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**ELECTRICITY METERING TECHNOLOGY**

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**USAID | Iraq Economic Governance II**  
**PREPARED FOR:**  
**IRAQ ELECTRICITY SECTOR MINISTRY OF ELECTRICITY (ME)**  
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# 1 INTRODUCTION

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## 1. INTRODUCTION

This report has been prepared after examination of the current state of Electricity Metering in Iraq with the intention of proposing recommendations for future metering strategy. The existing Electricity Metering population is in poor condition with, potentially, in excess of 30% faulty, damaged or missing meters. This figure is largely anecdotal and is taken from a previous document concerning the Billing & Collection Systems and Processes produced by BearingPoint in November 2003. Accurate information of defective and inaccurate metering is a prerequisite to completing a strategy and the gathering of this information forms an integral part of these recommendations.

Some basic factual information regarding manufacturers, meter types and age profile, however, has been provided by the Ministry of Electricity on the existing metering systems installed throughout Iraq. The metering types currently in use are listed in Appendix A - [Existing Meters in use in Iraq](#) and consist of 100% Electro Mechanical (EM) meters, some of which have been in service since 1966. EM meters, as their name suggests, have mechanical moving parts which are subject to wear over a period of time and it is customary, in Europe and other countries, to limit the period in service of an EM meter to a prescribed maximum period (15 years for residential metering in the UK). After this period of time a meter would be removed from service, cleaned and refurbished by replacing any worn parts, tested and recalibrated and, if satisfactory, returned to stock for re-use when required. Any unsatisfactory metering would be removed from circulation. The meters in Iraq that are over 15 years old are therefore potentially inaccurate and it is necessary to gather information on metering accuracy to provide evidence of the need to carry out a structured replacement policy where necessary.

In order that the billing and collection function can be returned to normality it is necessary to ensure that all faulty and inaccurate metering is replaced as soon as practicable and, to facilitate this, two activities have already been planned.

Firstly, a survey needs to be carried out to ascertain the volume and diversity of new meters required to replace those that are damaged and faulty. The survey requires a database to store all the survey details for analysis and for subsequent loading into a Meter Asset Management System when one becomes available. The design of this application is currently being carried out by BearingPoint. A project plan is to be prepared to enable the survey to be carried out initially on a representative area before being rolled out to all areas of Iraq. The survey will fulfill several urgent needs.

- Ascertain the numbers and types of damaged and faulty meters.
- Enable inaccuracies in billing master file customer details to be identified and corrected.
- Identify properties that are not on the billing file.
- Identify properties that are on the billing file but are no longer habitable.
- Identify properties with electricity but no meter.

Secondly, a sample accuracy survey is required to better understand the longer term need to replace inaccurate metering when circumstances allow and to provide more accurate system loss information to the Distribution Directors General. Partial results for a small sample of 3 phase residential metering are available and included in Appendix B - [Existing Metering Accuracy Survey](#). This survey needs to be more comprehensive and contain results from single phase metering and particularly meters that are greater than 15 years old.

Whilst these exercises are being carried out to quantify the full extent of the problem, a concurrent requirement is to decide on the metering technology that will be used to replace the meters as required. It is therefore necessary to identify the metering technology available and the potential meter manufacturers which is the

## Introduction

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purpose of the current report. Alternative technologies are presented in this report and the Ministry will be required to choose from the alternatives based on the current needs, future intentions regarding meter reading and tariff requirements and, of course, price and availability.

Although all the metering currently in use in Iraq is EM, a large proportion of new meters purchased across the modern world are of Solid State (SS) i.e. electronic construction. SS meters have now been in production for 20 years and any early concerns about their long term stability and ability to maintain accuracy have long been cast aside. A comparison of relative advantages is included in this report to better enable the MoE to choose their future direction.

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## **2 METERING TECHNOLOGY**

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## 2. METERING TECHNOLOGY

In addition to the overwhelming need to renew existing faulty, damaged and inaccurate metering, consideration should be given to moving forward with more modern metering technology. Another driving force is the need to improve revenue collection. The use of prepayment metering in the emerging markets has found great favor over recent years where revenue collection has been historically difficult and the Ministry of Electricity has requested that prepayment systems be considered as a potential option.

### The case for Solid State Meters.

The majority of meter manufacturers have both EM and SS meters in their product range but the sale of SS metering is now outstripping that of the EM products. The main reason for the gain in popularity of SS metering is that the price differential has narrowed whilst the technological advantages of SS far outweigh any initial cost implications.

In order for the MoE to influence consumption patterns and better control system demand, new tariffs need to be introduced but the existing EM metering cannot be used to measure any new tariff bands that may be introduced. The current manual meter reading process has a high level of failure due to lack of access to properties and the introduction of remote meter reading would greatly assist in overcoming this difficulty. The future needs for flexible tariffs and eventual migration towards automatic/remote meter reading techniques demand that future metering purchases should be based on new Solid State electronic metering. The table below gives a list of the benefits of moving towards the newer advanced metering.

Electromechanical (EM)	Solid State Electronic (SS)
Lower cost	Higher cost (<20%)
No tariff flexibility	Available with multiple tariff options
Easy to tamper	Enhanced tamper prevention and notification
Accuracy degradation with age	Higher accuracy device with life time stability
Periodic refurbishment needed to maintain accuracy	Maintenance free
No potential for automatic reading	Available with automatic meter reading features
No prepayment option	Available as Prepayment system

Meter manufacturing is a global business – meters can be sourced from any country that provides the mix of price, quality and features that the purchaser requires. There are many manufacturers in the field of SS devices both single and three phase for either credit or prepayment revenue collection. A comprehensive list is attached at Appendix C - [Solid State Meter Manufacturers](#).

Choice of manufacturer should obviously take into account the required metering types, future tariff and meter reading requirements as well as systems and costs involved. Accurate costs can only be obtained once the true volume required is known from the metering survey and tenders have been issued to a chosen short list of manufacturers, since quantity discounts from manufacturers, as well as the competitive effect of a tender process, can drive prices downwards significantly.



## Credit Meters

In making the choice of credit meter manufacturer, consideration needs to be given to all aspects of the future direction of the Ministry with regard to tariffs and AMR. The final choice will depend on the results of formalized tenders that can be issued once a short list has been chosen. Appendix D - [Available Credit Metering Companies](#) contains a comprehensive list of all suitable credit meter manufacturers with contact details and product availability. All manufacturers were appraised of the potential requirements and requested to provide product availability and appropriate manufacturing locations. Some manufacturers did not respond to the initial enquiry and have not been included in the list below but their details are included in Appendix D if the Ministry wishes to consider alternative suppliers. A more detailed enquiry has been sent to the manufacturers that responded to the initial approach to give them a complete picture of the potential requirements and an opportunity to consider offerings to the Ministry once the tender documents have been formalized. It is suggested that the short list be selected from those manufacturers contained in the list below since these manufacturers have already expressed interest in competing for the supply of new meters to Iraq.

Company Name	Nearest Location	Web Address
Actaris metering system	Actaris Saudi Arabia. PO Box 4793, Al-Khobar 31952, Baglaf Industrial Area.	<a href="http://www.actaris.com/">http://www.actaris.com/</a>
Ampy Automation Ltd	Engineering Trade Office, Ahmed HadHoud, 6 ABD Elkawy Ahmed St. El Mohandseen, 12411, Cairo, Egypt	<a href="http://www.ampy.co.uk/">http://www.ampy.co.uk/</a>
Elgama-Elektronika Ltd	2 Visoriu street, Vilnius city, zip code 08300, Lithuania	<a href="http://www.elgama.lt/en/">http://www.elgama.lt/en/</a>
Elymer International Pvt. Ltd.	37 Bungalow Road, Delhi 110007 (India)	<a href="http://www.elymer.com/">http://www.elymer.com/</a>
EMCO Ltd.	N-104 MIDC Area, Plot No F-5 Road No 28, Wagle Industrial Estate, Thane-400 604, Maharashtra, India	<a href="http://www.emcoindia.com/">http://www.emcoindia.com/</a>
Genus Overseas Electronics Limited	SPL-3, RIICO Industrial Area, Sitapura, Tonk Road, Jaipur -302 022, India	<a href="http://www.genusoverseas.com/">http://www.genusoverseas.com/</a>
Henan Jinque Electric Co., Ltd	999 Jinque Road, Zhumadian City, Henan Province, P.R.China.	<a href="http://www.jin-que.com/">http://www.jin-que.com/</a>
Iskraemeco d.d.	Savska loka 4, 4000 Kranj, SLOVENIA	<a href="http://www.iskraemeco.si/">http://www.iskraemeco.si/</a>
Landis+Gyr AG	Feldstrasse 1, 6301 Zug, Switzerland.	<a href="http://www.landisgyr.com/">http://www.landisgyr.com/</a>
Polymeters Response International Ltd (PRI)	PRI house, Moorside Road, Winchester Hants, SO23 7RX, UK.	<a href="http://www.pri.co.uk/">http://www.pri.co.uk/</a>
Shenzhen Star Instrument Company Limited	5th Floor, No. 5 Kehua Road, Science Industry Park, Nanshan District, Shenzhen, China	<a href="http://www.szstar.com/">http://www.szstar.com/</a>

All manufacturers of SS metering offer a range of products from a simple single rate meter to multiple tariff meters and with and without remote reading facilities. The lowest cost option is obviously the meter with the least functionality but the MoE should opt for a meter with multiple tariffs to avoid having to replace new meters in a few years time when the billing system is ready to accept multi tariff information and produce the requisite bills. Meters can also be purchased equipped with the remote meter reading hardware in preparation for migration to automatic meter reading as soon as practicable.

## Future Meter Reading Option

Most meter manufacturers offer Automatic Meter Reading (AMR) facilities with their product range. However each manufacturer may not offer all the options with their meters and, since the systems vary greatly in cost and infrastructure, the MoE's future intentions towards AMR must be specified before the choice of credit meter manufacturer can be made. Fully automatic systems such as Power Line Carrier, radio fixed network, and dedicated communications links at each meter are expensive to implement but short range radio is an alternative requiring little infrastructure other than the handheld devices to collect the readings and the central data repository for downloading data and interfacing with the billing system.

Below is a brief description of each of the available technologies and a list of the Suppliers of these AMR technologies are listed by supplier in Appendix E - [AMR Technologies](#).

### Hand Held Collection.

This would involve utilizing the existing meter reading force and introducing handheld technology to speed up the process thereby reducing manual errors and potential for fraud. The handheld device can be used to key in the reading manually thus reducing the transfer of data to the billing system. It could communicate with the meter by cable connection or optical port thus removing any keying activity at the meter or billing system. However, these methods still need the meter reader to have access to the meter and a full meter reading force therefore providing few of the advantages of full AMR.

### Short Range Radio

Meters are available with inbuilt short range wireless communications to enable meter reading to be done by walk by or drive by meter readers. Some manufacturers of the AMR technology do not produce the actual meter and their systems require an interposing device which links the meter to the meter reader's handheld receiver. It is preferable, from a simplicity standpoint, to select a meter with the technology already on board but cost will be the most decisive factor.

### Power Line Carrier

Power Line Carrier systems utilize the existing power lines to transmit and receive data from a locally positioned data concentrator. These local concentrators are then connected to the host computer via standard communications links. This system is simple to install and easily expandable. It establishes a utility owned continuous bi-directional communications path to every meter and enables enhanced control for meter reading, outage detection and load monitoring.

Disadvantages are that the system requires data concentrators at every substation with communication links back to the main office, which has a cost implication. The meters are specific to the reading technology supplier or require an additional device to communicate between the meter and data concentrator. So, although very flexible, they require expensive infrastructure and do not lend themselves easily to an overhead network.

### Remote collection by GSM, fixed radio network or PSTN Network

All meter manufacturers produce meters with onboard modems to facilitate communication with the management and meter reading software. The modem will be designed to interface with the chosen communications media which could be Fixed Radio Network, GSM digital network, public switched network or even satellite link. However, all these systems require a communications infrastructure in place to enable the data collection. Fixed Radio Network requires a network of radio receivers, PSTN requires the installation of a phone line or a sharing device for the existing phone line at each customer and GSM requires the use of the

GSM network. All the communications modems serve to raise the cost of the meter, the cost of the infrastructure and the cost of the communications with the meter on a regular basis.

## MoE Benefits

There are substantial benefits to be gained from adopting this technology.

- Reduced meter reading costs.
  - Conventional meter reading is a labor-intensive process and can represent a considerable percentage of a utility's operating cost. In addition to the labor component, ancillary elements such as vehicle costs, insurance claims, uniforms, etc. are recurring costs that can be avoided by using a technology solution.
- Reduces billing estimation.
  - Missing meter readings resulting from no access are reduced to zero.
- Removes access difficulty.
  - In the majority of cases, electricity meters are either located inside the customer's premises or within their property area with no easy access. Accessing these meters requires the meter reader to gain physical access to the meter to read it. Access issues lead to a rise in estimated bills, re-reads, lost revenues, and undetected meter tampering or theft. With any of the versions of AMR, access is no longer an issue.
- Increased staff security and safety.
  - Whether it is a dog, a high crime area or a confined space, meter readers today can easily find themselves in unsafe environments. AMR helps to reduce the threat of dangerous situations by automating the meter data collection process.
- Reduced read-to-bill time.
  - AMR allows utilities to reduce their read-to-bill time, by tightly integrating the meter data capture and billing process. In many cases, improved meter data acquisition permits utilities to increase billing frequency or offer more billing options to their customers.
- Improved fraud detection.
  - AMR allows utilities to detect whether or not a meter has been tampered with or if wires have been cut at the meter. The system will flag the account with a code notifying the meter reader to investigate the situation. No human interference with meter readings removes element of potential fraud by meter readers.
- Improved customer service.
  - In a deregulated environment, customer satisfaction and retention are key components of a successful utility. AMR can help utilities improve customer service by providing timely and accurate bills, automating outage notification, reducing customer disruptions caused by manual reads and improving the process of resolving meter reading disputes.
- Enables real time pricing.
  - Variable rate tariffs based on the time of day can be used to encourage consumers to shift their consumption of valuable resources to off-peak hours, while also discouraging the usage during peak hours. This enables energy producers to reduce the maximum capacity of their plant and therefore achieve a better return on capital.

- Enables improved distribution planning.
  - AMR can allow utilities to provide better customer service by enabling a greater level of functionality over their distribution network, including: remote credits to pre-payment meters, remote connect/disconnect services, tamper detection and outage notification.

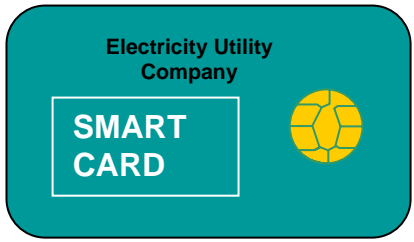

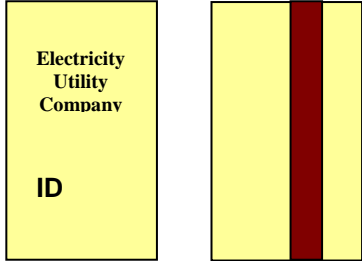
### **Customer Benefits.**

In addition to the Utility benefits above, the customer also gains numerous ways:

- Accurate billing statements and improved customer service through the reduction of estimated readings and billings.
- Improved meter reading accuracy through the reduction of errors from manual readings.
- Improved security because the meter readers no longer need to gain access to the property or households.
- Customers can move more easily between different rates creating greater choices.
- Improved information on energy consumption for tracking purposes and conservation.
- Improved cash flow from more frequent, smaller bills.

## Pre-payment Meters

Pre-payment metering, as its name suggests, is a method of collecting revenue from customers before they use the electricity. The various methods described below all involve customers paying for a token to be issued or a card or key to be programmed to instruct the electricity meter to allow electricity to be used up to the value of the purchase. Pre-payment technology varies from smart cards to tokenless keypad metering and a brief comparison of the various systems is given below. To take full advantage of smart card technology, it is necessary to have country wide modern IT infrastructure in place preferably with on-line banking. It will be some considerable time before Iraq is in a position to take advantage of all the smart card benefits and it is recommended that a more robust token or tokenless keypad system be chosen for any trial to be carried out.

<p><b>Smart Card</b>                  Memory cards contain a chip embedded in a credit card.                  Enhanced versions of this type of token include microprocessors, which are able to perform complex functions and provide higher levels of security.                  There are other, less popular types of cards with optical storage devices or those, which do not need physical contact (non-contact cards).                  Re-usable tokens but expensive.                  Two way data transfer to collect meter readings, error codes and update tariff information.</p>	
<p><b>Smart Key</b>                  Uses a non-volatile circuit memory device integrated into a plastic key.                  Two way data transfer                  Tokens re-usable but expensive                  Meters and keys prone to damage from static electricity.</p>	
<p><b>Disposable Token</b>                  Non meter specific.                  Pre-encoded multi-value tokens with magnetic stripes.                  Inherently insecure since token can be used in any meter.                  One way data transfer – no information returned from meter.                  Later Magnetic Card Meters have better security and are meter specific i.e. lost cards cannot be used in another meter.                  Reasonable cost disposable tokens (but still a significant cost)                  One- way data transfer.</p>	 <p style="text-align: center;"><b>Front</b>                      <b>Back</b></p>
<p><b>Tokenless</b>                  Low cost meters and low cost "tokens".                  No physical token required (customer receives an encoded number on printed slip and keys it into the meter).                  Telephone, radio and Internet vending possible.                  Very high security. Codes are payment/customer/meter specific and will be of no use if stolen. Once keyed in the meter the customer cannot re-use or claim to have "lost" the code.                  One way data transfer.</p>	

Once a specific system has been chosen and installed it would be impracticable to change to an alternate system and it is therefore of paramount importance that the first choice is taken with care. There are numerous benefits that are attributable to all the systems and include:

- Ensures revenue collection before usage.
- Requires no meter reading - periodic security checks.
- Enables and encourages customer budget management.
- Requires no cost for disconnections and reconnections.
- No delays in reconnection.
- Provides ability to collect back debts.
- Requires no customer deposits.

The table below gives details of those prepayment manufacturers that have shown interest in supplying their system and the appropriate training to the Iraq MoE and it is suggested that visits be organized to a chosen short list to observe demonstrations and actual installations of these systems before the final choice is made. A more comprehensive listing of all prepayment manufacturers is given in Appendix F - [Available Prepayment metering Companies](#) .

Company Name	Nearest Location	Web Address
Actaris metering system	Actaris Saudi Arabia. PO Box 4793, Al-Khobar 31952, Baglaf Industrial Area.	<a href="http://www.actaris.com/">http://www.actaris.com/</a>
Ampy Automation Ltd	Engineering Trade Office, Ahmed HadHoud, 6 ABD Elkawy Ahmed St. El Mohandseen, 12411, Cairo, Egypt	<a href="http://www.ampy.co.uk/">http://www.ampy.co.uk/</a>
CONLOG (Schneider Electric)	P.O. Box 2332, Durban 4000, South Africa	<a href="http://www.conlog.co.za/">http://www.conlog.co.za/</a>
Energy Controls	PO Box 1141, Stratford-upon-Avon, CV37 7XY, UK	<a href="http://www.econtrols.co.uk/">http://www.econtrols.co.uk/</a>
Henan Jinque Electric Co., Ltd	999 Jinque Road, Zhumadian City, Henan Province, P.R.China.	<a href="http://www.jinque.com/">http://www.jinque.com/</a>
Iskraemeco d.d.	Savska loka 4, 4000 Kranj, SLOVENIA	<a href="http://www.iskraemeco.si/">http://www.iskraemeco.si/</a>
Landis+Gyr AG	Feldstrasse 1, 6301 Zug, Switzerland.	<a href="http://www.landisgyr.com/">http://www.landisgyr.com/</a>
Polymeters Response International Ltd (PRI)	PRI house, Moorside Road, Winchester Hants, SO23 7RX, UK.	<a href="http://www.pri.co.uk/">http://www.pri.co.uk/</a>
Shenzhen Star Instrument Company Limited	5th Floor, No. 5 Kehua Road, Science Industry Park, Nanshan District, Shenzhen, China	<a href="http://www.szstar.com/">http://www.szstar.com/</a>

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### 3 CONCLUSIONS

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### 3. CONCLUSION

In order that the Ministry can move forward with updated technology and reap the benefits of tariff flexibility, Automatic Meter Reading methods and improved revenue collection, it is recommended that future meter purchases should be Solid State. It is necessary for the MoE to make several important decisions before there can be any progress made in improving the current metering situation. These decisions can be summarized as follows:

- AMR and multiple tariffs.

The choice of credit meter has to be taken with full consideration for future tariff strategy and any potential remote meter reading methods that are likely to be introduced. Replacement meters can then be purchased with the requisite technology built into the meters for subsequent activation. The next steps for the Ministry are as follows:

- Select the technology or choice of technologies for AMR.
- Select a short list of credit metering manufacturers that supply the chosen technologies.
- Prepare and issue tenders for supply of credit meters.
- Evaluate tenders and make final choice of suppliers.
- Prepare and implement installation plan for credit meters.

The choice of SS metering is quite diverse but the lists above of both Credit and Prepayment meters are manageable and a short list should be chosen from these lists after consideration of the future strategy. Once technical acceptability has been established, and tenders issued, the choice may be made purely on availability and economic considerations.

- Prepayment meters.

Tokenless pre-payment metering is best suited to the current Iraqi IT infrastructure. It is recommended that a pilot installation be carried out in a suitable location within Rusaffa Distribution Directorate, as suggested by the MoE. This will require careful choice of the area to be piloted to maximize acceptance of this new revenue collection method. A centralized office location will need to be set up equipped with the relevant computer hardware and software of the chosen system. Training will be required in both the operation of the new meters and the software to collect revenue and issue the coded payment slips. Each manufacturer has its own software and therefore training will be carried once the final choice of manufacturer has been made. The revenue systems available in Appendix F have very similar functionality and the choice can be based on cost and availability of equipment and training.

The MoE needs to decide on its long term strategy regarding implementation of prepayment revenue collection.

The key actions are:

- Make the initial decision – is prepayment metering the .
- Study tour of potential prepayment system suppliers.
- Select pilot area for prepayment metering.
- Prepare and issue tenders for supply of prepayment meters for the pilot project.
- Choose prepayment metering system supplier.
- Set up appropriate prepayment collection center.
- Prepare and implement installation plan for prepayment meters.
- Review pilot installation results.
- Rollout prepayment systems on successful completion of pilot review.



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## 4 APPENDICES

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## 4. APPENDICES

### *Appendix A – Existing Meters in use in Iraq.*

This is a list of meters that are currently used in Iraq with indicative periods of use and, hence, the likely age profile.



ExistingMetersInIraq

### *Appendix B – Existing Metering Accuracy Survey.*

These are the limited test results of the Metering Accuracy Survey carried out to date and consist of 50 3 phase residential meters. Further accuracy tests on single phase meters and, particularly those meters over 15 years old, are to be carried out.



Meter Accuracy Test  
Results

### *Appendix C – Solid State Meter Manufacturers.*

This spreadsheet contains details of all metering companies currently manufacturing the required solid state metering products.



Metering Companies

### *Appendix D – Available Credit Metering Companies.*

This spreadsheet contains details of all metering companies currently manufacturing the required credit metering products and indicates those that have responded to an initial request for product details. This appendix is still fluid.



Credit Metering  
Companies

### *Appendix E – AMR Technologies.*

This spreadsheet contains details of the different methods of AMR methods available by supplier.



AMR Methods

***Appendix F – Available Prepayment metering Companies.***

This spreadsheet contains details of all metering companies currently manufacturing prepayment metering systems and indicates those that have responded to an initial request for product details. This appendix is still fluid.



Prepayment  
Metering Companies