appeared on television to promote the label. However, if the differences between the ministries and business and consumer groups are not continually resolved the project could loose its momentum.

- ✓ **Continue to Assist Multiple Government Agencies in Promotion of Energy Efficiency.** This is an area where possibilities for support are endless. Never the less, all support for energy efficiency in whatever agency should be explored. One of the unseen roles that USAID contractors play is to provide support to government and non government agencies alike that cannot provide their own assistance. This assistance comes in the many forms, from procuring documents when foreign exchange is a problem to downloading a document from the Internet for an agency without an Internet connection. **This role should not be ignored.**

- ✓ **Expand Municipal Pumping Work**. This work had beginnings in Ahmedabad with the first phase of EMCAT DSM and the Sustainable Cities Project. In India, this work probably has the greatest potential of any one energy efficiency activity. Literally there are hundreds of municipalities, from the big metropolises to the "small" towns of a few hundred thousand people, that have extremely inefficient pumping and distribution systems. USAID should make every effort to continue this work. In every liter of water wasted there is embedded energy cost.

- ✓ **Complete Procurement Work with Center Government and Selected State Governments.** It is recognized in developed countries that the government procurement process can have a great impact on the push of energy efficiency technologies. To be convinced of the power of government tenders, just look in any Indian newspaper at the amount of tenders every week. EMCAT DSM Phase II worked in the area of procurement and initiated dialogue at the state level with TNEB. Future work should concentrate on one state and work with them to create a success. Changing the standard of procurement from 40W to 36W sounds like a small change, but will reap a whirlwind of benefits in savings. The Indian bureaucracy is notorious for fighting change as most bureaucracies are and a success would help give them the support to change.

- ✓ **Finance Energy Efficiency Projects.** This area must be promoted until the successful financial model is found. A model that will facilitate the financing of Energy Efficiency projects in India will allow the lending institutions to break down the misperceptions surrounding Energy Efficiency projects.

- ✓ **Continue to Promote Energy Efficiency throughout India.** The hardest work is the work that goes against the status quo. Energy Efficiency in India is a growing discipline and with the overwhelming number of engineers there is no shortage of capable people to promote the role of Energy Efficiency in industry and society at large. However, much work needs to be done to insure that Energy Efficiency is incorporated into the business model and the purchasing decisions of individuals.

Appendix-A Deliverables on CD-ROM

- **Quarterly Reports**

1. First Project Review Committee Report (May-November 1997)
2. Quarterly Report (December 1997 – March 1998)
3. Quarterly Report (April - June 1998)
4. Quarterly Report (July – September 1998)
5. Quarterly Report (October – December 1998)
6. Quarterly Report (January – March 1999)
7. Quarterly Report (April – June 1999)
8. Quarterly Report (July – September 1999)
9. Quarterly Report (October – December)

1. WO#1, (Carol Mullholand and Margaret, December 3-12, 1997) – Trip Report)
2. WO#2, (Linda Dethaman – "Indian Consumer Views of Appliance Efficiency and labeling)
3. WO#4, (Daniel Bailet, October 20 – November 7, 1997 – Trip cum Final Report)
4. WO#6
   - Glen Weisbrod's Trip Report
   - Glen Weisbrod's Report "Lessons learned and remaining needs for expanded application of DSM at AEC"
   - Paper on DSM presented in AESP Conference in Florida in Dec' 98
   - Power Point presentation on DSM
5. WO# 7&11,
   - Recommendations
   - Background reading material
   - Presentations
6. WO#8, (Daniel Bailet, Jan 23-31, 1998 – Trip Report and Final Report in the form of a White Paper)
7. WO# 12&21
   - Report on the Preliminary Energy Audit of Water and Sewage Pumping Systems at Faridabad Municipal Corporation
   - Demonstration Project – (Design Note, Specifications, Evaluation Note, Inspection Note)
   - Report on Demonstration Project
   - Energy Efficiency in Municipal pumping – Case Study
8. WO#13
   - Linda Dethman – "Appliance Standard Labeling, 'Final Four Research', March 8-26, 1999
   - IRG/Preliminary Findings: Public Sector Procurement as pert of Demand Side Management efforts in India
9. WO# 16
   - Linda Dethman "Trip Report" (April 27-May 16, 1998)
   - Linda Dethman's Report "Insight from 10 focus groups \on appliance Efficiency"
10. WO#17
    - Dana Kenny (April 19-May 10, 1998)

- V M Thakor's Presentation

11. WO#18, (Feasibility Reports on "LT less System & Agriculture Pumps" plus Report on Walk Thorough Audit of Irrigation Pump sets are the deliverables
12. WO#19, (Workshop back-ground material, Workshop Presentation and Workshop Recommendation/Summary Report
13. WO#20, (Trip Report by John Di Modica)
14. WO#22
    - Work for the following activities: Appliance Standards and Labeling "Final Four Research"
    - Appliance Efficiency, Market Research and label Development in India, Part III: Final Label Preference Research
15. WO#26, (Training Workshop at HSEB, Chandigarh)
16. WO#27
    - Pat Tangora (Feb – March, 1999) Trip cum Main Report
    - Dick Ernsting (March – April, 1999) Trip cum Main Report
    - Dick Ernsting (August – September, 1999) Trip Report+TNEB Presentation, August 1999
    - Final Report on DSM at TNEB by 3 EC
17. WO#29. (Ramesh Juvekar – "Energy Audit of Water Supply Pumping Systems" of Kolhapur Municipal Corporation, March 2000
18. WO#30, Training Program; Road Map for the establishment & implementation of appliance labeling in India (Lloyd Harrington – A note on Energy Labeling & Energy Efficiency Standards for India: Options for Implementation
19. WO# 31, (Preeti Shridhar – Energy Efficiency Appliance Labeling Marketing Program
20. WO# 32 – "a brief Report by TC Kapoor

Appendix-B Presentations on CD-ROM

1. Presentation on 19th PRC Meeting
2. Presentationat Workshop at Nashik, Improved Management Systems for Water Supply and Sanitation services, December , 1998
3. Presentation on Labelling – Mark Tribble
4. Presentation At TNEB on DSM – IRG/ Hagler Bailey,/Alliance to Save Energy
5. DSM Presentation at HSEB – V M Thakor
6. DSM Presentation at HSEB – Vijay Deshpande
7. DSM Presentation at HSEB – Bhasker Natrajan
8. DSM Presentation at HSEB – G Rao/PG Narasmihan
9. Energy Efficiency Program. September 1999, Pune
10. Presentation on MCF Mode at CEEC Seminar, PHD Chamber of Commerce, Dec 1999, Vijay Deshpande
11. Presentation at CEEC Seminar, Mark Tribble
12. Strategic Options for Energy Efficiency, IIEC, Mumbai, May 1999
13. DSM- Distribution Efficiency
14. Presentation by Lloyd Harrington at CII Workshop, Sept, 1998

Appendix-C List of Miscellaneous Paper Documents

1. Energy Efficiency Improvement Utilizing high technology – Report & Case Studies, 1995
2. Eco-Refrigeration – Conference on Hydrocarbon Fluids in Domestic and Commercial Refrigeration Appliances
3. The Electricity (Supply) Act, 1948
4. Compilation of selected Energy – Related Legislation – Committee on Commerce, US House of Representatives, January 1997
5. DSM 495 – Commercial and Industrial Program Evaluation
6. DSM 330 – Residential Electric Conservation Program evaluation
7. DSM 110 – Agricultural and Agribusiness energy Efficiency Program Evaluation
8. DSM 395 – energy Efficiency Upgrade Program Evaluation
9. Teri Energy Data Directory & Yearbook 1996/97
10. Haryana State Power Sector Restructuring Project – Energy Efficiency Services Volume 1 – Main Report
11. Teri – Demand side management plan for Gujarat Electricity Board – Final Report, 1997
12. Workshop Towards Energy Conservation Law, October 7, 1997 – Background Paper
13. Manual on Business Planning – How to construct a business plan for energy efficiency projects – United Nations- 1994
14. Indian energy Efficiency Industry Director – A networking and Buying Guide – CEECI
15. Asian Development Bank Energy Efficiency Support Project – Background paper
16. Demand Side Load Management and Energy Efficient Equipment – IEEMA, 1999
17. Haryana State Power Sector Restructuring Project Demand Side Management Component, Status Report, June 1998
18. Workshop on Development and Financing of energy Efficiency Services in Haryana, 1997, HSEB & World Bank
19. All india seminar on Refrigeration and air – conditioning, Proceedings, Ect. 30& 31, 1998, Videocon Appliances Ltd, Aurangabad
20. Standards for Safety, January 1999, Catalog – Underwriters Laboratories Inc.
21. RMA- Energy Management Consultation and Training Project (EMCAT):DSM, (April 27- May, 1997), H
22. RMA- Energy Management Consultation and Training Project (EMCAT):DSM, (April 19- May 3, 1996), Charlie Fafard
23. RMA- Energy Management Consultation and Training Project (EMCAT):DSM, (March 13, April 8, 1997), Ashok Sarkar
24. RMA- Energy Management Consultation and Training Project (EMCAT):DSM, (June 20-July 15, 1994), Jennifer Fagan & Colling Green
25. RMA- Energy Management Consultation and Training Project (EMCAT):DSM, (June, 1995), Paul Farrell
26. RMA- Energy Management Consultation and Training Project (EMCAT):DSM, (April 29- May 23, 1996), Mr. Niels Wolter & Dr. H
27. RMA- Energy Management Consultation and Training Project (EMCAT):DSM, (August 29 – September 12, 1995), Charlier Fafard
28. RMA- Energy Management Consultation and Training Project (EMCAT):DSM, (Feb 13 – March 4, 1997), Jennifer Fagan and Ashok Sarkar
29. RMA- Energy Management Consultation and Training Project (EMCAT):DSM, (March 8-22, 1997), Charles Fafard

30. Energy Management Consultation and Training Project (EMCAT): Loan Portfolio Development Project (LP) : Pre-Investment Survey - Fertilizer Industry: By JW Foster for RMA: June 1995
31. Energy Management Consultation and Training Project (EMCAT): Loan Portfolio Development Project (LPD): Pre-Investment Survey: Paper and Pulp Industry: By R A Young for RMA: Pre-Investment Survey-Paper and Pulp Industry, September 1995
32. Energy Management Consultation and Training Project (EMCAT): Loan Portfolio Development Portfolio Development Project (LPD): Pre-Investment Survey, Commercial AC Buildings Sector, December 1995: Prepared by Doug Presny, Gurvinder Singh (RMA)
33. Energy Management Consultation and Training Project (EMCAT): Loan Portfolio Development Project (LPD): Pre-Investment Survey-Textile Industry: By Lewis Price (RMA): December 1996
34. Energy Management Consultation and Training Project (EMCAT): Loan Portfolio Development Project (LPD): Pre-Investment Survey-Direct Reduced Iron Industry (Sponge Iron): By J Feinman (RMA): September 1995
35. Energy Management Consultation and Training Project (EMCAT): Loan Portfolio Development Project (LPD): Pre-Investment Survey-Commercial AC Building Sector, December 1995
36. Energy Management Consultation and Training Project (EMCAT): DSM Pilot Program for Ahmedabad Electricity Company, April 29 - May 23, 1996
37. Energy Management Consultation and Training Project (EMCAT): January 11 – 25, 1997, Charles Fafard, Ashok Sarkar, Wes Foell and Hameed Nezhad
38. Energy Management Consultation and Training Project (EMCAT): DSM Pilot Program for Ahmedabad Electricity Company, April 29 - May 23, 1996, Mr Niel Wolter and Hameed Nezhad
39. Energy Management Consultation and Training Project (EMCAT): Energy Audit Improvement Program and Information Dissemination Components, Feb 7 – 24, 1995, Donna Lewein
40. Energy Management Consultation and Training Project (EMCAT): Loan Portfolio Development Project (LPD), Pre-Investment Survey – Textile Industry, December 1996
41. Energy Management Consultation and Training Project (EMCAT): Energy Audit Improvement Program Component , March 2 – April 2, 1995, Chuck Sasso, Doug Presny
42. Energy Management Consultation and Training Project (EMCAT): Energy Service Company Development and Loan Portfolio Design Components, August 15 – September 7, 1994, Jim Hansen, Charlier Fafard & Ashok Sarkar
43. Energy Management Consultation and Training Project (EMCAT): DSM Component and Project Management, September 9 – October 1, 1996; Charles Fafard, Niels Wolter & Dr. hameed Nezhad
44. Indian Economic Survey, 1996 –1997
45. Project Appraisal Document on a proposed Loan in the amount of US$60 million equivalent to India for a Haryana Power Sector Restructuring Project in support of the first phase of the Haryana power sector restructuring and development program
46. International Seminar on environment sustainability through architecture and energy management in buildings – abstracts, 26 – 28 April, 1999
47. Agricultural Pumping – emerging Dimensions and Impact in Power Sector, 27-28 August 1998, Bangalore – CBIP
48. DSM Program Design and implementation guidelines for the Ahmedabad Electricity Company, Sept. 1997, Hagler Bailly

49. Energy Management Consultation and Training Project (EMCAT): DSM Management/Project Management, March 6 – 21, 1995, Charlie Fafard
50. Energy Management Consultation and Training Project (EMCAT): Loan Portfolio development Project (LPD) – Strategic Study, January 23 – February 12, 1995, Niels Wolter
51. Energy Management Consultation and Training Project (EMCAT): Loan Portfolio development Project (LPD) – Pre-Investment Survey, Taj Palace Hotel, December 1995, Doug Presny
52. Energy Management Consultation and Training Project (EMCAT): Energy Audit Improvement Program Component, Audit Equipment and Training, August 1 –20, 1994, Mary Worzala, Robert Hammacher
53. Energy Management Consultation and Training Project (EMCAT): DSM Component, January 4 –February 4, 1996, Dr Hameed Nezhad
54. Energy Management Consultation and Training Project (EMCAT): Training Report, 1995, RMA
55. Energy Management Consultation and Training Project (EMCAT): Project Management and Energy Audit Improvement Program Componenets, May 6 – 25, 1995, Charlier Fafard, Mary Worzala
56. Energy Management Consultation and Training Project (EMCAT): DSM Management/Project Management, Jan 6-18, 1996, Charlie Fafard
57. Energy Management Consultation and Training Project (EMCAT): Administration of Overall project, Nov 28 – Dec 9, 1994, Charlie Fafard
58. EMCAT-Demand Side Year 3 Work Plan – Final: April 1, 1996 – March 31, 1997: By Charlie Fadard Mary Worzala: April 2, 1996
59. Energy Management Consultation and Training Project (EMCAT): Loan Portfolio Development Project (LPD), Pre-Investment Survey – Direct Reduced Iron Industry (Spone Iron), September 1995, J Feinman
60. Energy Management Consultation and Training Project (EMCAT): Loan Protfolia Development Project (LPD), Pre-Investment Survey, Cement Industry, June 1995, Alex Mishulovich
61. Energy Management Consultation and Training Project (EMCAT): Loan Protfolia Development Project (LPD), Pre-Investment Survey – Paper and Pulp Indstry, September 1995, R.A. Young
62. Energy Management Consultation and Training Project (EMCAT): Loan Protfolia Development Project (LPD), Pre-Investment Survey, Fertilizer Industry, June 1995, J.W. Foster
63. Energy Management Consultation and Training Project (EMCAT): Loan Protfolia Development Project (LPD), Pre-Investment Survey – Leela Kempinski hotel, December 1995, Doug Presny, Gurvinder Singh
64. Energy Management Consultation and Training Project (EMCAT): Loan Protfolia Development Project (LPD), Pre-Investment Survey – Hinduja Hospital, December 1995, Doug Presney, Gruvinder Singh
65. Energy Management Consultation and Training Project (EMCAT): Loan Protfolia Development Project (LPD), Pre-Investment Survey – Cement Industry, June 1995, Alex Mishulvich
66. Energy Management Consultation and Training Project (EMCAT): DSM Componenet, August 1 – September 1995, Dr. Hameed Nezhad and Mr. Niels Wolter
67. Energy Management Consultation and Training Project (EMCAT): DSM. Municipal Water Pmping, Calcutta, August 1 – 16, 1997, Charles Fafard & Doug Presny

68. Energy Management Consultation and Training Project in India : Information Materials: July 1997
69. Energy Management Consultation and Training Project (EMCAT): Private Sector Consulting – ESCO Component, December 1-17, 1995, James C Hansen
70. Energy Management Consultation and Training Project (EMCAT): Private Sector Consulting – ESCO Component, Feb 3-20, 1995, Jim Hansen
71. Energy Management Consultation and Training Project (EMCAT): Private Sector Consulting – ESCO Component, May 8-24, 1995, James C Hansen
72. Energy Management Consultation and Training Project (EMCAT): DSM Technical Assistance Component, September 15-3, 1994, Clair Fulenwider, Ashok Sarkar
73. India: Haryana State Power Sector Restructuring Project – energy Efficiency/Demand Side Management Component – Roder Peters (3 copies)
74. The World Bank – Project Appraisal Document, December 16, 1997 (2 copies)
75. Federal Register . Dept. of Energy, Standard for Room Air Conditions- Final Rule
76. TERI – DSM in the agricultural sector of Uttar Pradesh investment strategies and pilot design, August 1996
77. Haryana State power Sector Restructuring Project – Energy Efficiency Services, Volume II Annexures for World Bank by Dalal Consultants
78. "Energy Efficiency in a Competitive Environment", September 1998, Lloyd Harrington
79. DSM At Haryana State Electricity Board: DSM Cell St5ructure and Training Plan, May 1998, Dana Kenny
80. DSM at Tamil Nadu State Electricity Board, DSM Cell, Structure and Training Plan, October 1999 (2 Copies)
81. DSM at Haryana State Electricity Board: DSM Cell, June 1998
82. Appliance Energy Labels from Around the World, 22-24 January, 1998, Lloyd harrington
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84. Energy labelling in Europe- an emerging success story
85. Review of energy efficiency Test standards and Regulations in APEC Member Economics, Main Report, Nov. 1999, APEC
86. Review of energy efficiency Test standards and Regulations in APEC Member Economics, technical Annexes A to G, Nov. 1999, APEC
87. Communicating with Whom? The effectiveness of appliance energy labels in the U.S. and Thailand
88. Peter du Pont – Energy Labelling – Presentation
89. Steps for DSM to Increase Utility Company Profits and Reduce Company Losses , (AEC/USAID/IRG)
90. Appliance Efficiency Labels – Report of the Final short Listing Survey, Mode, March 1999.
91. Indian Consumer Views of Appliance Efficiency and Labeling
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93. Implementation of Energy of Efficiency Labeling regimes – Presentation by Lloyd Harrington
94. Prefeasibility Report on LT Less Distribution System and energy efficiency Pumping System for Bastra Feeder (HESB)
95. Feasibility Report on Upgrading of Agriculture Distribution Network for Alampur Feeder, Oct 1998, HSEB
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98. Feasibility Report on Upgrading of Agriculture Distribution Network for Palara Feeder, Oct 1998, HSEB
99. Workshop on the consumer acceptance of energy efficient label formats and Product standards, January 1998
100. DSM Meet"99, organized by the Ahmedabad Electricity Co. Ltd, January 1999
101. Sustainable cities initiative for Ahmedabad, India, Achievements and Results, Sept 1997, AEC
102. Principles and Practice of DSM, Barakat & Chambertin
103. ADB, energy Efficiency Support Projects, Buyer – Seller Meet on Energy Saving Devices, July 1998
104. Indian energy Efficiency Industry Director – a Networking and Buying Guide
105. Papers presented at the seminar on energy efficiency – under EMCAT Project of USAID, Jan 1997
106. List of Important Organizations & Manufacturers
107. India Energy Training Program Course , DSM at Regulatory Regime including VM Thakor's Presentation from IRG.