Eskom

Corporate Services Division

Assurance and Forensic Department

Contracted the North-West University to execute this project

The Measurement and Verification Guideline for Energy Efficiency and Demand-Side Management (EEDSM) Projects and Programmes

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EXECUTIVE SUMMARY

The following document provides a guideline on the general issues surrounding Measurement and Verification (M&V), and the application thereof in the context of Eskom's demand-side management programme. The first chapter of this guideline gives an overview of the M&V process, why M&V plays an important role in the DSM programme and explains the basic principles followed. It then describes the benefits that M&V add to DSM projects.

Chapter two of this guideline document provides an overview of the stages associated with a DSM project and how each of these stages influences the project's energy use. The third chapter provides a detail look at the various stages associated with the M&V process and describe what each of these stages entail. A section on condonable days is also included in this section and how these occurrences should be handled in the South African context.

The fourth chapter describes how the M&V process and its various stages interact with the actual DSM projects. The fifth and sixth chapters describe the basic responsibilities of the Energy Services Company (ESCo) and the Clients of DSM project and what they can do to ensure maximum effectiveness of the M&V process.

Chapter seven provides a basic approach that M&V teams can follow to derive data when confronted with data loss. The chapters that follow deals with lessons learnt from various M&V projects and then cover a section on safety during the M&V process.

The M&V guideline is the result of years of effort to ultimately result in an M&V process and related methodologies to deliver transparent, accurate and repeatable results in the quantification of DSM project impacts, as well as the evaluation of the sustainability of these results. The guideline is continuously updated and any feedback, comments and contributions that will ultimately benefit the M&V process and the EEDSM programme is welcome, and can be forwarded to the authors whose contact details are included in the last chapter of this document.

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NOMENCLATURE

DMP	Demand Market Participation
DSM	Demand side management
EEDSM	Energy Efficiency and Demand-Side Management
ESCo	Energy Service Company
EVO	Energy Valuation Organisation
FEMP	M&V guidelines for federal energy management projects
IPMVP	International Performance Measurement and Verification Protocol
M&E	Monitoring and evaluation
M&V	Monitoring / measurement and verification
MW	Megawatt
MWh	Megawatt-hour
NERSA	National Electricity Regulator of South Africa
PAR	Performance Assessment Report
PCP	Power Conservation Program
PTR	Performance Tracking Report
RLM	Residential Load Management
SLA	Service Level Adjustment
T&E	Tracking and evaluating
R	Rand

CHAPTER 1: INTRODUCTION

1.1 Background

Demand-side management (DSM) projects are implemented to achieve energy consumption and energy demand savings, and ultimately cost savings. DSM projects cover a wide range of electricity related activities and strategies, which may consist of energy efficiency, load shifting, load shedding, or combinations of the above. The basis of successful DSM projects rests on the fact that impacts can be determined to a degree of accuracy and trust that is acceptable to all stakeholders. This process is known as measurement and verification (M&V). The objectives of M&V are to provide an impartial, credible transparent and replicable process that can be used to quantify and assess the impacts and sustainability of DSM projects.

The M&V process is designed to provide an impartial quantification and assessment of project impacts and savings that result from DSM activities. Once the project impacts are known, the utility (Eskom) can monitor and evaluate (M&E) the performance and progress of all the DSM project activities. This will help to identify present and future focus areas for DSM, as well as potential problems with implementation. M&V therefore makes a critical contribution towards the successful implementation of DSM in South Africa.

This chapter describes the concept of M&V. This chapter will answer the following questions:

1. What is measurement and verification?
2. Why should we measure and verify?
3. How does one measure and verify?
4. What is the rationale behind the savings determination?

The aim of this guideline document is to provide guidance to the various DSM stakeholders and assist in the successful deployment and capacity building of DSM in South Africa. The purpose of this guideline is to provide a basic and standardized understanding of the M&V process and how it fits into the scope of a DSM project.

This guideline will firstly describe what M&V is, why M&V is necessary and how M&V is conducted. The rationale behind M&V is discussed and how it is structured to complement the efforts of DSM projects. The guideline then proceeds to explaining the basic stages associated with DSM projects and M&V projects. The interaction between DSM and M&V is discussed. The

guideline describes what is expected from both the ESCo and the Client by the M&V team in terms of assistance during the M&V of the DSM project. The guideline document also includes a section on lessons learnt on issues that either facilitated better implementation or affected the M&V of DSM projects.

Previous versions of the M&V Guideline included various sections on a proposed methodology on under-performance penalties and over-performance banking. The draft methodology that was originally proposed for the banking of over-performance and penalties incurred during under-performance of DSM projects provided a good kick-off point for the issue of banking and penalties. However, the draft methodology was not sufficient to be used in its current form since it contained a number of deficiencies that limited it practicality and applicability in the South African DSM market. These sections have consequently been removed from the M&V Guideline until a workable methodology has been drafted, tested and finalised.

A number of appendices were also included in previous versions of the M&V Guideline that contained examples of the various M&V deliverables (M&V scoping report, M&V plan, M&V Baseline report, etc.). These appendices have also been removed to firstly shorten the M&V Guideline document and secondly for the reason that the M&V teams are in the process of standardizing the layout and contents of these documents. The Assurance and Forensic Department and the authors can be contacted to obtain copies of these documents. Contact details are available at the end of this guideline.

The energy efficiency and demand-side management industry in South Africa is extremely dynamic. This guideline aim to provide guidance on the methodologies and standardised approach towards the measurement and verification methodologies for these industries. The Measurement and Verification guideline consequently needs to be updated constantly with new developments and procedures. The approach that is followed is the following:

- Stakeholder suggestions, comments, inputs, additions and procedural changes to this guideline is noted throughout the year;
- All M&V Practitioners is formally consulted before approval is provided to update the M&V Guideline. Their comments, feedback and additional inputs based on their perspective and experience, as well as best practices (EVO, IPMVP, etc) are taken into consideration when performing any updates.
- The updates that will improve and contribute towards the overall M&V methodologies and the processes is made to the guideline.
- The updated guideline is then shared with the EEDSM project and programme implementers and stakeholders for their feedback and comments;

- The M&V Practitioners will then consider and incorporate the comments and feedback into the M&V Guideline where necessary;
- The M&V Guideline is then issued to policy makers and stakeholder parties such as NERSA, DME and NEEA for comments, feedback and additions which is again considered and incorporated into the guideline.
- The final document is then published to the Assurance and Forensic Department Energy Audit Website where stakeholders have free access to it:

  http://www.eskom.co.za/live/content.php?Category_ID=328
- Updates to this document is made at least twice a year (February and November) and on an ad hoc basis;

The fact that the above process is followed during the development and updating of the M&V Guideline ensures that the EEDSM industry and regulating bodies agree and accepts the guideline and the overall M&V process.

1.2 What is Measurement and verification?

There are a number of stakeholders in any DSM project. These stakeholders include the utility, the client and the ESCo. The clients want to reduce their monthly energy costs when they reduce their peak demand and/or energy consumption. The DSM funding party (Eskom) needs to protect its investment in the DSM project. The ESCo wants to implement the DSM and energy-efficiency projects and get paid for their services (Figure 1.1). This situation makes it necessary that the project impacts be determined to a certain level of accuracy that is acceptable to all stakeholders.

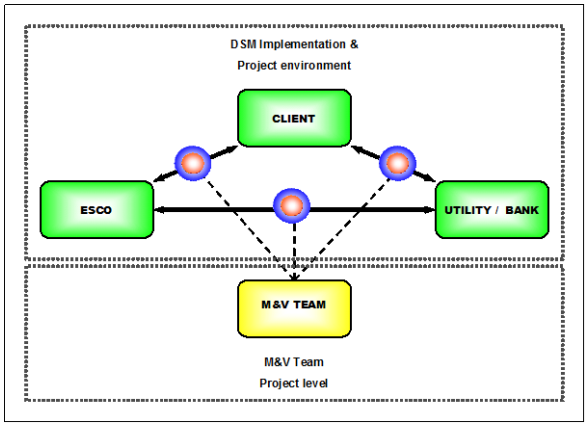

Figure 1.1: DSM Project stakeholders.

The ESCo or the client usually identifies the need or a potential for a project and performs savings calculations as part of the preliminary and design phases of the DSM project. A letter of intent is then provided by the client to the ESCo. A proposal is then submitted to Eskom for DSM funding. Once project funding is approved, the ESCo can proceed and implement the project on the client's site. After the DSM intervention has been fully implemented, these impacts and savings need to be quantified to determine the effectiveness of the intervention for the stakeholders. Since the contractual agreements rely on accurate and impartial savings and

impact information, the task of saving assessment and quantification need to be performed by a party outside the group of principal project stakeholders.

The primary questions that all project stakeholders want answered are: **How much are we saving and are the savings being sustained?** The dynamics in DSM projects make it difficult, and certainly not preferable, to assign any one of the principal stakeholders to deliver an objective assessment of the savings. The quantification and assessment of the savings must remain impartial and the complete process transparent. The long-term success of many projects is often hampered by the inability of project partners to agree on the quantity of savings that have been obtained. It is for this reason that another party needs to be included in the process to determine and verify the savings, hence the M&V Team.

M&V is the vehicle to provide all the DSM project stakeholders with an impartial quantification of the savings. Figure 1.1 shows a schematic representation of the interaction between the principal stakeholders and the M&V team. It can be seen that the M&V team is active on all the levels between the various project stakeholders. The M&V team, however, stands apart from the project environment in order to ensure impartiality. However, the project parameters are measured, baselines are developed and the savings calculated by the M&V team within the project environment. The purpose of M&V is thus to facilitate agreement between the stakeholders on the project outcomes through accurate reporting of results.

Accurate measurement, a replicable methodology, as well as a consistent and reliable process are some of the requirements to determine the savings that result from DSM projects.

1.3 Why should we measure and verify?

The South African utility Eskom, has embarked on a national DSM initiative in the industrial, commercial and residential sectors. The projects that fall under the scope of DSM form part of Eskom's long-term strategy to reduce South Africa's electricity demand during peak periods and to increase the level of electricity efficiency [1].

The importance of M&V to the success of DSM in South Africa is obvious. Large financial investments are being made and an increasing number of clients are realizing the need for DSM to maintain sustainability in their operations. An increasing number of agreements are also being forged between project stakeholders. M&V is designed to quantify and assess the savings that result from projects in an impartial manner. If the project impacts are known, stakeholders can identify focus areas for DSM, as well as potential problems. M&V will also help with the proper implementation of projects. M&V is therefore an essential part of any energy-related project.

M&V encourages investment in the DSM industry and reduces the risk for investors. M&V thus help to overcome barriers to the implementation of energy and demand-reducing projects. The process of M&V provides credibility and broad based acceptance to the energy market.

The process of M&V also provides valuable feedback to stakeholders regarding the way in which savings are influenced. Efforts can thus be focussed to optimise the project impacts. The fact that the savings are measured and verified encourages better design and management of projects. M&V not only provides energy consumption (MWh) and demand (MW) impacts, but also provide the monthly and annual cost savings, together with a number of environmental impacts.

1.4 How does one measure and verify?

The South African energy market has had limited experience with regards to M&V prior to 2000. The focus was consequently placed on international measurement and verification protocols in order to gain an understanding of M&V and its requirements.

These protocols were the International Performance Measurement and Verification Protocol (IPMVP) [2], as well as the M&V Guidelines for Federal Energy Management Projects (FEMP) [3]. These protocols have been in use internationally for a number of years and have proved to be a valuable source of information on the requirements of M&V. These protocols were adjusted and in some cases expanded for the South African situation [4]. The M&V process was streamlined and structured in a more focussed manner for each type of project since the inception of the DSM initiative with the help of valuable experience gained from the actual DSM projects. Substantial work and research has also been conducted by the South African M&V teams on the development of M&V methodologies and baseline development, which is a critical component of the quantification of the project impacts.

The basic principle of M&V is to compare the measured electricity consumption and demand after implementation with what it was before implementation in order to determine the impacts [2]. This is demonstrated in Equation 1.

Electricity savings = (Pre-implementation electricity use) – (Post-implementation electricity use) ± Adjustments (Eq. 1)

This pre-implementation electricity use conditions is described by a baseline. The baseline represents the electricity use linked to a set of conditions under which the system in question was operating prior to implementation. This could include factors such as production, weather, building occupancy, system use, and electricity tariff structure. If the above factors remain unchanged, the post-implementation electricity use can be directly compared to that of the

Baseline. Service level adjustments (SLA) are, however, necessary to bring the two time periods under the same set of operational conditions if any of the pre-implementation conditions were to change. Service level adjustments are thus made to restate baseline electricity use under post-implementation conditions.

Baseline adjustments are another form of adjustment as shown in Equation 1. This adjustment is done in the case of equipment or scope changes to projects and is done on an ad hoc basis and not periodically as in the case of service level adjustments.

The M&V process is implemented in various levels of complexity. This depends on the selected M&V Option and the measurement equipment required to M&V, as well as the accuracy level required by the various parties involved. The M&V team uses four Options of which any one can be adopted to a particular impact determination task. These options are the following:

Option A - Partially Measured Retrofit Isolation: Option A involves isolation of the electricity use of the equipment affected by a project from the electricity use of the rest of the facility. Measurement equipment is used to isolate all relevant electricity usage for the pre-implementation and post-implementation periods. Only partial measurement is used under Option A, with some parameter(s) being stipulated rather than measured. However, such stipulation can only be made where it can be shown that the combined impact of the plausible errors from all such stipulations will not significantly affect overall reported savings.

Option B - Retrofit Isolation: The savings determination techniques of Option B are identical to those of Option A except that no stipulations are allowed under Option B. In other words, full measurement is required. Short term or continuous metering may be used under Option B. Continuous metering provides greater certainty in reported savings and more data about equipment operation.

Option C - Whole Building: Option C involves use of utility meters or whole building sub-meters to assess the energy[1] performance of a total building. Option C assesses the impact of any type of project, but not individually if more than one is applied to an energy meter. This Option determines the collective savings of all DSM activities applied to the part of the facility monitored by the energy meter. Also, since whole building meters are used, savings reported under Option C include the impact of any other changes made in facility energy use (positive or negative). Option C may be used in cases where there is a high degree of interaction between implemented

[1] This guideline focuses on electricity usage during DSM projects. The term energy is however also used throughout this guideline, but refers to electrical energy in the context of this guideline and the DSM programme.

activities or between activities and the rest of the building, or the isolation and measurement of individual project activities is difficult or too costly.

Option D - Calibrated Simulation: Option D involves the use of computer simulation software to predict facility energy use for one or both of the energy use terms in Equation 1. Such a simulation model must be "calibrated" so that it predicts an energy use and demand pattern that reasonably matches actual utility consumption and demand data from either the base year or a post-implementation year. Option D may be used to assess the performance of all project activities in a facility, akin to Option C. However, different from Option C, multiple runs of the simulation tool in Option D allow estimates of the savings attributable to each project activity within a multiple activity project.

The M&V project has a total of six deliverables. They are the following:

- M&V Scoping report;
- M&V plan;
- M&V baseline report (draft and final);
- Post-implementation M&V report;
- Performance assessment report(s); and
- Performance tracking reports (Monthly, annual, or agreed interval).

These deliverables and reports are structured in such a way as to facilitate buy-in into the M&V project procedures and provide all the project participants with a clear understanding and layout of the way in which M&V will proceed. These reports and deliverables are discussed in more detail in the sections that follow in this guideline document. Example reports in a standardized format are available from the Assurance and Forensic Department and the authors.

1.5 What is the rationale behind the saving determination?

A DSM project comprises of three basic stages. These stages are the pre-implementation stage, the implementation stage and lastly the post-implementation stage. The timeline for each of these phases may vary according to the project complexity and a range of other factors. These stages can be seen in Figure 1.2.

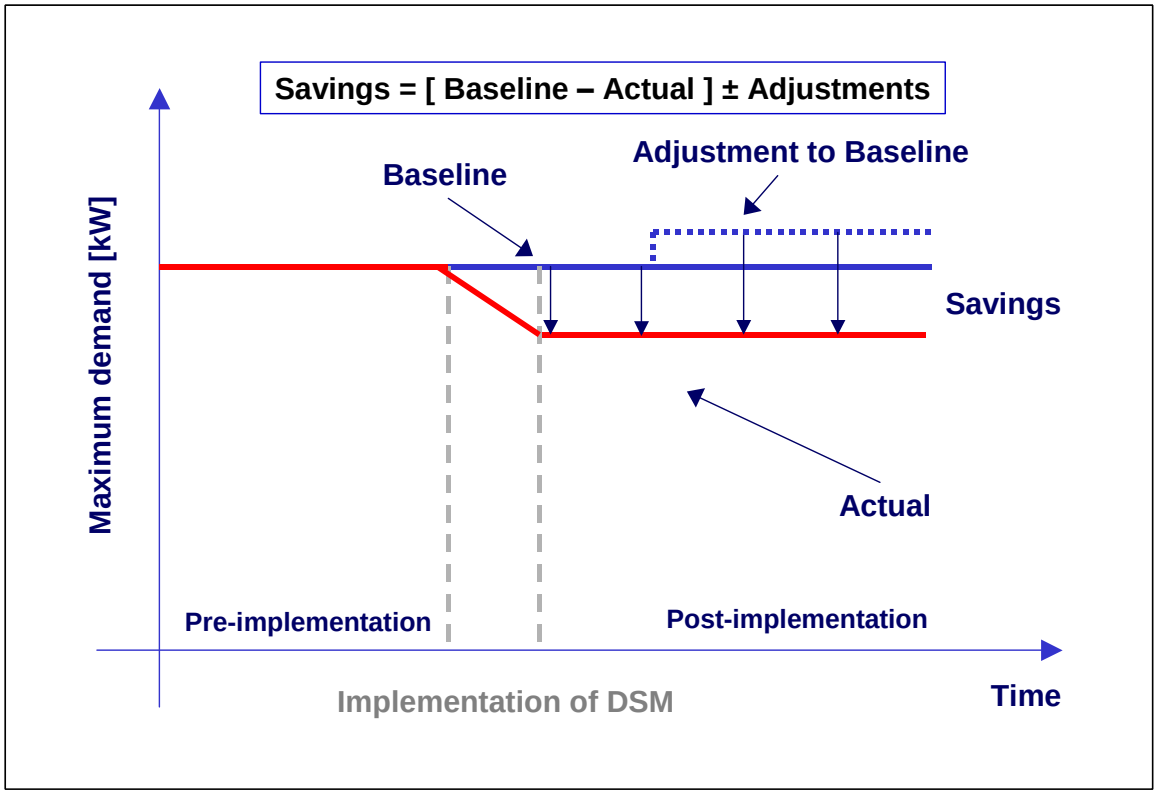

Figure 1.2: Basic project stages and approach of saving calculation.

A system has a characteristic energy usage before a DSM intervention is implemented. After implementation the energy usage is reduced by a certain amount. In order to determine what the savings are, we need to establish what the energy usage after implementation would have been, had the DSM intervention not taken place.

This is achieved through the use of a baseline that describes the energy usage based on certain known and/or measurable input variables or patterns. This enables calculation of the savings that were achieved by the DSM intervention by obtaining the difference between the baseline and the

actual energy usage. All baselines are based on certain assumptions and criteria. Adjustments are made to the baseline when any of these assumptions become invalid or criteria are no longer satisfied by the baseline. These adjustments are not done on a regular basis (daily, monthly, etc.) as is the case with the Service Level Adjustments described earlier, but rather when they become necessary.

Baselines are critical to the process and care need to be taken during the development of baselines. It is not sufficient just to look at what happened the previous year and use it as a baseline. It could occur that energy costs increase after implementation, and a baseline should be able to pick this up. Consider Figure 1.3 where a DSM intervention is implemented, but soon afterwards the actual cost starts to rise. Saving would thus occur only to a point X in time. This could result in disputes if baseline 1 were used (simple extrapolation of previous behaviour). An accurate baseline (baseline 2) shows that the energy cost would have risen as well in the absence of the DSM intervention and that savings are actually still being achieved. This principle applies to all baselines and it is for this reason that all the M&V baselines are linked to a service level, be it production, occupancy, etc. This means that the baseline should accurately reflect increased electricity use due to either increased production for industrial sites, or due to increased occupancy in commercial buildings for instance.

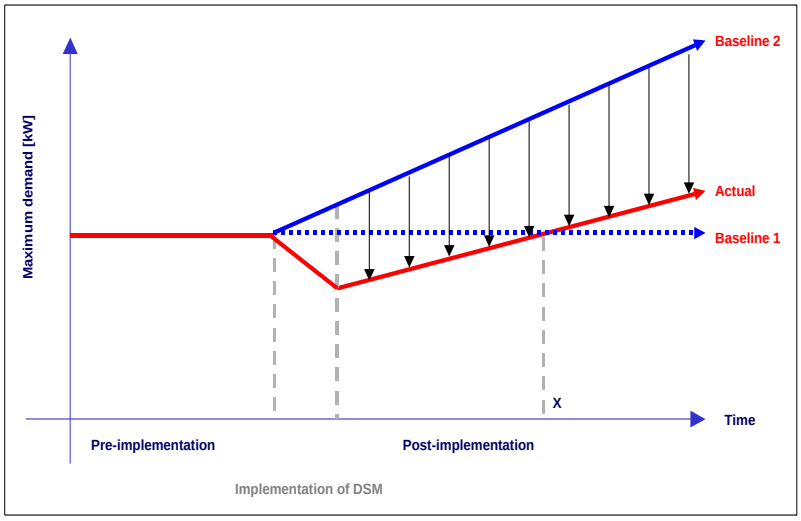

Figure 1.3: Baseline development issues.

The fact that measurements are used during M&V to obtain the baseline, actual (or post-implementation) energy consumption and demand, makes the M&V process a negotiated process. The number of measurement points is determined by the possibility of measurement and the cost to measure. If it were possible to measure everything, an almost perfect baseline and actual energy consumption would be available. However, the high cost to measure limits the number of measurements and the overall accuracy of the baseline. All the involved stakeholders (the client, the ESCo and Eskom) must agree on the method of calculating the savings. The level of detail of the M&V efforts should be in proportion to the size of the savings. Thus, projects with small expected savings would be measured and verified by a simple M&V process (typically

Option A). The level of detail of the M&V process would increase as the size (quantity) of the savings increases.

It is also important to note at this stage that the M&V teams require at least 3 months worth of data for the development of project baselines (in a 30-minute interval at the least). When seasonal variance is expected, the baseline should be developed from data spanning over 12-months. Data suitable for baseline development include electricity use and operational data from historian systems, SCADA systems and metering equipment (permanent, temporary or portable). The purpose of the baseline is to represent system electricity use that is representative of energy use before the DSM intervention. It has been found in many instances that the intervention commenced the moment when the ESCo disclosed control strategies and methodologies to the client, which then pro-actively adopt these DSM measures before the ESCo actually implement. This made it necessary for the M&V team to obtain data for a period of 3 months (or 12 months) prior to the ESCo becoming active on the project site.

Care should also be taken in instances where data is available for long periods of time. It has been found that data that reach back further than 12 months can include operational practices and electricity use patterns that are no longer valid, which will result in baselines not representing the actual case just prior to the DSM intervention. If seasonal impacts are expected it is suitable to use 12 months worth of data for baseline development. Baseline development data gathered over a period of a tariff change on the client's side will be truncated and only the available data after the tariff change will be used in the development of the M&V baseline.

Metering equipment can be installed by the ESCo on the project site. It is however important that the M&V Team be actively involved in this process if this data is to be used for M&V baseline development. Portable metering equipment installed by the ESCo without M&V Team involvement or verification is not acceptable for baseline development purposes. It is also essential that all metering equipment used should be calibrated every 12 months and the certificate kept a proof.

The South African M&V process is designed to be extremely adaptable. Statistical sampling techniques can be used to reduce the number of measurements without compromising the accuracy of the information or jeopardising project buy-in [5]. More information on acceptable statistical sampling techniques can be obtained from Eskom's Assurance and Forensic Department.

1.6 Advantages of M&V

There are a number of advantages to performing M&V on a project. It not only adds value for Eskom, but also for the clients and the ESCo. If the DSM impacts are known, one can track and evaluate (T&E) the performance and progress of all the DSM activities, which will help to identify focus areas for DSM, as well as potential problems. M&V will enable Eskom to evaluate the verified savings against their DSM targets and help with proper implementation of DSM projects. M&V is therefore an essential part to integrate into any DSM project.

M&V encourage investment in the DSM industry and reduce the risk for financial investors. M&V helps to overcome barriers to DSM implementation and provides a level of confidence in the ESCo's DSM efforts. It will also become a crucial requirement when participating in international markets such as the clean development mechanism, which allow countries to benefit financially from emission reductions that result from DSM projects that deliver electricity consumption reductions.

The process of M&V provides valuable feedback to stakeholders regarding the savings and how it is influenced. This feedback is done on a monthly basis to Eskom's Assurance and Forensic Department in the form of a standardised status report from the various M&V teams. Efforts can thus be focussed to optimise the impacts of DSM. The fact that the savings are measured and verified encourages better design and management of DSM projects. M&V not only give demand and energy consumption impacts, but also provide cost savings and emission impacts.

CHAPTER 2: DSM PROJECT STAGES

2.1 Introduction

This chapter describes the different stages that are associated with DSM a projects. The stakeholders in these project stages are the client, Eskom and the ESCo. The project stages are shown in Figure 2.1 together with a conceptual representation of the impact on a system's electricity demand in Figure 2.2.

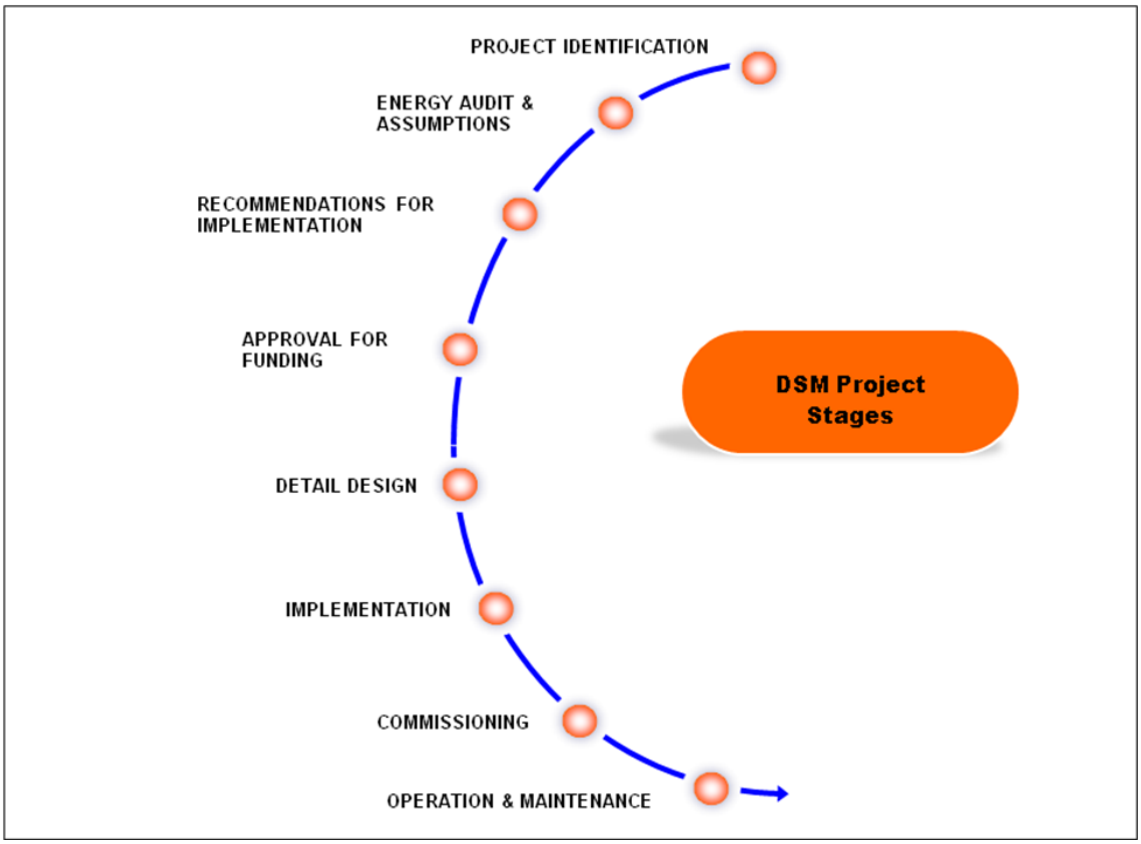

Figure 2.1: DSM project stages.

2.2 Project Stages for DSM and energy-efficiency

This section will describe the basic stages that are adhered to when an ESCo implement a DSM project. The detail and timelines of these stages may vary between different types of DSM projects, but should include one or another form of the stages included in this section.

2.2.1 Project identification

Either the Client or the ESCo identifies the need, potential or opportunity for DSM savings during this stage. On most occasions an ESCo would be contracted to determine the potential impacts and savings that can be achieved as part of evaluating a project's financial viability. A letter of intent is provided by the client to the ESCo, which accompanies the application and proposal for DSM funding.

2.2.2 Energy audit and assumptions

An energy audit is conducted to determine the type, quantity and rating of all relevant energy using systems. This information is used to determine the potential savings that can be achieved with DSM activities. The audit usually consists of a preliminary walk-through audit followed by a detailed audit. Assumptions are also stated regarding system information that isn't available. Factors that could influence the potential to generate savings are identified.

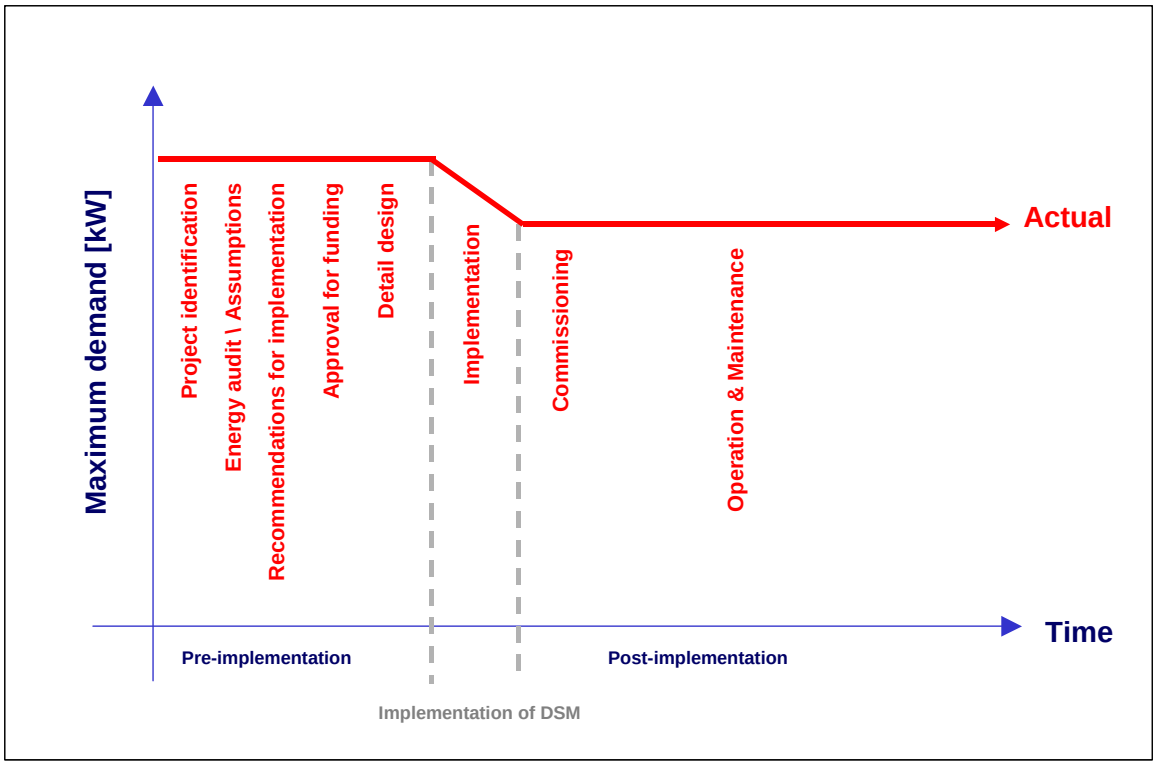

Figure 2.2: Basic DSM project stages transposed on project impacts.

2.2.3 Recommendations for implementation

A better estimate of the potential savings can be calculated once building and/or system information has been gathered. Upon evaluation of the various potential DSM activities together

with a feasibility study, the DSM activities are selected that show the greatest potential, based on their individual and combined feasibility. The ESCo then submits these recommendations to the client. The client then evaluates the feasibility of the project and decides whether to go ahead with the project or not. If the project is approved by the client, the proposal can then be submitted to Eskom to qualify for DSM funding.

M&V plays an important role during this phase since it will reduce the risk for the stakeholders. It is during this stage that Eskom will notify the M&V to commence with measurement and verification activities.

2.2.4 Approval for funding

Approval for DSM project funding is granted (by the Utility) once it has been established that the recommended DSM activities will deliver satisfactory results within an acceptable budget, timeframe and risk level.

2.2.5 Detail design

A detail design is made by the ESCo of the recommended DSM activities once project funding has been approved.

2.2.6 Implementation

The DSM activities are then implemented based on the detail design. This phase is characterised by fluctuations in energy usage (see Figure 2.2). The Utility (Eskom) and the M&V Team is notified during this stage and a completion certificate is issued by Eskom. This stage is the beginning of the performance assessment stage of the M&V process.

2.2.7 Commissioning

Commissioning of the installed equipment is necessary after implementation to ensure that actual implementation has been done in the correct manner and the equipment and systems are performing to the specified requirements. The commissioning is usually done by the ESCo or by the contractors that the ESCo used during the project.

A commissioning report is compiled and submitted to the client.

2.2.8 Operation and maintenance

The implemented DSM measure needs to be maintained to ensure that the DSM activities deliver the same level of performance as during commissioning and continue to reduce maximum demand, consumption and energy costs. Operation and maintenance for the system can be the responsibility of either the ESCo or the client, depending on the contractual agreement that exists between the two parties. It is however critical that such an agreement is in place since the client will be held liable for the applicable performance penalties from three months onwards after implementation up to the end of the contractual agreement with Eskom. The ESCo will be held liable for project under-performance during the first three months after implementation.

CHAPTER 3: M&V PROJECT STAGES

3.1 Introduction

The stakeholders in the M&V process are the M&V team, the client, the utility (Eskom) and the ESCo. These stakeholders provide valuable information to the M&V process and need to give buy-in for M&V to continue through its various stages.

The M&V project has a total of six deliverables, which are the following:

- M&V Scoping report;
- M&V plan (which requires acceptance from both ESCo and Client);
- M&V baseline report (which must be signed by the ESCo);
- Post-implementation M&V report;
- Performance assessment report(s) & performance certificate; and
- Performance tracking reports (Monthly, annual, or agreed interval).

These deliverables and reports are structured in such a way as to facilitate buy-in into the M&V project procedures and provide all the project participants with a clear understanding and layout of the way in which M&V will be conducted. The M&V plan is distributed between the ESCo and the Client. Both need to confirm receival of this report via e-mail. The M&V plan then needs to be reviewed by them. If both parties are satisfied, they must both accept the M&V plan as suitable via an e-mail to the relevant M&V team. The same process is followed for the M&V baseline report, but here only the ESCo need to sign the report and return the original to the relevant M&V team. The project stages and various deliverables are discussed in more detail in the sections that follow.

3.2 Project stages for M&V

This section describes the various stages associated with the measurement and verification of a DSM project. The basic layout of the M&V project can be seen in Figure 3.1 whilst the M&V project stages are transposed on the DSM impacts in Figure 3.2.

3.2.1 Scoping study and scoping report

The scoping study is the first stage in the M&V process. Once Eskom has approved the DSM project, the M&V team is instructed to proceed with their measurement and verification activities.

The purpose of the scoping study is to enable the M&V team to gather all relevant and available data on the project and to obtain a clear understanding of what the DSM project will entail. The scoping study starts with a kick-off meeting between the M&V team and the client and/or the ESCo. A site visit is also conducted during this or the next stage, depending on the availability of information and time constraints.

The scoping report is the deliverable for this stage and need to clearly state the following:

- Project information – This section must contain the contact details of the involved parties and the persons that represent them. The contact detail of the M&V team is stated as well as the contact details of persons representing the ESCo and the client;
- Project objective – The objective states which project impacts the stakeholders require to be quantified and verified by the M&V team;
- Site description – The description of the site provides information on the size and utilisation of the system or facility under investigation. Also included is information on the typical annual energy consumption, maximum demand and electricity account. The control of the system / facility is described as well as the layout.
- Tariff structure – The tariff structure under which the system or facility operates need to be stated and described in detail in this section;
- Audit of system – This section provides detailed information and data on the system(s) that are affected by the proposed DSM measure. It is also important to include a description of the layout of the system's electrical supply for reference from the M&V plan that will eventually contain a section on measurement of the system. If the project is concerned with a lighting retrofit, one needs to state the layout and quantities of the current lighting system, as well as the current mode of operation. This section is critical in establishing the base year (and thus the baseline) for the system or facility;
- Proposed activities by the ESCo – This section provides a description of the activities that the ESCo propose to implement. This information must be obtained from the ESCo and the client;
- Expected results – The ESCo should supply the M&V team with an estimate of the expected impacts on the system. This data need to be supplied for the monthly maximum demand, the energy consumption and the electricity cost impacts. This section should also contain an

estimate of the expected impacts as determined by the M&V team if the process is repeatable (which is not possible in the case of simulation models developed by the ESCo). The ESCo should also clearly specify if they expect their DSM project to deliver only demand impacts or whether it will result in efficiency impacts as well. This will determine the approach towards the routine service level adjustments that the M&V team will follow; and

- Conclusions and comments – This section contains a summary of the expected results for the project and must contain comments and concerns raised by the M&V team. The M&V teams are however not allowed to make any recommendations or advise the ESCo or client towards project implementation if any concerns are identified.

The scoping report is an important document for the Utility as the financing party of the projects in the sense that it provides them with the expected impacts of the project as assessed by the M&V Team. The scoping report is also of value to the client and the ESCo since it often outline misunderstandings and discrepancies that exist between the client and the ESCo in terms of proposed DSM project activities.

Examples of standardised M&V scoping reports are available upon request for various project types from the authors of the M&V Guideline.

3.2.2 Develop M&V plan

The M&V plan forms the backbone of the whole M&V process and outlines the complete process that is expected for the project. The M&V plan is the first deliverable on which the ESCo and client must give acceptance before M&V activities can proceed. The report is distributed to the ESCo and the client by the M&V Team and they must both confirm receival via e-mail. They then need to review the report and provide comments and feedback. They must then accept the report by means of an e-mail stating the fact to the M&V Team.

This stage of the project is associated with a site visit. If the stakeholders give approval they are agreeing with the proposed M&V activities that will be followed and are satisfied with the manner in which the baseline and savings will be determined. The M&V plan is updated with the negotiated recommendations of the stakeholders if approval is not obtained with the first submittal.

As mentioned, the M&V plan describes the activities and procedures that will be followed to M&V the DSM activities. The first part of the M&V plan repeat the first few sections of the scoping report. This is done to ensure that the M&V plan forms a “stand-alone” report that provides a complete overview of the project. The plan should include the following sections:

- Project information – This section must contain the contact details of the involved parties and the persons that represent them. The contact detail of the M&V team is stated as well as the contact details of persons representing the ESCo and the client;
- Project objective – The objective states which project impacts the stakeholders require to be quantified and verified by the M&V team;
- Site description – The description of the site provides information on the size and utilisation of the system or facility under investigation. Also included is information on the typical annual energy consumption, maximum demand and electricity account. The control and layout of the system / facility is described.
- Tariff structure – The tariff structure under which the system or facility operates need to be stated and described in detail in this section;
- Audit of system – This section provides detailed information and data on the system(s) that will be affected by the DSM measure. It is also important to include a description of the layout of the system’s electrical supply for reference from the M&V plan that will eventually contain a section on measurement of the system. This section is critical in establishing the base year for the system or facility;

- Proposed activities by the ESCo – This section provides a description of the activities that the ESCo propose to implement. This information must be obtained from the ESCo;
- Assumptions – This section provides the assumptions that were made by the ESCo or implementing party when they estimated/calculated the expected project impacts;
- Expected results – The expected project impacts as calculated by the ESCo is once again provided in the M&V plan as in the case with the scoping report;
- Evaluation – An evaluation of the expected impacts is given by the M&V team where comments and concerns are raised on the assumptions and calculation methodology of the expected project impacts;
- M&V Option selection – This section is concerned with the selection of the M&V Option that will be utilised to determine the project baseline and ultimately the project savings. There are four M&V-options that can be used to determine the baseline. These four options are:

  Option A - Partially Measured Retrofit Isolation: Option A involves isolation of the electricity use of the equipment affected by a project from the electricity use of the rest of the facility. Measurement equipment is used to isolate all relevant electricity usage for the pre-implementation and post-implementation periods. Only partial measurement is used under Option A, with some parameter(s) being stipulated rather than measured. However, such stipulation can only be made where it can be shown that the combined impact of the plausible errors from all such stipulations will not significantly affect overall reported savings.

  Option B - Retrofit Isolation: The savings determination techniques of Option B are identical to those of Option A except that no stipulations are allowed under Option B. In other words, full measurement is required. Short term or continuous metering may be used under Option B. Continuous metering provides greater certainty in reported savings and more data about equipment operation.

  Option C - Whole Building: Option C involves use of utility meters or whole building sub-meters to assess the energy performance of a total building. Option C assesses the impact of any type of project, but not individually if more than one is applied to an energy meter. This Option determines the collective savings of all DSM activities applied to the part of the facility monitored by the energy meter. Also, since whole building meters are used, savings reported under Option C include the impact of any other changes made in facility energy use (positive or negative). Option C may be used in cases where there is a high degree of interaction between implemented activities or between activities and the rest of the building, or the isolation and measurement of individual project activities is difficult or too costly.

Option D - Calibrated Simulation: Option D involves the use of computer simulation software to predict facility energy use for one or both of the energy use terms in Equation 1. Such a simulation model must be "calibrated" so that it predicts an energy use and demand pattern that reasonably matches actual utility consumption and demand data from either the base year or a post-implementation year. Option D may be used to assess the performance of all project activities in a facility, akin to Option C. However, different from Option C, multiple runs of the simulation tool in Option D allow estimates of the savings attributable to each project activity within a multiple activity project.

- Boundaries – This section states the boundaries of the saving impact determination in detail. It states whether the savings will be determined to include or exclude interactive system effects, etc. This section must also clearly state all the boundaries and/or assumptions that were used by the ESCo to develop the project, its proposal to Eskom and to define and develop the project baseline. If any of the boundaries and/or assumptions becomes invalid, the complete baseline process needs to be repeated by the M&V team. The M&V baseline must also be renegotiated in instances where it can be justified and/or proven that the boundary conditions and/or assumptions cause errors larger than 10% during the determination of the project impacts. This stage is extremely important in order to protect the ESCo, the client and Eskom.

- Baseline characterisation – A description is provided in this section on the means by which the baseline will be determined. The independent variables are stated that will be used to quantify the dependent variables (which will ultimately be the demand and/or energy consumption of the system). A complete description must be provided in this section whether baselines will be developed for each separate system or for the complete facility;

- Baseline adjustments – All the envisaged variables and situation that will necessitate adjustments to the project baseline need to be stated and described in this section;

- Pre-implementation metering plan – A complete layout and description of the electrical supply to the system or facility must be provided in this section. It is also important to state all the data requirements, variables and measurement points that will be metered, as well as the equipment that will be used. This section must state the interval of the measurements as well as the duration of the pre-implementation metering activities. It is important to note that all metering equipment needs to be calibrated at least once per year and the calibration certificated need to be filed by the M&V Team for later reference if needed.

- Post-implementation metering plan – This section provides the same information as in the case of the pre-implementation metering plan, but is adjusted to describe the post-

implementation data requirements, variables, metering intervals, equipment and metering positions;

- Saving calculation methodology – The methodology that will be used to determine the savings in demand, electricity consumption and cost is stated in this section with all the relevant equations describing the process. This section must also contain the methodology and emission factors to calculate the environmental impacts for the project;
- Condonable periods – This section must give a detail description of what incidents will qualify as condonable periods. These condonable periods need to correspond with those included in the DSM agreement between Eskom, the ESCo and the client. More detail on condonable periods can be obtained from Section 3.3 of this guideline.
- The M&V team must specify how instances of lost data will be handled during the performance assessment and performance tracking phases. An agreed methodology needs to be stipulated here and the methodology needs to be negotiated with the ESCo and/or the client.

The schedule to perform M&V is closely linked to the implementation schedule of the DSM project, which is usually determined by the ESCo and or the client. Enough time must, however, be scheduled by the ESCo to allow the M&V Team to perform baseline measurements for at least a three-month to 12-month period.

The M&V Plan is submitted to the ESCo and the client for approval. They review the M&V Plan and make recommendations on any of the contents. Once the ESCo, client and M&V Team are satisfied, M&V may formally proceed. If approval is not obtained, the M&V Plan is refined and submitted again.

Measurements should commence once approval has been received on the M&V Plan. These measurements will be used for the development of the M&V Baseline.

An additional but separate deliverable to accompany the final submittal of the M&V plan is the M&V Cost and Scheduling document. This document needs to be submitted to Eskom only once the final M&V plan is submitted to Eskom. This document must contain the following sections:

- Project cost – A cost breakdown need to be provided in this section for each of the M&V activities together with their expected submittal dates. This deliverable is submitted to Eskom only; and
- Project schedule – An M&V activity schedule need to be included in the M&V plan to provide a detailed breakdown of all the activities associated with each M&V deliverable and their

expected delivery dates. It is also important to include key project timelines such as the implementation date and the completion date of the DSM project. This deliverable is submitted to Eskom only.

Examples of standardised M&V plans are available upon request for various project types from the authors of the M&V Guideline.

In the case of Residential Load Management (RLM) projects, the baseline can only be developed after implementation has been completed. The M&V plan is however very critical since it stipulates the methodology that will be used by the M&V team to determine the project impacts. This M&V plan must be agreed upon by all stakeholders and must be signed off before M&V activities and implementation can commence. RLM project consequently follow a different approach when compared to the standardised M&V approach as provided in this guideline.

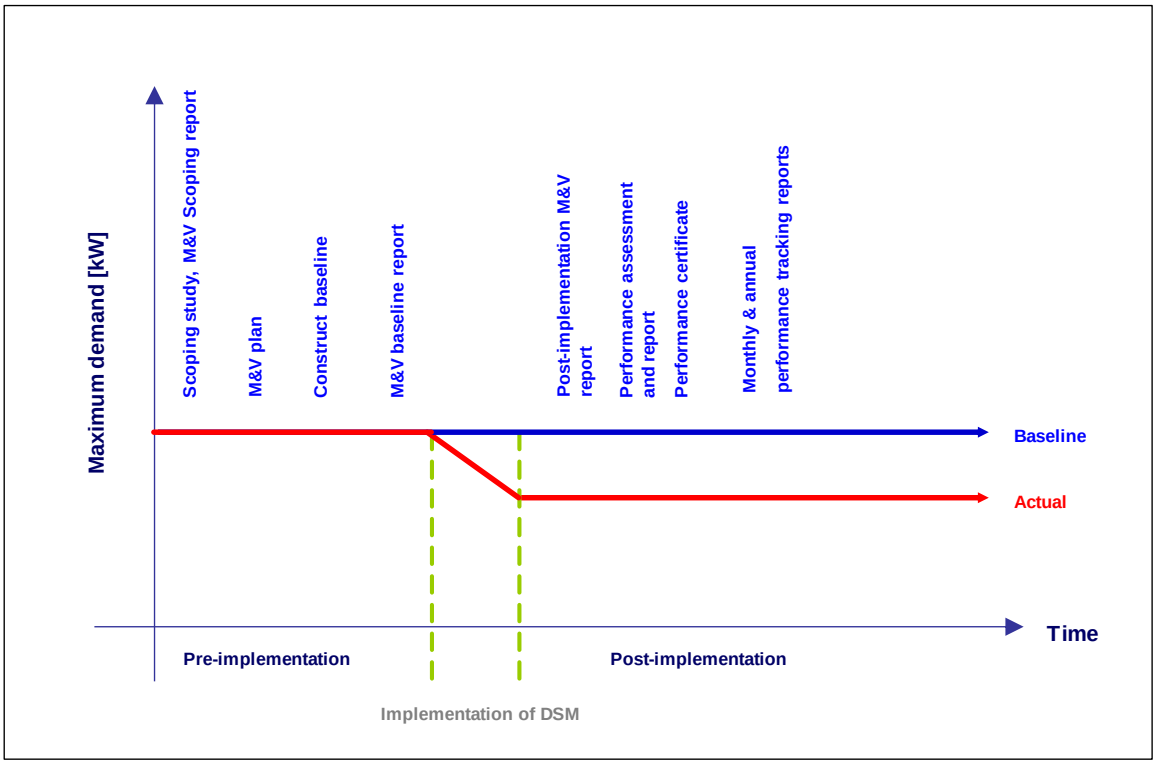

Figure 3.2: Basic M&V project stages transposed on DSM impacts.

3.2.3 Develop M&V baseline and M&V baseline report

Pre-implementation measurements need to commence once acceptance has been obtained for the M&V plan from the ESCo and the client. The pre-implementation measurements will be used in the development of the baseline(s). It is important to note that all metering equipment needs to

be calibrated at least once per year and the calibration certificated need to be kept by the M&V Team for later reference if needed. These measurements need to be taken for an acceptable period prior to implementation (preferably 3 months, but may vary for certain projects) to allow for sufficient data and project buy-in for the M&V baseline. If seasonal variance or impacts are expected for the project, 12 month data need to be used for baseline development. If possible, the M&V Team should attempt to obtain data for a period of the most recent months just prior to ESCo involvement on the project site.

The M&V baseline report must contain the actual baseline that will be used during the saving calculations. All other information relevant to the baseline also needs to be included in this report to ensure that the report and baseline can be determined in a repeatable manner by the stakeholders.

The baseline report should include the following:

- The report should once again include the project information, the objectives and the site description;
- Variables used to characterise baseline;
- A description of the pre-implementation metering data used, as well as information on the metering period and interval;
- Data used to develop baseline;
- Characterisation procedures;
- Assumptions used during baseline characterisation;
- Baseline service level adjustment procedures;
- Baseline adjustment procedures; and
- The actual demand baseline profile(s) and energy consumption values that will be used in the determination of the project's savings.

Upon delivery of the M&V baseline report, all parties need to review the report and state any changes that should be made. Once they all are satisfied and buy-in is obtained in the M&V baseline report, M&V can proceed to its next stage. If this is not the case, the M&V baseline report must be refined and submitted again until buy-in is obtained. The final M&V baseline report is delivered only after all parties have met mutual agreement on all the issues involved with the development and use of the baselines.

This final M&V baseline report will also form a sign-off copy which must be signed by the client, ESCo and the M&V team. Copies of the signed baseline report will be distributed to each of the project stakeholders.

The baseline report is the last stage in the M&V process prior to implementation. The baseline report may contain a number of sub-deliverables before the complete report is submitted to all the stakeholders. The reason for these sub-deliverables is to assist the stakeholders in reducing the risk associated with each project. As M&V metering activities continue and data is gathered, a 2-week, 4-week and a 2-month (if necessary) "operational conditions for period" is compiled that contain the operational and electricity use profile of the systems inside the scope of work for the DSM project. This assists the stakeholders in evaluating the viability of the DSM project. These sub-deliverables is however not always required. The Baseline report is submitted once the complete set of data is available and incorporated into the project baseline.

Examples of standardised M&V baseline reports are available upon request for various project types from the authors of the M&V Guideline.

As mentioned in the previous section, RLM projects follow a different approach to the standardised once provided in this guideline. The baseline can only be developed once implementation has been completed. The baseline and baseline report is developed and submitted in conjunction with the first performance assessment report.

3.2.4 Post-implementation report

The post-implementation audit is done once implementation has been completed, but prior to commissioning of the equipment and systems. This forms part of the M&V team's responsibility to verify that the implementation has indeed taken place to specification. This stage usually consists of a walkthrough audit. The post-implementation measurements are also taken or commenced during this stage.

The measurement data (independent variables) obtained from the post-implementation measurement phase is used to define the baseline energy usage. The actual energy usage, also obtained from the post-implementation measurement phase, is subtracted from the baseline to obtain the savings.

The post-implementation M&V report contains all the information relevant to the M&V project. The following section needs to be included in the post-implementation report:

- Project information – This section is once again repeated for the post-implementation report;

- Project objective – The objective states which project impacts the stakeholders require to be quantified and verified by the M&V team;
- Site description – The description of the site provides information on the size and utilisation of the system or facility under investigation. Also included is information on the typical annual energy consumption, maximum demand and electricity account. The control of the system / facility is described as well as the layout;
- Original system description – This section must contain a description of the original system as it was found to be operational during the pre-implementation phase of the project. This section needs to concur with the M&V plan;
- Proposed changes – This section needs to describe the DSM intervention as it was proposed by the ESCo;
- Actual changes – The actual changes to the system or facility, due to the intervention, need to be described in this section. This information needs to be obtained via a post-implementation audit;
- Deviation – The difference between the intervention that was proposed (as in the M&V plan) and the one that was actually implemented (as determined during the post-implementation audit) needs to be described in this section. If available, the M&V team can also provide the reasons for the deviation as discussed with the ESCo or client; and
- Comments – Any comments on deviations need to be stated in this section. If possible, the M&V also needs to state how deviations will potentially influence the estimated impacts of the project.

3.2.5 Performance assessment

The performance assessment stage is basically the assessment of the project's performance over a period of 3 months. **Please note that none of the performance assessment reports or the M&V performance certificate will be submitted to the stakeholders (Eskom, ESCo and client) if sign-off has not been obtained for the M&V Baseline.** The performance assessment will be done for each of the 3 months and feedback provided to the ESCo in the form of a monthly performance assessment report. The performance assessment period can however be shortened if it is requested (or contractually agreed) from the client or the ESCo and it could be proven that the project delivered its contracted target in the first month or two months. The purpose of this stage is to allow the ESCo to make adjustments to their DSM intervention to ensure that it delivers what was contracted to Eskom. Each monthly performance assessment

report is delivered to Eskom, the ESCo and the client. The contract between the stakeholders is enforced based on the agreement between all the relevant parties (Eskom, ESCo and the client).

It is also important to note that project with seasonal variance (and an annual average target) needs to have a performance assessment period of 12 months to fully evaluate the project.

If the DSM intervention delivers less than the contracted impacts, the ESCo will be held liable and penalties will be paid to Eskom. The contracted DSM target is then adjusted to the value that is actually obtained before the M&V team proceed to the next phase in the M&V process. It is important to note that the ESCo is the responsible party during the performance assessment phase.

The performance assessment report provides the following information:

- Basic project information that includes the site name, the name and contact details of the person that is responsible for the report (on the M&V team), the date that the project's implementation started and the period for which the savings are stated in the report;
- The project impacts need to be stated for the relevant period in terms of the baseline value, the actual value and the resulting savings for the energy consumption, the electricity cost and the environmental impacts (CO_2, NO_x, SO_x, particulate matter and water consumption); and
- The average impact on the demand and consumption needs to be stated, also in terms of the baseline, actual and savings, for all the relevant time-of-use periods which are weekday morning peak, weekday standard, weekday afternoon peak, weekday off-peak, Saturday standard, Saturday off-peak and Sunday off-peak.

This report will also include the average weekday, Saturday and Sunday profiles for the baseline and actual energy use. The actual profiles are also provided for the complete period. The report will also include comments by the M&V team regarding the performance of the project.

Condonable periods are periods in which the system could not perform due to factors outside the control of the ESCo and/or the client. These days are both included and left out of the performance assessment calculations and the results of both instances are reported. More detail on condonable periods can be obtained in Section 3.3 of this guideline. It is however important that the ESCo and/or client declare and motivate all condonable periods to Eskom DSM, which need to give approval before they notify the M&V team. Only then may condonable periods be removed from any impact determination.

At the end of the performance assessment phase the M&V Team issues a M&V performance certificate that contains the performance summary of the project as it was determined during the

performance assessment period if baseline signoff has been obtained. The certificate is distributed to both the ESCo and the client.

In the case of RLM project, the first performance assessment must be accompanied with the project baseline and baseline report. The RLM project baseline is only developed after implementation has been completed, but before performance assessment start.

3.2.6 Performance tracking reports (Agreed submittal interval)

The data obtained from post-implementation measurements is used in calculations and compared to the baseline energy performance to determine the savings due to the implemented DSM measures. The savings are then compiled into the performance tracking reports, which is then submitted to Eskom, the client and the ESCo.

The performance tracking reports provide a summary of the savings that are achieved for each agreed upon interval. These reports are submitted on a regular agreed upon basis to all the DSM stakeholders. The purpose of this report is to provide verified savings to the stakeholders. This report has the same basic structure and sections as the performance assessment report. The only difference is the fact that the first part of the report provides the project impacts for the evaluation period for which the report is compiled. The accumulated section provides the impacts obtained over the total period to the date of the report for which the project delivered were active.

The performance tracking reports are incorporated into the M&V process to answer the two principal questions of the stakeholders: How much is the project saving and are the savings being sustained over time? The performance tracking reports are generated from measurement data on the system's actual energy performance and compared to the baseline developed in the M&V Baseline Report. The baselines can also be adjusted during this phase when any of the original development assumptions and criteria is no longer valid.

The performance tracking reports are required for the duration of the M&V project. Again, condonable periods are both included and left out of the performance assessment calculations and the results of both instances are reported. More detail on condonable periods can be obtained in Section 3.3 of this guideline. It is however important that the ESCo and/or client declare and motivate all condonable periods to Eskom DSM, which need to give approval before they notify the M&V team. Only then may condonable periods be removed from any impact determination.

During this phase of the project, the client will be held liable for the performance of the DSM project. The client will be held liable through penalties should the project not sustain its performance in terms of the megawatt demand reductions during the contractual specified

periods. It is thus critical that the client put mechanisms in place to sustain the DSM project's performance.

Please note that the submittal interval of the performance tracking reports needs to be agreed upon between Eskom's Assurance and Forensic Department, the M&V team and the ESCo based on the M&V team's motivation. The interval for these reports would be based on the following:

- Sustainability of the project;
- The variance in the project impacts;
- The risk of not reporting on a monthly basis; and
- The costs associated with M&V reporting.

An example of a project that would typically not require monthly reporting intervals is a commercial lighting retrofit where the risk of changes to the lighting system is small and the change to the monthly and quarterly savings are minimal.

The interval that the M&V team need to report the actual and baseline figures to Eskom's Assurance and Forensic Department database also needs to be agreed upon between the Assurance and Forensic Department and the M&V teams. These intervals will be agreed upon for all the individual projects.

3.2.7 Performance tracking reports (Annual)

An annual performance tracking report is generated once a year where necessary. This report is generated from all the monthly data and performance tracking reports and serves as a summary report for a specific year. This report has the same structure as the performance tracking report. It however, provides the total project impacts for a single year (coinciding with Eskom's financial year from 1 April to 30 March).

3.3 Condonable periods

3.3.1 What are Condonable/Force Majour Periods?

Funding for Eskom's DSM Programme is obtained through the National Electricity Regulator of South Africa (NERSA). The funding from NERSA is allocated on the basis of consistent and actual delivery of annual approved MWs during contractual periods as determined by the various M&V teams. Eskom annually reports the actual DSM project performance to NERSA after which time the funds are released to them. It is therefore of utmost importance that DSM projects deliver the MWs that they promised.

Eskom DSM receives their funding from NERSA only after projects deliver. Funding is based on the MWs that the grid saw.

The performance of DSM projects, like any other engineering project, are however often susceptible to unforeseen and uncontrollable circumstances that can influence a project negatively in terms of delivering consistent results. Typical examples of unforeseen events that can influence a DSM project's ability to deliver is lighting strike damage to sub-stations, cable theft, breakdowns, accidents and unplanned maintenance.

A period during which a DSM project could not deliver its contracted impact(s) due to factors that are outside the control of either the ESCo or the client is defined as a condonable period. The purpose of this section of the M&V Guideline describes how the various stakeholders in DSM should deal with condonable periods.

It is possible that a DSM measure could not deliver any actual savings at all and still be declared successful if the effects of condonable periods are not considered carefully. Any internal or external planned event(s) which may have an effect on the project savings should be incorporated into the project plan and baseline calculations before formal approval thereof. If all the above is considered and included into projected calculation it consequently stands to reason that a project will then perform adequately against the proposed savings.

It is the essential that the ESCo, in conjunction with the client, evaluate all their risks with regards to the typical events within their project environment that could potentially influence their project's ability to perform. These events need to be clearly defined and listed and MUST be negotiated and incorporated into their contractual agreement with Eskom DSM as condonable events, prior to project approval.

The duration of condonable periods can vary from a single 30-minute to longer periods of time.

Condonable periods are used during the performance assessment phase (see Section 3.2.5) and the performance tracking phase (see Section 3.2.6) of a project. It is during these M&V stages that the project's performance is determined and its sustainability is evaluated over the project life. If an ESCo or Client had condonable events within their month, they need to make a motivated request to Eskom DSM (either directly of via their M&V Team). Eskom DSM evaluates whether the requested condonable periods have been specified within the DSM agreement and if they are satisfied with the motivation(s) provided. If approved these condonable periods are communicated through to the M&V team which will incorporate them into their calculations. The acceptance of periods as condonable is a purely contractual matter which needs to be decided upon by stakeholders involved in the contract. M&V is therefore not part of this acceptance process.

M&V may however make a request for condonable periods where M&V sees the impact on the savings and knows/believes the reason to be condonable. This is also applicable in situations where the M&V team finds it impossible to establish the savings due to insufficient information or data loss (More than one of the following; No metering data available, No history, No operational information).

Condonable periods may be requested from Eskom DSM by the ESCo, the client or the M&V team.

Definition: *Condonable period(s) excluded.*

The periods designated as condonable is ***not*** *taken into consideration by the M&V team when determining project performance. The resulting performance is the one that the Eskom Grid saw over the evaluation period. This is also the performance reported by Eskom DSM to NERSA.*

Definition: *Condonable period(s) included.*

The periods designated as condonable is taken into consideration by the M&V team when determining project performance. The resulting performance is determined over the period that the DSM project was not influenced by condonable periods.

Two sets of impacts are determined and reported to Eskom by the M&V teams during the performance assessment and performance tracking phases. The first set of impacts reported will always reflect what the Eskom grid experienced over the complete evaluation period. This is consequently the true average impact for all the various periods determined over a complete calendar month, thus **condonable periods excluded**. These results are incorporated into the main body of the performance assessment and performance tracking reports. **It is also these impacts that are reported by Eskom to NERSA towards their annual claiming of overall DSM performance.**

M&V Performance reporting to stakeholders

Main Body: Condonable periods excluded (What the Grid saw)

Comments: Condonable periods included (Performance when the project could deliver)

If the ESCo, Client or M&V team has requested condonable periods within a reporting month, Eskom DSM notifies the M&V team of approval to include these condonable periods in the impact calculations. A second calculation is then done by the M&V team where **condonable periods are included** in the month's performance determination. These results are then described in the last section of the applicable performance assessment or performance tracing report. The M&V team consequently reports on both sets of impacts (what the grid saw and with condonable periods included in the calculation).

Condonable periods will also be designated as positive condonable periods and negative condonable periods by the M&V Teams. The first being instances where a condonable period actually resulted in electricity reductions, e.g. the plant had a shut down and the DSM measure could not operate to enable the contractual savings. The second being where the condonable period resulted in an increase in electricity use, e.g. the example mentioned above where the plant had to keep on operating (pumping) during periods where the DSM measure had to achieve savings. This designation is made by the M&V team and used during project performance evaluations for the Assurance and Forensic Department.

3.3.2 Data loss and condonable periods

The M&V process and the subsequent performance evaluations of DSM projects are highly dependent on data. Unfortunately data loss is a fact of life and the M&V team has two options to deal with the issue.

If data loss is minor, the missing data may be replaced with derived data. Alternatively, if data loss is significant and the M&V team cannot derive replacement data, the periods of data loss need to be requested as condonable periods and should be included in both impact determinations as discussed in section 3.3.1.

"No data collection is without error. The M&V plan should consider two aspects of data collection aspects:

- *Establish a maximum acceptable rate of data loss and how it will be measured. This level should be part of the overall accuracy consideration. The level of data loss may drastically affect cost.*
- *Establish a methodology by which missing or erroneous data will be interpolated for analysis. In such cases, baseline and post-retrofit models may be used to calculate savings.*

IPMVP (2007)

Data loss will normally not be considered as a condonable event and it is the responsibility of the M&V team in conjunction with the ESCo and/or the Client to resolve these events. The

methodology used to develop "derived data" in these instances, needs to be stipulated in the M&V plan and must be agreed upon by stakeholders. More information on derived data can be obtained from Chapter 7 of this guideline.

"If energy data is missing from the post-retrofit period, a post-retrofit model can be created to fill the missing data. However, the reported savings for the period should identify the report as "estimated"."

IPMVP (2007)

In the case where lost data was replaced with "derived data", the M&V team should report the following three sets of impacts in their performance assessment and performance tracking reports and clearly indicate to which instance the impacts are applicable:

1. Impacts achieved over complete evaluation period with condonable periods excluded and all derived data included (main body of report);

2. Impacts achieved over complete evaluation period with condonable periods included and all derived data included (results summarised in comments section);

3. Impacts achieved over complete evaluation period with condonable periods included and all derived data excluded (results summarised in comments section);

All these impacts need to be reported by the M&V team to the various stakeholders. As indicated, the declaration and approval of condonable periods is entirely a contractual matter which should be decided upon by those involved contractually. The following are an M&V perspective and will be influenced by decisions communicated to M&V teams by Eskom DSM.

3.3.3 Full performance including condonable days

As mentioned earlier in this section, NERSA funds only the actual and consistent performance of DSM projects. They do not take the effect of condonable periods into consideration and want the impacts that the Eskom grid experienced. On the other hand, Eskom do not want to penalise an ESCo for lack of DSM performance due to unforeseen circumstances. This implies that Eskom is actually penalised for all condonable events by NERSA and both parties have not received the full benefit of the DSM activity.

Eskom and NERSA want the full value of their investment. A potential solution to this problem is to extend the contractual project life with the number of condonable periods at the end of the contractual period. A practical example would be a five year DSM project that experienced half a year of condonable periods over the five years. This project should historically run for five and a half years, even though the project contract was only for five years. NERSA and Eskom have now received the full benefit of the five year DSM project which they have funded. The client and ESCo were also not unfairly penalised.

The same principle could be applied for the performance assessment period, based on a maximum allowed period as agreed upon by the major stakeholders. This system however still needs to be agreed upon by DSM and does not represent standard practice under the current DSM programme.

3.3.4 Interaction between Projects and/or Programmes

Programmes and/or projects may have an impact on the project being measured and verified. This may be particularly true where media campaigns are motivating people to switch electrical appliances and equipment off (e.g. Power Alert), money are offered to shed load (e.g. Demand Market Participation or DMP), Electricity Conservation Programmes being enforced and Eskom introducing planned load shedding, These activities are usually planned and should not qualify for being declared condonable. This is due to these events being planned and scheduled before it actually happens and the risk of double counting of impacts. In some cases this may also imply that double payments are also being made for the same savings, e.g. with DMP, a customer gets paid to shed load which may have an impact on the savings of the DSM measure which was also paid for.

Typically all these programmes and projects are also verified and the savings impacts reported on. When these periods are declared condonable the savings will in fact be double counted, which in turn will be reported incorrectly. An example of this happening could be where Power Alert (advert) request customers to manually switch of their geysers while a DSM Residential Load Management (RLM) system is in operation on the same geysers. The Power Alert evaluation may show that the savings objective was achieved while the RLM evaluation impacts are declared condonable (because of the adverts' influence) and credit be given to the RLM project as well. In this case the Advert + RLM ≠ savings experienced by the grid.

Unplanned events may qualify as condonable periods and could be motivated to Eskom DSM for consideration. An M&V team's impact calculation on a load shedding event may then look as follows: If a day experienced a 2-hour load shedding event, the M&V team should make the corresponding baseline periods zero for that period. If service level adjustments are based on kWh-neutrality, the kWh-neutrality between baseline and the post-implementation data then needs to be applied only for the remaining 22 hours of that day. If the service level adjustment is based on a relationship such as kWh/day versus ML pumped/day, this principle also needs to be applied for only the 22 hours outside of the load shedding event.

Events that influence project performance into the next day or more may also be declared to Eskom DSM and clearly motivated for consideration as condonable periods.

CHAPTER 4: INTERACTION OF DSM AND M&V

The interaction between the DSM project and the M&V project can be seen in Figure 4.1 and Figure 4.2 [6].

After the ESCo has made their recommendations for implementation to the client and Eskom, the M&V team needs to gather all the relevant information and data to develop the M&V plan. The M&V Plan is then submitted, reviewed and revised according to the inputs of the ESCo and the client. Once acceptance is obtained, the M&V project can continue to the next stage.

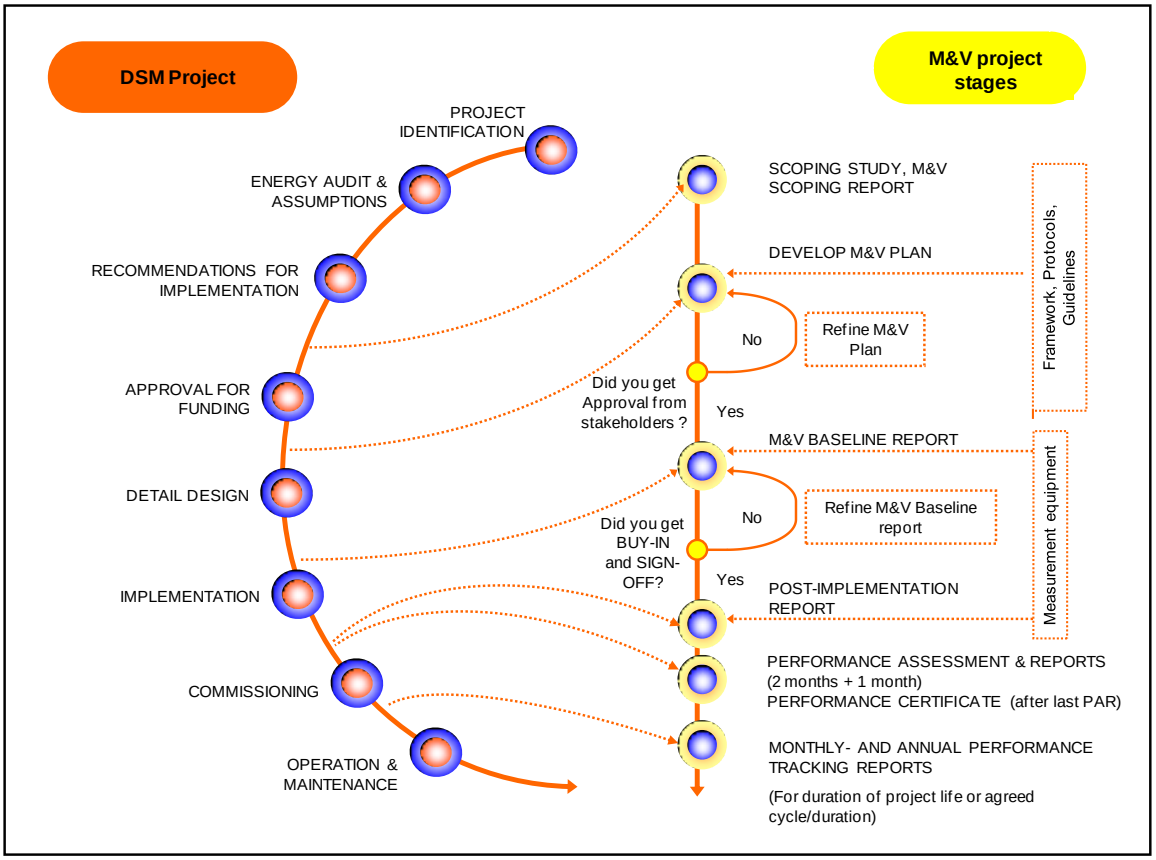

Figure 4.1: Interaction between DSM and M&V.

The development period between the M&V Plan and the M&V Baseline Report is used by the M&V Team to gather measurement data from the system. This period needs to be of sufficient length to allow for sufficient data measurements and is project specific. This data will be used to develop the baselines that will be used in the saving calculations. The M&V Baseline report is submitted to the client and ESCo before implementation and will also form the second stage of project buy-in. Once buy-in is obtained from the ESCo only, implementation may proceed.

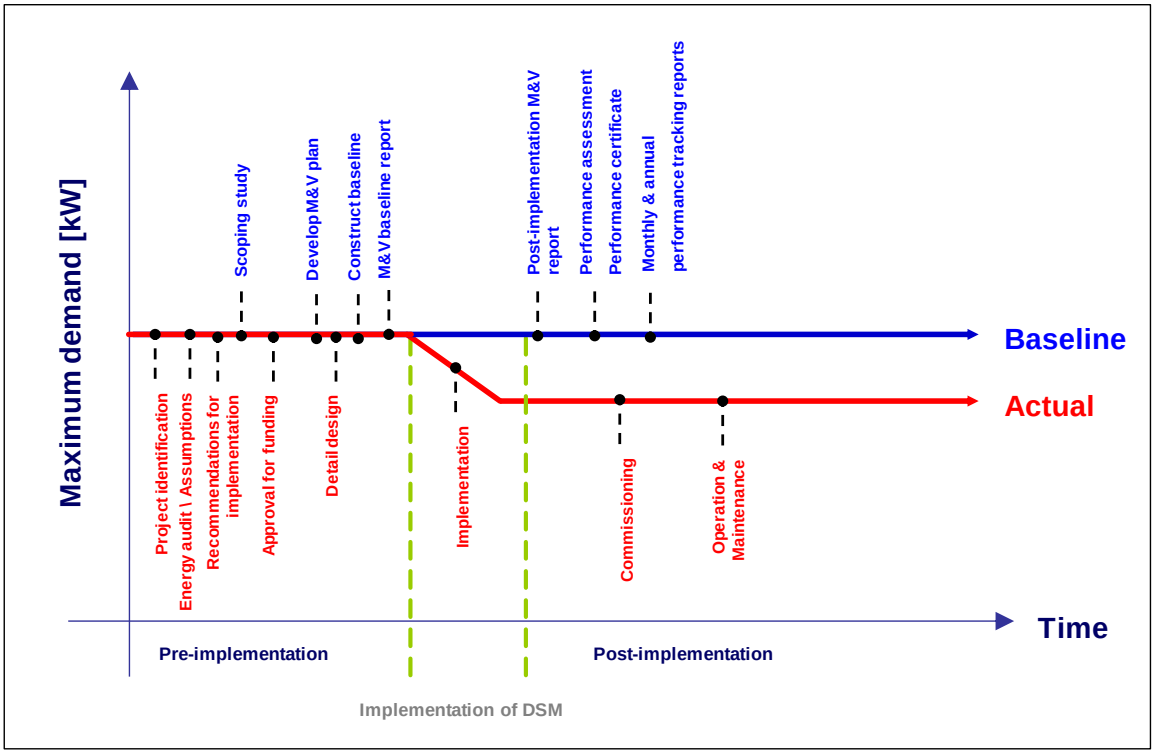

Figure 4.2: Basic DSM and M&V project interaction transposed on DSM impacts.

Post-implementation measurements are taken directly after implementation. These measurements are used to determine the actual energy performance of the system after full implementation of the DSM measures. The difference between the actual- and the baseline energy is the savings of the DSM measure. The M&V Team also conducts an audit prior to system commissioning. The function of this stage is to verify that the DSM measures have been implemented according to specification. The project's performance is then tested during the performance assessment period and a M&V performance certificate is issued by the M&V Team after this stage and distributed between the stakeholders.

The performance tracking reports are then compiled and submitted to the ESCo and to the client for the duration of the M&V contract.

CHAPTER 5: RESPONSIBILITIES OF THE ESCO DURING M&V

5.1 Introduction

This chapter will describe a number of actions that the ESCo can follow to assist the M&V team. Included in this chapter is a list of questions that the M&V team will typically ask to the ESCo. This will ensure that scoping reports and M&V plans are developed with the maximum input from the ESCo.

The M&V team will contact the ESCo in order to set up a meeting. During this stage the M&V team will ask a number of questions for which the ESCo can prepare from section 5.2.

5.2 Interaction between the ESCo and the M&V team

When the M&V team is formally instructed to proceed with M&V on a project, their first tasks will be to contact the ESCo and set up a meeting. During this initial phone conversation and kick-off meeting the ESCo can expect the following question from the M&V team:

- Provide full contact details of contact person tasked to liaise with the M&V team.
- Who is the client?
- Provide full contact details of the main contact person from the client's side that will liaise with the M&V Team.
- Provide a brief scope of the DSM Project – What are you (as the ESCo) planning to do; where are you planning to do it; how are you going to do it?
- Provide M&V team with all available documentation, technical documents and proposals for the project at the kick-off meeting / site visit.
- Provide the expected savings (demand, energy consumption and energy cost) you aim to achieve – Is it for the whole day or just over certain time-of-use periods.
- Provide the expected time-line of the project (implementation date, completion date).
- Provide the expected implementation cost of the project?
- Schedule a kick-off meeting and a site visit to introduce the M&V team to the client.
- Provide details on who will attend the kick-off meeting on the ESCo's and Client's behalf.
- Provide a roadmap to the site if necessary.

- State who will attend the site visit on the ESCo's behalf and on the Client's behalf? Get full details. If contractors are used to perform the bulk of installation they need to be there as well.
- What is the status with regards to security clearance? Can the M&V team enter with measuring and photographic equipment?
- Who will arrange for the necessary security clearance?
- Have you arranged for an electrician and/or proper maintenance personnel to be part of the site visit to aid with measurements and description of systems?

The following information will be required by the M&V team for the completion of the scoping report:

- Detailed description of the DSM project and documentation from the ESCo and/or Client.
- A detailed description of the project site in order to provide a site description in the M&V scoping report. (This must include the site location, is it a commercial building, industrial site or multiple residential sites. What is it used for and by whom).
- On which tariff structure is the project operating (Standard, Megaflex, RTP, custom, municipal, etc.) and obtain the tariffs if not a standard Eskom structure. Are any changes in tariff structure planned in the near future?
- Request that the client provide you with electricity accounts to verify the above if necessary.
- Gain a clear understanding of the site layout and its operation (7 pumps of capacity x on levels A, B & C of the mine, typically pumping for y hours per day from point 1 to point 2, etc). Obtain a schematic layout of the system to include in the scoping report.
- Detailed and complete ratings and quantities of systems affected by the DSM measure
- How the system is controlled (manual, automatic)?
- What are the operational schedules for the system and its components during weekdays, Saturdays, Sundays and public holidays?
- Are there any constraints to the system and the DSM project (reservoir levels must remain between 30% and 100% of full capacity at all times) that can influence the savings?
- Provide full detail on the project boundaries and assumptions that was used to develop this project, to develop the proposal to Eskom and that was used to develop the project baseline as defined by the ESCo. This detail need to be included in full in the M&V plan and the M&V Baseline report. If any of the boundaries and/or assumptions becomes

invalid, the complete baseline process needs to be repeated by the M&V team. The M&V baseline must also be renegotiated in instances where it can be justified and/or proven that the boundary conditions and/or assumptions cause errors larger than 10% during the determination of the project impacts. This stage is extremely important in order to protect the ESCo, the client and Eskom.

- If multiple systems form part of the DSM project are there interactive effects between the systems and have these effects been included by the ESCo?
- Get a detailed description of the actions / activities that the ESCo proposes to perform during the implementation of the DSM project.
- Confirm the expected impacts with both the ESCo and the Client.
- How did the ESCo calculate these expected impacts;
- Ask the ESCo to provide you with these calculations and the data used if possible;
- Who will control and maintain the system after implementation has been completed;
- Are there any concerns or risks that can influence the performance of the system and the expected impacts of the project?

The following information will be required for the completion of the M&V plan:

- Provide a list of possible instances which would result in condonable periods as specified in the DSM agreement;
- Confirm the boundaries and assumptions as specified by the ESCo and the client that was used to develop the DSM project; to develop the proposal to Eskom; and to develop the project baseline and include in detail in the M&V plan.
- Is there a metering system installed on the systems or the whole site affected by the DSM project?
- If YES, what is being metered and is the data logged (in what intervals, for which period is the data available, how is the data logged)?
- Can this data be used to determine a baseline for the DSM project (and is it available to the M&V team for use)?
- If NO, where can the M&V team install metering equipment?
- The same metered data need to be obtained after implementation (Actual) in order to determine the project impacts. Can the same data be used and will the metering points/locations remain unchanged?

The above questions and information requirements represent only a basic set and will be customized to the specific DSM project.

It is important that the M&V team and the ESCo remain in constant contact with regards to the projects and its progress. The M&V team must be notified immediately of any changes in the project's scope of work, excepted performance and schedules.

The ESCo will receive electronic copies of all the M&V deliverables and will also receive the performance tracking reports. One of the most important M&V documents to the ESCo is the M&V Baseline report. This report provides the baseline that will be used during the calculation of the project impacts. It is critical that the ESCo give buy-in in this baseline. When buy-in is obtained, the ESCo will be asked to sign a copy together with the other DSM stakeholders after which one will then be distributed to each stakeholder.

CHAPTER 6: RESPONSIBILITIES OF THE CLIENT DURING M&V

6.1 Introduction

This chapter will describe a number of actions that the client can follow to assist the M&V team. Included in this chapter is a list of questions that the M&V team will typically ask to the client. This will ensure that scoping reports and M&V plans are developed with the maximum input from the client.

The M&V team will contact the ESCo and the client in order to set up a meeting. During this stage the M&V team will ask a number of questions for which the client can prepare from section 5.2.

6.2 Interaction between the client and the M&V team

When the M&V team is formally instructed to proceed with M&V on a project, their first tasks will be to contact the client and the ESCo and set up a meeting. The following questions may be asked to the client during this initial phone conversation. It could thus greatly speed up the process if the client prepares the following information in advance:

- What is the client's understanding of the DSM project: What, where, when and how is the ESCo going to do it?
- What is the expected time-line of the project (implementation date, completion date)?
- What is the expected implementation cost of the project?
- Provide the M&V team with all available documentation, technical documents and proposals for the project at the kick-off meeting / site visit.
- What are the potential barriers to the project from the Clients point of view?
- The M&V team will ask you to schedule a kick-off meeting which will be held with the ESCo, preferably on the site where the DSM project will be implemented?
- What special requirements are necessary to perform a site-visit? Safety shoes, clothing, restrictions.

The following information will be required by the M&V team for the completion of the scoping report:

- Detailed description of the DSM project and documentation from the ESCo and/or Client.

- A detailed description of the project site in order to provide a site description in the M&V scoping report. (This must include the site location, is it a commercial building, industrial site or multiple residential sites. What is it used for and by whom).
- On which tariff structure is the project operating (Standard, Megaflex, RTP, custom, municipal, etc.) and obtain the tariffs if not a standard Eskom structure. Are any changes in tariff structure planned in the near future?
- Request that the client provide you with electricity accounts to verify the above if necessary.
- Gain a clear understanding of the site layout and its operation (7 pumps of capacity x MW on levels A, B & C of the mine, typically pumping for y hours per day from point 1 to point 2, etc). Obtain a schematic layout of the system to include in the scoping report.
- Detailed and complete ratings and quantities of systems affected by the DSM measure
- How the system is controlled (manual, automatic)?
- What are the operational schedules for the system and its components during weekdays, Saturdays, Sundays and public holidays?
- Are there any constraints to the system and the DSM project (reservoir levels must remain between 30% and 100% of full capacity at all times) that can influence the savings?
- Provide full detail on the project boundaries and assumptions that was used to develop this project, to develop the proposal to Eskom and that was used to develop the project baseline as defined by the ESCo. This detail need to be included in full in the M&V plan and the M&V Baseline report. If any of the boundaries and/or assumptions becomes invalid, the complete baseline process needs to be repeated by the M&V team. The M&V baseline must also be renegotiated in instances where it can be justified and/or proven that the boundary conditions and/or assumptions cause errors larger than 10% during the determination of the project impacts. This stage is extremely important in order to protect the ESCo, the client and Eskom.
- If multiple systems for part of the DSM project are there interactive effects between the systems and have these effects been included by the ESCo?
- Get a detailed description of the actions / activities that the ESCo proposes to perform during the implementation of the DSM project.
- Confirm the expected impacts with both the ESCo and the Client.
- Who will control and maintain the system after implementation has been completed;

- Are there any concerns or risks that can influence the performance of the system and the expected impacts of the project?

The following information will be required for the completion of the M&V plan:

- Provide a list of possible instances which would result in condonable periods as specified in the DSM agreement;
- Confirm the boundaries and assumptions as specified by the ESCo and the client that was used to develop the DSM project; to develop the proposal to Eskom; and to develop the project baseline and include in detail in the M&V plan.
- Is there a metering system installed on the systems or the whole site affected by the DSM project?
- If YES, what is being metered and is the data logged (in what intervals, for which period is the data available, how is the data logged)?
- Can this data be used to determine a baseline for the DSM project (and is it available to the M&V team for use)?
- If NO, where can the M&V team install metering equipment?
- The same metered data need to be obtained after implementation (Actual) in order to determine the project impacts. Can the same data be used and will the metering points/locations remain unchanged?

The above questions and information requirements represent only a basic set and will be customized to each specific DSM project.

It is important that the M&V team and the client remain in constant contact with regards to the project and its progress. The M&V team must be notified immediately of any changes in the project's expected scope, performance and schedules.

The client will receive electronic copies of all the M&V deliverables and will also receive the performance tracking reports. One of the most important M&V documents to the client is the M&V Baseline report. This report provides the baseline that will be used during the calculation of the project impacts. It is critical that the client give buy-in in this baseline. When buy-in is obtained, the client will be asked to sign one copy together with the other DSM stakeholders. Copies of this signed-off baseline report will be distributed to each project party.

CHAPTER 7: DERIVED DATA

7.1 Background

Accurate data forms the backbone of the measurement and verification (M&V) process and all its activities. This data is not only used to develop project and system baselines, but also to track the actual monthly performance and sustainability of the individual projects over their life.

In the South African context, Eskom Demand-Side Management (DSM) finances the DSM projects through funding obtained from the National Energy Regulator of South Africa (NERSA). Eskom DSM and the Assurance and Forensic Department thus have an annual obligation to report back to stakeholders, including NERSA, on the true and actual performance of the DSM programme. This performance is also not only reported for the periods in which the DSM projects could perform, but over the full performance period (full calendar month). This imply that the performance assessment results must represent the actual performance of the project for that month, whether it was able to deliver its contracted performance or not (and not just for the days in which the project was performing).

Condonable days or periods is a collective description for days or periods in which a EEDSM project could not deliver its contracted performance due to the influence of events or circumstances that were completely outside the control of the ESCo or the client.

The performance of the DSM projects consequently has a direct influence on the funding allocated by an investor (NERSA) for DSM activities. It is for this reason that all reporting functions performed by the various M&V teams on the full range of DSM projects be accurate and provides a true representation of project performance and sustainability. M&V will always endeavour to report on the impacts as experienced by the national grid. The above is the reason why the concept of condonable days (or periods as little as 30-minutes) is not practical for Eskom DSM since the moment condonable days are included, the performance no longer give a true representation of the project's performance. Condonable days are consequently always excluded when DSM performance is reported to stakeholders and NERSA.

... baseline data consist of real facts about energy and independent variables as they existed during the baseline period. Therefore baseline data problems should not be replaced by modelled data, except when using Option D (calibrated simulation). Where baseline data is missing or inadequate, seek other real data to substitute, or change the baseline period so that it contains only real data.

IPMVP (2007)

DSM projects are however implemented in an environment where everything does not always work as planned. Data loss is a very real problem and has a direct impact on the M&V team's ability to report on a

DSM project's performance. Data loss can be the result of a substantial number of reasons such as system errors to critical failures in measurement equipment. In the case of baseline development, this problem can often be solved by extending the baseline data metering period (if possible), or using relevant data that is available. This is possible since baseline metering often extends over periods of three months or more.

The M&V teams (and consequently stakeholders) however often find themselves in a predicament when data loss is experienced when the DSM projects are in their performance assessment- or performance tracking phases. It is the results from these phases that are reported to stakeholders. What do we (M&V Teams) do when we do not have data to perform the calculations? What system or approach can we use to derive data for such instances? Is it possible to derive data based on other known facts or data that is available? These are the questions that need to be answered when M&V Teams encounter such a scenario. A standardised approach is consequently essential to ensure that all the various M&V teams handle such instances in a consistent manner. This approach will however differ between various project types and scenarios.

The purpose of this chapter is to provide a number of proposed basic approaches that can be used towards a standardised approach to derive data to replace lost/missing data. This chapter by no means offers a complete scenario or solution to the problem and aim to solicit feedback and input from all stakeholders to ultimately result in a standardised approach that will be incorporated into future updated versions of the M&V Guideline document. All comments and proposals are consequently vital and welcome.

7.2 What the IPMVP says?

The IPMVP only briefly touches on the issue of data loss. It firstly states that modelling or the use of derived data in the case of baseline development is not acceptable (see Section 1.1) except in the case of M&V under Option D which is a calibrated simulation. The IPMVP further states that where baseline data is missing or inadequate, the M&V team need to seek other real data to substitute, or change the baseline period so that it contains only real data. This is however not the primary reason why a standardised approach to derived data is needed. The problem also exists during the performance assessment and tracking phases.

In terms of data loss during the performance assessment- and performance tracking phases, the IPMVP states that a methodology must be established by which missing or erroneous data can be derived by one or more methods of imputation to allow for final analysis. Detail on the methodology is however not elaborated on. It is consequently up to the M&V Teams to develop such methodologies for the various (project- and situation specific) instances. It is however

important that this methodology, once developed, be communicated to the stakeholders, especially the ESCo and the client to ensure that they agree with the methodology.

7.3 What happened to the DSM project during data loss?

The first step to be taken when data loss is experienced during a project is to establish the reason for the data loss. **The M&V team then need to ascertain if the data loss had any influence on the DSM project**. Consider the following three scenarios for a mine pumping system:

Scenario A: Data loss is experienced. After contact with the ESCo and the client it is established that an error occurred on the metering system, but that the pumping system was still effectively controlled to deliver DSM results during the evening peak. It is preferred that this is substantiated with some type of proof, e.g. production schedules, water flow measurements and communication be done via e-mail to ensure a paper trail. The M&V team can thus assume that the pumps were operated in the usual manner, but that they just can't prove it by means of concrete data. In such cases it would be acceptable to set the actual profile for the days with data loss equal to the average actual profile of the days for which data is available (Figure 1). Here it is however very important to consider the variability of the available profiles. If the inherent variability of the system is significant of the historical distribution is skewed, care should be taken when using averaged profiles. These cases should be handled as they occur and the most representative profile(s) should be utilised.

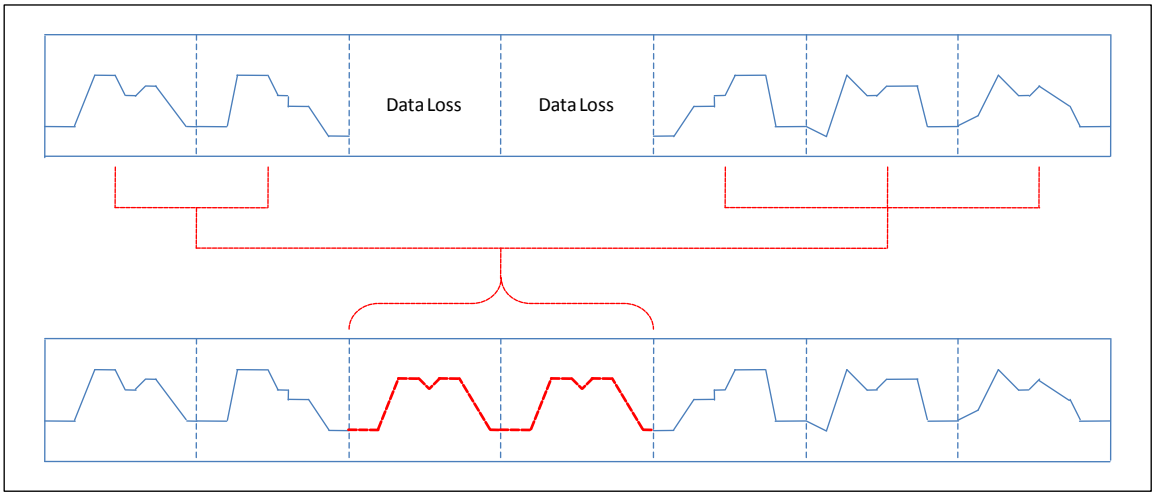

Figure 1: Deriving data from a variable system operational profile.

In certain cases the daily actual (post-implementation) operational profile is basically constant as in the case of many commercial lighting projects. This daily profile can simply be substituted into the days for which data was lost (Figure 2).

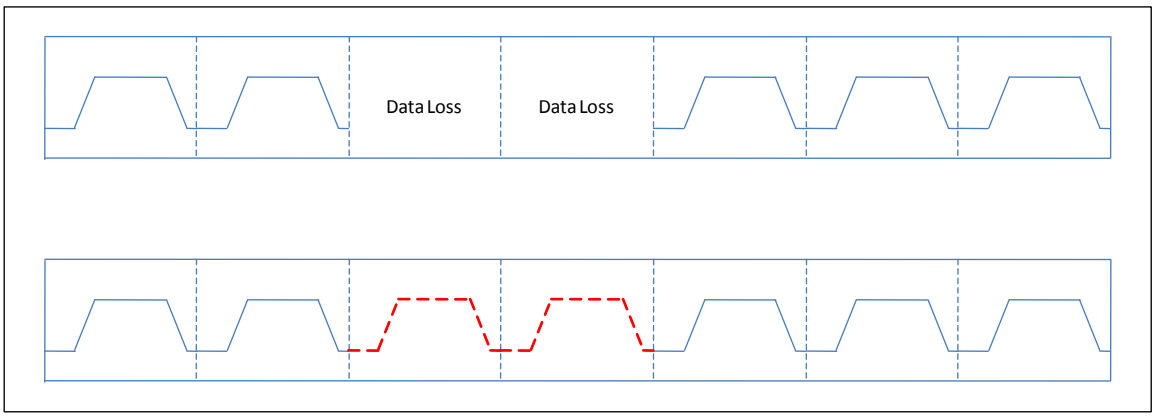

Figure 2: Deriving data from a constant system operational profile.

It is however important that the M&V team clearly indicate in their performance assessment and performance tracking reports which periods experienced data loss and that they used derived data to determine the impacts of the project.

Scenario B: Data loss is experienced. After contact with the ESCo and the client it is established that an error occurred on the metering system and the system controlling the DSM project. The system was consequently operated in a manual mode (as it was done prior to the DSM intervention). This implies that the system temporarily reverted back to the pre-DSM operation. In this case it will be impossible for the M&V team to quantify whether the system obtained any DSM impacts under the manual operation mode. In such a case it is proposed that the actual kW profile be made equal to the applicable baseline (weekday, Saturday, Sunday) profile for the days that experienced data loss. The outcome would be that the impacts for these days are equal to zero (baseline – baseline = 0). The second result will however be that these days will effectively reduce (dilute) the overall monthly average of the project.

Scenario C: Data loss is experienced. After contact with the ESCo and the client it is established that an error occurred on the metering system and the system controlling the DSM project. The pumps were also not operational due to a critical failure. In such a case it is proposed that the actual kW profile be made equal to zero for the days (or hours) that experienced data loss. However, the baseline also needs to be set equal to zero for the corresponding periods since it must reflect system behaviour in the absence of the DSM intervention. This will result that the impacts for these periods are equal to zero (baseline – actual = 0). Under this scenario the result will however also be that these days will effectively reduce or dilute the overall monthly average of the project.

From the above it is obvious that the M&V teams need to **investigate what happened to the system during the data loss period and then make a call on how to proceed**. If a model

exists for linking the energy use to water pumped (Scenario A), and the water pumped figure is still available, the model should be used to derive a kW profile. It is however often the case that only energy use is monitored for M&V purposes and that no other independent variables are recorded. In these instances it is not possible to model the energy use and averages will need to be used. It is important to note that the above is highly dependent on the system in question and the specific nature of the DSM project.

7.4 Using derived data

One of the more serious risks associated with the use of derived data and the standardised methodology proposed in this document is the abuse and manipulation of the system for projects that are not delivering the contracted performance.

A proposed rule of thumb is that the M&V teams use the remainder of a current month's available data to derive data when one week or less of data is lost. When data loss is more than one week, the previous month's data should also be included in conjunction with the current month's data to derive data, taking variation into account.

The situation where complete months are subject to data loss is currently also a serious problem for the M&V Teams and a decision has been taken to that the performance against the baseline be reported as zero.

Proposed rule of thumb:

(1) 1 week or less data loss / month: Use remainder of month to derive data

(2) More than 1 week data loss / month: Use remainder of month and previous month to derive data

(3) Complete months of data loss: Set actual profile equal to baseline profile and report impacts as zero

7.5 General Comments

The ease of developing derived data is obviously linked to the complexity of the DSM project and the level of variation that is found within the project environment.

The M&V Team firstly need to establish what the DSM project was doing during the period of data loss. The following alternatives exist:

- Operational & controlled for DSM purposes
- Operational but not controlled for DSM purposes
- Not operational
- Combination of above

Based on the above outcomes, the methodologies discussed in Scenarios 1-3 may be applied.

It is however important that a paper trail exist in terms of communications between the M&V Team, the ESCo and the client and that all stakeholders be kept up to date.

It is also important that adequate motivation and proof of the DSM system's operation be provided to the M&V Team by the ESCo and/or the client.

All results determined with the assistance of derived data need to be clearly indicated as such in all performance assessment and performance tracking reports.

CHAPTER 8: LESSONS LEARNT

8.1 Introduction

Over the course of the last few years a number of valuable lessons have been learnt with regards to project implementation and the way in which DSM should be managed. We have also learnt from experience that certain pitfalls do exist during the implementation of DSM projects by the ESCos. All the processes have evolved throughout the implementation of DSM but certain mistakes are still being made due to a lack of communication. This chapter hopes to share some of the lessons learnt over the previous few years with ESCos to ensure that projects are implemented faster and in a more effective manner, and that they consistently deliver on their intended DSM targets.

8.2 Lessons learnt

8.2.1 Project assumptions

It has been found on numerous occasions that the assumptions on which ESCos base their DSM target are wrong to detrimental effect for the ESCo. Check all assumptions and verify that your assumptions are correct. Consider the case of the Kruger National Park's lighting retrofit of 3 large camps. A lighting operational schedule was assumed based on profiles for other holiday resorts and residential behavior. This operational profile however proved to be wrong since behavior of occupants was drastically different in the Kruger National Park when compared to other resorts. People tended to keep their lights off for game viewing purposes and also tended to go to bed early. This caused the project not to reach its DSM target.

Get a layout plan of the facility to make sure all areas are covered during an audit. It is common that certain areas are not accessible, but there is a difference between assuming there is an office behind the closed door when there actually is a complete wing behind the door.

Use a reliable reference when determining operating capacities if it isn't metered. Always attempt to check your assumptions; preferably with metering. Measure at least a demand profile for a week. Use this to check assumptions made regarding operating hours.

8.2.2 Project implementation

Don't rely on personnel of the facility to implement your project for you. If you do, expect delays and expect that the project will not be implemented as intended. It has also been found that

projects implemented by sub-contractors for the ESCos experience critical delays if the contractors are paid too much in advance without a penalty clause for late completion.

Finalize the scope of the project as soon as possible; preferably before implementation starts. Keep accurate record of what is actually implemented and take photographs. Enforce deadlines! Keep accurate records.

8.2.3 Project testing and performance assessment period

Be sure to build a time limit into your agreement which will allow sufficient time for your DSM project to be completed and tested in time as per agreement with Eskom and your client. You will be allowed to make adjustments to the project during the performance assessment phase in order to ensure that your project reaches at least 90% of the intended project target. You should however be careful not to run out of time due to delays in implementation which can result in the ESCo paying penalties for non-compliance at the end of the performance assessment period.

The above offers only a few lessons learnt. You are however welcome to share your experiences with us in order to ensure that DSM and M&V are continuously streamlined in the future.

8.2.4 Project testing and performance assessment period

It has been found in certain proposed DSM projects that an ESCo proposes to retrofit the lighting system of a commercial building to deliver energy efficiency results. After inspection of the system by the M&V teams it has been found that the majority of the lighting fixtures are not operational due to poor maintenance. The retrofit of the lighting system will in fact increase the overall electricity use of the system. Eskom DSM is not prepared to fund the replacement or fixing of systems to deliver DSM impacts of lighting, or other relevant, systems due to poor maintenance of systems.

CHAPTER 9: SAFETY DURING MEASUREMENT & VERIFICATION

9.1 Introduction

Safety is a critical aspect of M&V since project teams are conducting site visits on a daily basis, often in dangerous and hazardous environments such as mines and industrial plants. The M&V teams are also frequently exposed to electrical distribution systems during metering installations. A number of safety fundamentals have been identified with the aim of:

- Addressing safety and health issues when conducting M&V;
- M&V teams are aware of their legal responsibilities and liabilities;
- M&V team members understand the safe use of their equipment;
- M&V team members are aware of the hazards in their project environments; and
- M&V team members familiarize themselves of emergency procedures.

9.2 The steps of safety

9.2.1 Personal protective equipment

Personal protective equipment or PPE is a requirement on many of the project sites that M&V teams visit. Make sure that contact is made with the client and the ESCo to determine which PPE is required. Ensure that you comply with these requirements when conducting site visits and system audits. It is often the case that safety equipment is arranged for M&V team members by either the client of the ESCo when conducting site visits. If this is not the case, the M&V team members need to ensure that they have adequate PPE available.

9.2.2 Competency and training

Ensure that M&V team members are adequately trained in all aspects of their field and they are familiar with all aspects of safety and health measures

9.2.3 Hazard and risk assessments

All hazards and risks for individual projects and project sites need to be identified by the involved M&V team members. These assessments need to be incorporated into the M&V Scoping Report where the various risks are identified. The M&V plan must include a section on the risks and list

the M&V team's response to these risks and hazards. Hazards and risks must be reviewed whenever processes, people or circumstances change.

9.2.4 Safety responsibility

All persons must take responsibility for their own safety and health as well as that of other people.

9.2.5 Protection

PPE as required by the project site must be worn at all times when on the project site. This is a mandatory as defined by the risk assessment (M&V Plan) and minimum project site requirements.

9.2.6 Safety devices

Under no circumstances must safety devices on project sites be tampered with or made inoperable.

9.2.7 Health and safety standards

M&V team members must always be in a position to know where they must go in case of an emergency, accident or incident.

Information on evacuation points, accidents and other incidents is part of site inductions or available from the site representative that should always accompany the M&V team members.

9.2.8 Electrical Installations and Equipment

If you are not qualified to work on any electrical systems, you must ensure that a qualified electrician accompany you to the site to perform the required work. Always ensure that systems are switched off or isolated when performing any work.

9.2.9 General safety

When in doubt, stop what you are doing and get qualified help. Always report to site representatives before commencing with any work on a project site. Remember that you are responsible for the safety of your colleges and yourself

CHAPTER 10: REFERENCES

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CHAPTER 11: Contact details

This Measurement and Verification Guideline document has been developed by the North-West University's (Potchefstroom Campus) M&V Team in conjunction with the Assurance and Forensic Department and the various appointed M&V Teams. Please feel free to contact the authors for more information on measurement and verification and the various aspects thereof:

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