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Optimized System Loss Calculation for Distribution Transformers for Meralco using Excel VBA

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Abstract: This paper is written for the system that is designed and developed for South System Analysis Department of Meralco San Pablo City, Laguna. The system practiced the applications and nuances of Visual Basic (VB.NET 2012) and MS Excel. A graphical user interface (GUI) was designed and created using VB.NET and a database using VB Macro which is a subprogram of MS Excel. The functions of the system include the automatic computation of monitored distribution transformers with installed check meter's system loss, listing new customers and identifying disconnected users.

Key Words: distribution transformer, checkmeter, system loss;

1. INTRODUCTION

1.1 Background of the Study

Manila Electric Railroad Light Co. (Meralco) is one of the biggest electric utility distributor of the Philippines together with its contractors [1].

One of the many business centers of Meralco is located in San Pablo City, Laguna. They deal with the households and different commercial places within and near their prospective vicinities. One of the departments in this branch is called "South System Analysis" where they are the ones in-charge of calculating the system loss of all installed transformers called *Distribution Transformers (DT's)* with installed checkmeters and have unique numbers from each other called the *Transformer Location Number (TLN)*. Each DT has several *Service Numbers (SIN's)* for each of the household they are supplying for. Up to date, there are 819 distribution transformers with installed checkmeters that are being monitored by the department.

System loss is the loss of each distribution transformers within a range of households. Specifically, there are two types of system loss: (1) technical and (2) non-technical. Technical system loss is from wire loss that can be accountable to heat or from dysfunctional and broken meters. Non-technical system loss is from illegally connected power from the line. However, there is a need to check the status of each installed transformer because it will determine the condition of each- whether it can still operate normally or it needs a replacement. And this is determined with the use of system loss calculation. Thus, the system loss is computed with the formula:

$$System\ Loss = \frac{input - output}{input}\ x\ 100\% \quad \text{(eq. 1)}$$

1.2 Problem Statement

Since the System Analysis Department of Meralco's one responsibility is determining and computing the system loss of a specific distribution transformer, they created a system for computing the system loss of a transformer using Excel VB Macro. However, the department's problem is (1) automatically finding un-filled data that will have a great bearing for the accuracy of results, (2) finding new customers and (3) identifying disconnected service numbers.

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Thus, the proponents developed a program that will aid the problems stated. The proponents work on MS Excel for the database of the system, and the GUI is designed using Visual Basic 2012 (VB.NET).

1.3 Objectives

The proponents intend to provide for the existing need(s) of the System Analysis Department of Meralco.

Specifically, this study aims to:

1. Design a GUI that is suitable to the system.
2. Develop a program that meets the requirement of the departments (finding un-filled data, finding new customers and identifying disconnected users)
3. Implement the system for Meralco.

II. METHODOLOGY

2.1 Proposed System

This system entitled "Optimized System Loss Calculation for Distribution Transformers for Meralco" is designed to save time and manhours. This will also keep records' availability for obtained data analysis.

The users of the system computes for the system loss of distribution transformers with installed checkmeters monthly, thus also keeping previous records for analysis.

	A	B	C	D	M	N	O
1	POST-EMC SYSTEM LOSS MONITORING OF DISTRI						
2							
3	TLN	kVA Rating	Meter Number	Address	Mar '15	Apr.'15	May '15
4							
5	125595	50	214HAL000397	BRGY III-C, SAN PABLO CITY	14,040	15,680	16,680
6							
7	Count	SIN	Service Number	Customer/User	Mar '15	Apr.'15	May '15
8							
9	1	273462301	419373830101	RAYMUNDO EMRALINO	109	125	130
10	2	745472401	419374860101	RONALD P SENADOZA	39	21	27
11	3	273462801	419373950101	AGUSTINA AQUINO	0	0	-
12	4	273462902	419373930102	SUSAN ROMERO	319	327	344

Figure 1 Sample record

Fig 1.1 shows a sample record which is encoded and kept in the database. Seen in the record that the obtained data each and every month were recorded and saved. And for the coming months, it will add the results to the database [2].

2.2 Data Flow Diagram

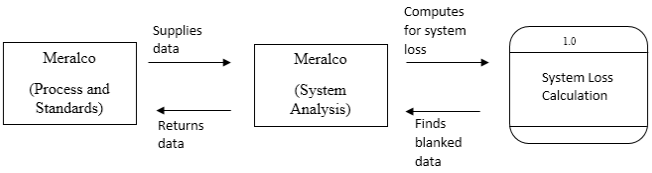

Figure 2 Level 0 data flow diagram

Fig 1.2 shows the level 0 data flow diagram which shows the major processes of the system. There are two external entities: (1) Process and Standards and (2) System Analysis. Both are departments of Meralco, in which Process and Standards supplies data for the System Analysis which is needed for the main process, the System Loss Calculation for Distribution Transformers. After calculating the system loss, the System Analysis will analyses the data and finds blanked data which will be returned to Process and Standards.

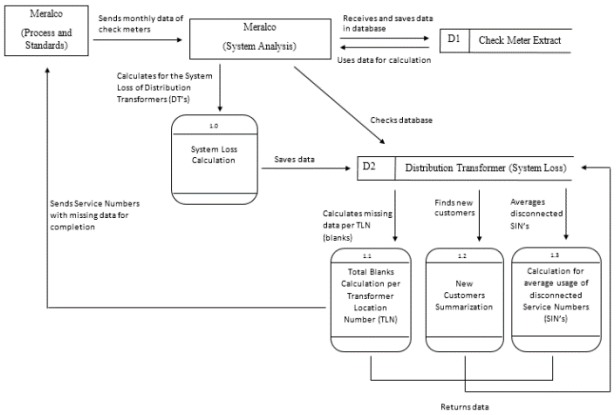

Figure 3 Level 2 data flow diagram

Fig 1.3 shows the system's level 2 data flow diagram which shows the overall processes. This diagram shows how information or data moves to and from processes. The process and Standards department of Meralco supplies data for the System Analysis in the form of database (Check Meter Extract). The System Analysis computes for the System Loss for Distribution Transformers. After computing, the department will use the system for finding blanked data, new customers and disconnected users. The results of these will be

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stored in the same database (workbook), only in different worksheets. The blanked data will be forwarded back to the Process and Standards Department for filling out of information.

2.3 Object-oriented Approach to Requirements

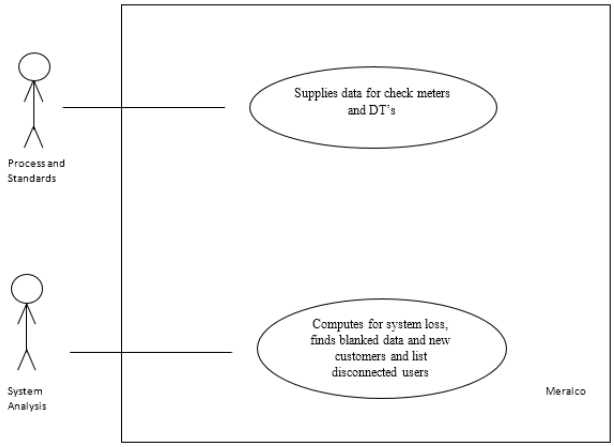

Figure 4 Use case diagram

Fig 4 shows the Use Case Diagram of the system. This diagram is used to pinpoint the key elements which are called actors. The actors in this diagram are the Process and Standards Department and the System Analysis Department. These two actors do the major processes. The Process and Standards supplies the data for check meters and distribution transformers. The System Analysis computes for the system loss and finds for the blanked data, new customers and disconnected users.

2.4 System Characteristics

This system automatically computes for the system loss of a specific distribution transformers with installed check meters.

POST-EMC SYSTEM LOSS MONITORING OF DISTRIBUTION TRANSFORMER

TLN	kVA Rating	Meter Number	Address	Revenue Meters	Mar '15	Apr.'15	May '15
125595	50	214HAL000397	BRGY III-C, SAN PABLO CITY	62	14,040	15,600	16,680

Count	SIN	Service Number	Customer/User	Meter No.	Mar '15	Apr.'15	May '15
70	273466101	419374640101	BERNARDO TARNATE	113BAG266839	151	170	188
71	273466401	419373960101	TICZON RINEL	113BAG266945	119	146	168
72	273466703	419375130103	MAXIMINA A TICZON	113BAG267458	0	0	-
73	273466301	419374740101	YOLANDA TORRES	113BAG267591	71	83	65
74	273465901	419374340101	CRISANTA ESTACIO	113BAG267327	51	57	52
75	273466201	419374020101	BRGY HALL	114BAG035874	353	654	533
76	273470001	419375120103	TEOXON,PRISCILA	107BA181979	88	94	96
77	273468703	419374230103	ARROGANCIA,MARILOU	114EAC017209	198	203	92
78	419375570103	419375570103	CRISTOBAL, MA. CRISTINA	114EAC019968	0	13	107
79	419374610106	419374610106	BELEN, JEFFREY	114EAC019852	75	129	151
80	419374610106	419374610106	Street Light	108BA079761	1,601	1,742	1,943
81	419374270111	419374270111	ALINEA, JOBELYN	114EAC007111	122	122	161
82	451472090101	451472090101	FERNANDEZ, MARILYN MARILAG	114EAC033120	119	136	142
				Total	13,836	15,524	16,905
				Average Loss, kWh	204	156	171
				Average Loss, %	1.45%	0.99%	1.03%

Figure 5 Sample record of system loss

Fig 5 shows a sample record of computed system loss.It shows the average system loss of a specific transformer location number which is shown on the upper left-hand side of the database. Each TLN has a number of service numbers which are also included in the database.

However, only the checkmeters and accounts extracted and provided by the Process and Standards Department can be computed by the system. Once the program ran, the blanked spaces are accounts that were not included or encoded in the extract provided by the department. Hence, the list of the blanked accounts will be sent to the department for filling out again to obtain accurate results.

III. RESULTS AND DISCUSSION

3.1 Graphical User Interface

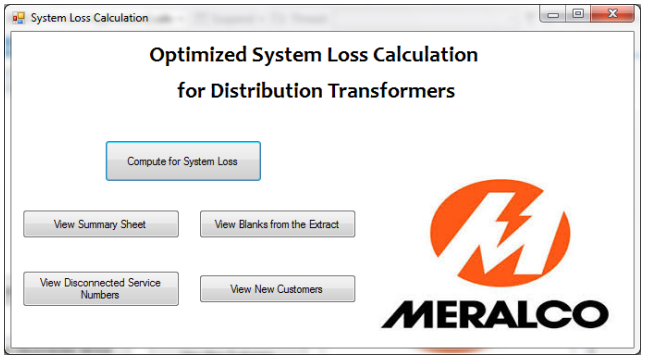

Figure 6 Graphical user interface

Fig 6 shows the graphical user interface (GUI) for the system *Optimized System Loss Calculation for Distribution Transformers*. The design of the GUI is simple, it displays five buttons for the system. The main button is for the computation of system loss which is initialized in Excel VBA Macro. The second button is for the viewing of summary sheet which will show the computed system loss for TLN's in a new worksheet. Since results from the summary sheet still very with the blanked data, the third button will display the TLN's and SIN's that has no data or reading for the month, this will be saved in another worksheet. The fourth button will show the list of disconnected users including their previous and active readings. The fifth button is for viewing new customers which affects the previous customer count of specific TLN. All the results of the four buttons are recorded in different worksheets but all in the same workbook [3].

3.2 System Functionalities

The functions of the system includes the computation of the system loss of distribution transformers. However, the accuracy of the results obtained will be dependent upon finding of blanked data or accounts because the computation varies of the total number of TLN's and leaving a blanked account would affect the whole computation and results. The system will also be responsible of finding new customers and listing of the previous and actual reading of disconnected users.

These functionalities will help the System Analysis of Meralco for doing their tasks easily and productively, thus saving more time and man-hours.

3.3 Work Breakdown Structure

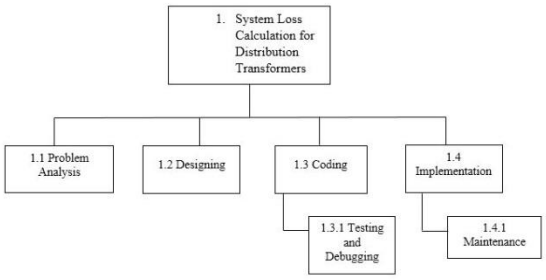

Figure 7 Organization-chart

Fig 7 shows the organization-chart of the system. This shows the overview of the system and its hierarchical categories. On the top is the system itself and the branches specifies the different processes that the system will go through since the beginning. It started with the problem analysis which is the initial planning of the project, followed by designing that includes the GUI and the database. The third one is the coding of the program and the testing and debugging. And the last one is implementation and maintenance.

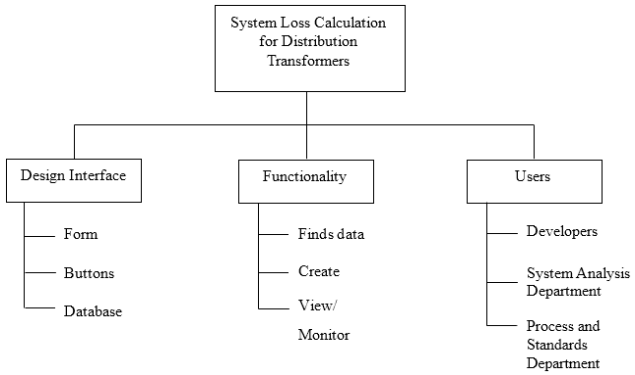

Figure 8 Functional-scheme

Fig 8 shows the functional-scheme WBS of the system. There are three sub-layers of the system: Design Interface, Functionality and Users. The design interface focuses on the system itself- how it is created which includes forms and buttons in VB.NET and database in MS Excel. The functionality states the functions of the system as a whole: finds data, creates worksheets for new data, view and monitor obtained data for analysis and keeping of records. Lastly, the users indicates who can use and access the system.

3.4 Network Diagram

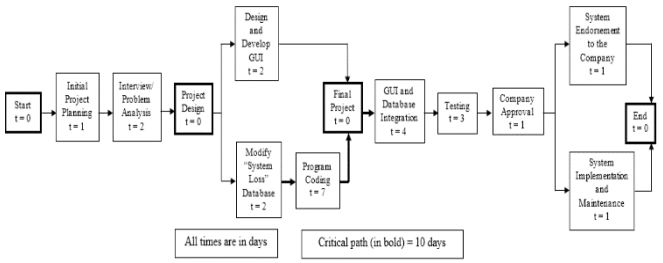

Figure 9 Network diagram

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Fig 9 shows the network diagram of the system. It displays the milestones in bold or highlighted format with indicates zero-time (t=0). In this diagram, the characterized milestones are the starting point, project design, final project and the end point. Within these milestones are activities which indicates the time needed for them to be finished.

The critical path are defined as the activities which accumulates more time than the other activities, in this diagram the critical paths are the program coding and the GUI and database integration which takes 10 days of the total working days.

3.5 CPM, PERT and Responsibility Assignment Matrix

Work Breakdown Structure		Responsibility Matrix		Gantt Chart												
Activity/Milestone		Personnel		Time (in days after start)												
WBS code	Title	Asegurado	Adalia	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Initial project planning	P	P														
2	Interview/Problem analysis	P	P														
3	Design and develop GUI	P	S														
4	Modify "System Loss" database	P	S														
5	Program coding	P	S														
6	GUI and database integration	P	S														
7	Testing	P	S														
8	Company approval	P	P														
9	System endorsement to the company	P	P														
10	Implementation and maintenance	P	P														

Figure 10 Gantt chart

Fig 10 shows the gantt chart of the project. This shows the sequence of the project, some actitivies are done simultaneously with some are done in order. The responsibility matrix indicated the people or personnel responsible for each activity or milestone in the work breakdown structure. The gantt chart serves as a timeline for the project.

IV. CONCLUSIONS

The proponents developed a system that will automatically computes the system loss of a distribution transformers with installed checkmeters with the utilization of VB.NET. The obtained data are saved and stored in a database in MS Excel for the users' convenience.

One workbook contains all the data required and needed by the users aside from the extract of the checkmeters. This workbook contains the individual worksheets that will keep the records of the service numbers with blanked accounts, list of the new customers and disconnected users.

Upon the development of the system, the proponents learned the nuance of the VB.NET when integrating to MS Excel. There are a lot of toolboxes and properties that are very convenient for this type of project.

V. RECOMMENDATIONS

For the further improvement of the system, the proponents recommend that:

- The users could add other useful functions for the system, and
- The users could also use MS Access as the database for more functionality.

VI. ACKNOWLEDGEMENTS

The success of this paper would not be possible without first of all God Almighty who's constantly showering His grace and wisdom all the time. For guiding the proponents while doing this study/project. Secondly, to the institution of LPU-L for serving as a training ground for the proponents in exercising their skills and talents and for giving a room for this kind of opportunity. And lastly, to the South System Analysis department of Meralco for allowing the proponents to create a system for them and for guiding them in order to meet the requirements of the system.

VII. REFERENCES

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