BEC Metering Department

New System Proposal

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Executive Summary

This research project describes a summation of the changes to be executed on Beltrami Electric Cooperative's (BEC) existing system. It will state in general terms what main modifications will be implemented to bring about the desired improvements to the present state of affairs in Beltrami Electric's metering department.

The return on investment for this project is very difficult to determine in any kind of definitive financial manner. There will be no expected increase in revenue. One time investment costs will be $2,000.00 for a new server and $1,000.00 for the *AMR Toolbox* software package. There will be an ongoing increase in cost of $40,000.00 annually for one additional employee. The return on this investment will be primarily in terms of intangibles such as increased customer satisfaction and heightened employee morale (Allen, 2003).

The return will be achieved in large part by implementing the *AMR Toolbox* offered by the STAR services group for report generation. This package is cost effective and covers the solutions important to Beltrami Electric Cooperative (BEC). The present system results in inefficient and ineffective customer service coming mostly after the fact with respect to electrical problems ("Utilities", 2002). Present complaints of less than pertinent current reports will be eliminated. Efficiency and effectiveness in all areas of meter and problem processing will improve.

The alternative to using the *AMR Toolbox* for report generation is to build the needed report structure in-house using present personnel. While this could be done, it would take much needed man-hours away from ongoing processes and from the implementation of the other aspects of the meter department modifications. This would extend the projected completion date

for the revised system considerably and put added pressure on an already overtaxed staff (Godwin, 2004).

The extensive integration of present stand-alone databases and paper records into one cohesive information system will address the technological problems of lack of integration and too much paper pushing. Streamlined data entry and consolidated data existence will greatly reduce the human factor presently resulting in confusion and lowered morale.

The addition of a technician to the meter department will result in increased time available to experienced personnel for implementation of the proposed system. This increase in time will reduce pressure to process backlogged meters and allow time to develop in-house maintenance programs to reduce field problems. Overall morale in the department should improve noticeably within a short period of time (Godwin, 2004).

In conclusion, the present system will gain a new server, one new employee and a new software package. The server and software package will integrate information; making the processing of meters and the solving of customer service problems considerably more efficient. The additional employee will relieve time pressure in the department resulting in increased morale.

Project Case

The project case is a statement of the present situation at Beltrami Electric. It outlines what existing conditions necessitate modification. It elaborates on what improvements are desired from a systems analysis.

Beltrami Electric Cooperative (BEC), located in Bemidji, Minnesota, supplies electric power to the rural residences and businesses located within approximately a 50 mile radius of Bemidji. The Metering department at BEC processes all new and used electrical power meters used to measure the power consumption of the coop's customers. BEC has approximately 25,000 meters deployed in the greater Bemidji area. This number grows by approximately 800 meters each year (Godwin, 2004). Within the past 8 years an Automatic Meter Reading (AMR) system has been added to the department's processing system. This includes an electronic device (called a *turtle*) installed in each meter which, once deployed, continually sends data from the deployment site to BEC's offices. This data is collected in a host computer in the Metering department, from which information is disemminated.

As the cooperative's customer base has grown and as the use of technology has increased, the Metering department's ability to keep up with the demand for field-ready meters and the demand for usable information has fallen below necessary limits ("Current", 2001). Customer service is suffering from a lack of timely information necessary for dealing with consumer issues in a satisfactory manner ("Utilities", 2002). It is felt that changes need to be implemented to bring the department's meter processing rate back up to an acceptable level and to organize the department's information handling procedures for optimum throughput.

Tables 1, 2, and 3 below demonstrate a breakdown of the current system, problems associated with it, desired enhancements for it, and constraints for the delivery of the new system (Hoffer, McFadden, Prescott, 2002, p.37).

Table 1: Statement of Work

Statement of Work
PROJECT NAME: BEC Metering Department
PROJECT SPONSOR:
Name: Dr. Kari Wood
Department: Computer Information Systems
Phone: (218) 755-3925
E-mail: KWOOD@Bemidjistate.edu
BUSINESS NEEDS: To increase efficiency of meter processing. To improve the flow of information between departments. To increase the effectiveness of customer service (Allen, 2003).
FUNCTIONALITY: An automated system that: 1) is more efficient 2) includes an integrated database that ties together all the key elements of meter processing 3) will utilize the World Wide Web to improve customer service (Trumble, Smith, 2003).
EXPECTED VALUE:
Tangible:
-Decrease of meter processing time
-Decrease of redundancy (Hoffer, McFadden, Prescott 21)
-Increase of hardware and software capabilities ("Current", 2001)
-Increased internet capabilities
-Decrease internal errors
Intangible:
-Increased customer satisfaction
-Increased staff morale

Special Issues or Constraints:
-No new facilities
-Personnel will increase by one full-time person
-One additional server will be purchased for this project
-Capital budget of $45,000 (for to-be system)
-One additional meter test station required

Table 2: Problem Definition

Problem Definition
People/Service Problems
1. The system does not provide any means for customers to access meter and power usage information. They have no way of monitoring consumption to anticipate billing fluctuations. They also have no way to accurately alert the cooperative to anomalies in their metering systems based on known usage (Allen, 2003).
2. There is inadequate interaction between departments within the coop regarding metering processes. Personnel are complaining that they do not receive information that is pertinent to their area. There are no protocols in place to insure that everyone receives the information they need when they need it (Godwin, 2004).
3. Service to customer's metering systems does not take place in a timely manner. Such service often takes the form of repairs to already faulty equipment, rather than pre-fault measures that could be implemented before a tangible problem exists (Godwin, 2004).
4. The metering department is understaffed. There are too few man-hours available to adequately cover the metering needs of the cooperative's customer base (Godwin, 2004).
5. Due to the pressure of inadequate staffing, not enough attention is given to the adequate

training of metering personnel. Cross-training is needed to assure that all personnel can proficiently handle all aspects of meter processing (Godwin, 2004).
PROCESS PROBLEMS
1. There is distinct redundancy in process functions. Information from service orders and work tickets are keyed into an Access database, and two National Information Solutions Cooperative (NISC) databases. Three copies of each work ticket are filled in and filed. Service orders pass through four sets of hands before being filed. Paper copies of various meter data are filled out and filed as well as being entered into several databases (Kim, 2003).
2. An unacceptable number of manual procedures exist in this system. Test forms are filled out with pencil and paper as well as meter registration forms. Information is passed from department to department by hand. Paperwork is lost in transit (Godwin, 2004).
3. Inventory is not being controlled to any effective degree. There is no working procedure in place to determine when depleted inventory needs to be replenished. Late shipments of needed inventory end up causing processing delays. These shipments must be tracked in some manner that assures timely delivery (Godwin, 2004).
4. In too many ways the process runs the people rather than people running the process. Demand for meters and repairs determines what gets done when. Procedures are not in place which would preclude the pressure of demand (Godwin, 2004).
TECHNOLOGY PROBLEMS
1. There is a definite lack of integration of information. Computer applications do not communicate with each other. Stand alone workstations and independent databases are the rule

rather than the exception (Kim, 2003).
2. Too much paper is being generated by this system. Cumbersome bundles of redundant paper forms are accumulating. Work tickets, service orders, meter test records and meter registration records are all done on paper. Such records all have to be filed manually, creating unnecessary work and requiring considerable storage space (Godwin, 2004).
3. The metering department's present computer equipment is too slow. Database queries take seconds rather than milliseconds to run. Large file sizes require state-of-the-art computers for rapid processing (Kim, 2003).
4. No efficient means of generating meaningful reports exists. The AMR system contains data that would provide for extensive system analysis. Everything from customer usage to the condition of power lines is addressed in the present storage of data, but that data cannot be translated into useful information at present. The system suffers from information stagnation. Much of the data being automatically recorded by the AMR system is simply not being used. Another significant portion is underused or is being accessed in an untimely manner ("Utilities", 2003).
5. The metering department does not have enough meter test equipment to handle typical meter volumes. Bottlenecks form which slow down processing of needed meters (Godwin, 2004).

Table 3: New System Performance Goals

New System Performance Goals
1. The person-hours it takes to process a meter will be reduced by 25%.
• Occurs through elimination of redundant data input and paperwork.
• Reduced errors performed by employees during entering process.

2. The department's hardware and software capabilities will increase by 100%.
• The metering server will integrate all metering activities as well as provide other departments access to the resulting data.
• The new test station and additional technician will relieve the present bottleneck in meter processing.
3. The web site will provide customer access to power usage information, reducing customer service calls by 35% (Trumble, Smith, 1998).
4. Rapid detection of field metering problems will reduce customer service calls by 35%.
• Problems will be corrected before customers are aware of them.
5. The reduction in manual/paper processing will reduce errors by 30%.
• Employee handling will be cut 75%.
• Necessary storage space will be reduced by 55%.

The metering department at Beltrami Electric is experiencing people problems in the form of a lack of customer access to information pertinent to their situations. There is also a problem of less than adequate communication between members of different departments. In addition, metering personnel are overworked and under trained due to understaffing.

Various process problems also exist. Too many processes are accomplished by hand rather than by computer. Also, there is redundancy where data is entered multiple times rather than just once. Inventory is not being adequately monitored and process demand is dictating process priority.

Lastly, the department's computer system is antiquated and lacks necessary integration. The software being employed has inadequate report generation capability. The meter test equipment is too limited for the volume of meters needing to be processed.

Certain constraints and assumptions will be a part of the new system and can be viewed in detail in appendix F. The constraints consist of specifications for facilities and equipment purchases, budget proposals and personnel requirements. The assumptions include: ongoing personnel, anticipated expenses, and facilities requirements (Godwin, 2004).

New hardware projections can be found in appendix G. The proposal is to implement a Dell PowerEdge server (Dell Incorporated, 2004).

Summary of Data and Process Improvements

The following section states how the individual problems being experienced in the existing system will be addressed by the new system. Problems addressed include customer service and morale difficulties, manual processes, redundancy, inventory inadequacies, and report deficiencies.

The system that is currently used has a great deal of inefficiency with its processes and data management. This inefficiency is causing customer service problems and morale problems. Many of the tasks performed on a daily basis were redundant and time consuming. To eliminate the inefficiencies, an integrated database system will be implemented. The system will be implemented to accomplish two primary tasks, report generation, and data integration (Kim, 2003).

Currently, when new meters are received, their specifications are recorded on paper. After 20 meters are received, the information is carried over to the billing department for system entry. With the proposed system, specifications will be immediately entered into the system. Eliminating duplicate recording and the existence of a paper record will save time and increase accuracy.

As used meters enter the shop from the field, they are processed on paper and on computer. The new system will eliminate all paper processing. This will abolish duplication, decrease processing time, and reduce errors.

Inventory management is another inefficient issue. An accurate count of meters and equipment is not kept. With the new system, inventory will be maintained on the system server. Having an accurate count of the inventory will let the technicians know when to reorder supplies to ensure processing is not slowed by a lack of parts.

The database information used for report generation at present is scattered over several different computers and numerous databases. The new software will draw from integrated information on one server. It will be available to all departments simultaneously. There will no longer be an information bottleneck in the metering department. Useful information will flow much more freely with far fewer errors (Kim, 2003).

In conclusion, an integrated database system will address data management and process inefficiencies while eliminating paper records and duplicate data entries. It will also provide a means to track inventory and facilitate the free flow of information between departments. The following sections describe in detail how each of these areas will be addressed.

Functional Description

Meter Processing with Integrated Information System

The basic functional processes of the BEC metering department, such as meter processing, report generation, service order processing, and checking for problems, will remain essentially the same. Methods of implementing the above processes will conform to more automated procedures (Dennis, Tegarden, Wixom 98). The following paragraphs will describe in detail the automated procedures for implementing such processes.

Meters can be ordered with a 3.5" disk containing test and meter specifications (Godwin, 2004). This information can be loaded onto the metering server directly by the meter technician with a simple entry routine. New meters will be inventoried upon arrival via manufacturer's disk.

Used meters arriving from the field will be given a standard status test. The test data will be automatically entered into the test database residing on the meter test computer. This database will be appended to the appropriate tables on the meter server automatically every night using an auto-schedule routine. If the meter is damaged, a "retired" entry will be made in the test database, indicating that the meter is to be disposed of, and the meter will be recycled. If the turtle is damaged, it will be replaced and the appropriate entry made in the turtle database on the metering server. The turtle will be programmed, updating the turtle database. The turtle database will be appended to the appropriate tables on the meter server automatically every night using an auto-schedule routine.

All work tickets and completed service orders will be submitted to the technician designated for data entry duties. Pertinent information regarding changes in meter field status will be entered directly onto the metering server. Single paper copies of the work tickets and service orders will be filed in file cabinets.

Service orders will be posted to the metering server by billing and customer service departments. The metering supervisor will review these daily to determine necessary actions (on site repair, database update, etc.). Orders will be closed on computer where possible and printed for execution where necessary.

Trouble report queries will be built and executed using consolidated tables on the metering server. These reports will be generated daily or weekly depending on the nature of the individual reports. Service orders will be generated directly on the server with the appropriate actions being taken to close the orders.

Reports requested by the engineering department will be posted to the metering server for the metering supervisor to review. These reports will be generated on the server; electronic copies will be available to engineering personnel.

Requests for meter systems by the engineering department will be posted to the metering server. The metering supervisor will review these postings daily. Work tickets for each service system request will be generated on the metering server for meter technicians to review daily. These work tickets can be closed electronically when the systems are finished.

Structural Description

Meter Processing with Integrated Information System

No new classes or objects will be present in the new system. However, where the old system had certain class objects only on paper, the new system will have all of them available on computer workstations.

The Meter class objects will contain all of the detailed information entered on various paper forms. It will include the information presently contained in the meter records and in the status cards. The Test Record class objects from the meter test computer will be linked to the Meter class objects on the meter server for easy test history lookup.

Service class objects will take the place of paper service cards. They will automatically be linked to the Meter class objects and the Test Record objects for fast service metering evaluation by technicians.

System class objects will replace paper system requests. Once the physical service is constructed, the System object will become a Service class object. It will electronically contain all the informational details previously stored in duplicate on paper.

Repair Record class objects will be integrated on the metering server in the tables designated for the meter class objects. They presently are contained in a stand-alone database on the AMR host computer.

The Location Record class objects will no longer be necessary. Information contained in these objects will be incorporated in the meter class objects as attributes of that class.

Dynamic Description

Meter Processing with Integrated Information System

Some of the class óbjects defined in the metering database will go through definite states of being in their life cycle in the BEC metering department. The two primary examples of these objects are the meters and turtles. The following paragraphs will describe common BEC terminology and contain an explanation of the above objects in detail.

Meters will begin their lives at BEC when they are received into inventory with an assigned unique four digit BEC number. That number is entered into the metering database along with the meter serial number. At this point they are "ready" meters. When a technician takes one of these meters from the shelf for processing, there are two possible resulting states. If the meter has a turtle AMR device installed in it, it will now be "turtle-ready", otherwise it is "field-ready". If the meter is put into use without a turtle, it becomes an "active non-turtle meter". If it is put into use with a turtle in it, it becomes an "active turtle meter". When a meter is brought in from the field it becomes an "inactive turtle-meter". Once tested it becomes either a "crippled meter" if repairs are needed or it is reinstated as a "turtle-ready meter". Once repairs are done to the "crippled meter" and it is retested, it becomes a "turtle-ready meter" as well.

Turtles also go through stages at BEC. First, they are received into inventory as "new " turtles. Second, they are installed in a meter and programmed at which point they are considered "installed". Once the meter goes out to a metered site, the turtle is "active". When that meter is returned to the cooperative, the turtle is "inactive" until a determination is made as to its condition. If it is in good working condition, it will go back into a meter for programming. It is then considered "installed" again from which point it can go back out in that meter as "active".

Conclusion

In conclusion, I would like submit this proposal to the management at Beltrami Electric Cooperative as a viable alternative to the present processing system in their metering department. The integrated database system with the *AMR Toolbox* software package would be the organization's best choice. It would cover all aspects of the present system including report generation, inventory control, and interdepartmental communication. Improvements in the new and used meter processing functions will result from a central server for the department. Improvements in handling customer service problems will result from implementation of the AMR Toolbox package.

This system will help the employees of BEC to be more efficient and effective in their work. With all of the positive attributes that this system will provide, it is difficult to imagine BEC finding a more effective solution. Meter processing time will decrease, customer service complaints will decline, and employee morale will rise (Dennis, Tegarden, Wixom, 2002, p. 242).

Appendix A: Use Cases

Use case name: Record Meter Changes **ID:** 1 **Importance Level:** Medium

---

Primary Actor: Supervisor **Use case type:** Detail / Real

Stakeholders and interests: Supervisor, Billing Staff, Engineering Staff

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Brief description: Update records of existing meter installations

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Trigger: Submission of work ticket

Type: External

Relationships:

- Association: Supervisor
- Include:
- Extend:
- Generalization:

Normal flow of events: 1. Work tickets brought to supervisor.

2. Supervisor selects pertinent data from tickets.
3. Supervisor records data in Location Record database table.
4. Supervisor submits work ticket to Operations Staff for filing.

Subflows:

Alternate/exceptional flows:

Use case name: Process Service Order **ID: 2** **Importance Level: High**

Primary Actor: Supervisor **Use case type: Overview / Essential**

Stakeholders and interests: Supervisor, Billing Staff

Brief description: Take necessary steps to address service order problems

---

Trigger: Service order issued

Type: External

Relationships:

Association: Supervisor, Billing Staff
Include:
Extend: Process New Meter, Process Used Meter
Generalization:

Normal flow of events: 1. Service order brought to supervisor.

2. **Supervisor classifies service order according to type: S1-Install, S2-Repair, S3-Remove.**
3. **Supervisor queries appropriate databases to obtain pertinent information.**
4. **Supervisor determines effective course of action based on information.**
5. **Supervisor executes course of action.**

Subflows:

S1 – Install

1. **Change meter in the field.**
2. **Submit used meter for testing.**
3. **Fill out service order.**
4. **Submit service order to billing staff.**

S2 – Repair

1. **Check meter in the field.**
2. **Program or change turtle in meter.**
3. **Fill out service order.**
4. **Submit service order to billing staff.**

S3 - Remove

1. **Change meter in the field.**
2. **Submit used meter for testing.**
3. **Fill out service order.**
4. **Submit service order to billing staff.**

Alternate/exceptional flows:

Use case name: Check for Problems **ID: 3** **Importance Level: High**

Primary Actor: Supervisor **Use case type: Overview / Essential**

Stakeholders and interests: Supervisor, Billing Staff

Brief description: Generate reports of problems with turtle meters from turtle database.

Trigger: Monthly

Type: Temporal

Relationships:

Association: Supervisor
Include:
Extend: Process New Meter
Generalization:

Normal flow of events: 1. Query Turtle database for problems.

2. **Print out pertinent reports.**
3. **Query databases for pertinent information.**
4. **Determine effective course of action based on information.**
5. **Execute course of action.**

Subflows:

Alternate/exceptional flows:

Use case name: Generate Reports **ID:** 4 **Importance Level:** High

Primary Actor: Supervisor **Use case type:** Overview / Essential

Stakeholders and interests: Supervisor, Engineering Staff

Brief description: Support reports are generated according to requests made by engineering staff.

Trigger: Request from Engineering Staff

Type: External

Relationships:

- Association: Supervisor
- Include:
- Extend:
- Generalization:

Normal flow of events:

1. Request received from engineering staff.
2. Queries made to various databases for pertinent data.
3. Reports generated from queried data.
4. Reports sent to engineering staff.

Subflows:

Alternate/exceptional flows:

Use case name: Process New Meter **ID: 5** **Importance Level: Low**

Primary Actor: Technician **Use case type: Detail / Real**

Stakeholders and interests: Operations Staff, Technician

Brief description: Prepare new meters for field use by recording information and installing a turtle.

Trigger: Low inventory reached

Type: Temporal

Relationships:

- **Association: Technician**
- **Include:**
- **Extend:**
- **Generalization:**

Normal flow of events: 1. Receive boxed meters from storage.

2. **Assign unique number and apply tag.**
3. **Install turtle AMR device.**
4. **Record designation information.**
5. **Send information to billing staff.**
6. **Place meter on ready to use rack.**

Subflows:

Alternate/exceptional flows:

Use case name: Build Meter System **ID: 6** **Importance Level: High**

Primary Actor: Technician **Use case type: Detail / Real**

Stakeholders and interests: Engineering Staff, Technician

Brief description: Build a new meter system based on request submitted by engineering staff.

Trigger: Meter system request submitted

Type: External

Relationships:

Association: Technician, Engineering Staff
Include:
Extend: Process New Meter
Generalization:

Normal flow of events: 1. Engineering staff submits a request for a new meter system to be built.

2. **Technician determines the appropriate equipment to be used.**
3. **Technician builds the new system.**
4. **Technician submits a work ticket documenting the installation.**

Subflows:

Alternate/exceptional flows:

Use case name: Process Used Meter **ID: 7** **Importance Level: Medium**

Primary Actor: Technician **Use case type: Detail / Real**

Stakeholders and interests: Operations Staff, Technician

Brief description: Prepare used meters for field use.

Trigger: Meter brought to shop.

Type: External

Relationships:

Association: Technician
Include:
Extend:
Generalization:

Normal flow of events: 1. Test "as found" condition of meter.

2. **If the meter is damaged, do S1.**
3. **If the turtle is damaged, do S2.**
4. **If both turtle and meter are damaged, do S3.**
5. **Place on ready for field installation rack.**

Subflows: S1 – Retire Meter

1. **Test meter if possible.**
2. **Make out retired meter card.**
3. **Remove turtle and return to inventory.**
4. **Delete meter from turtle database.**
5. **Throw meter away.**

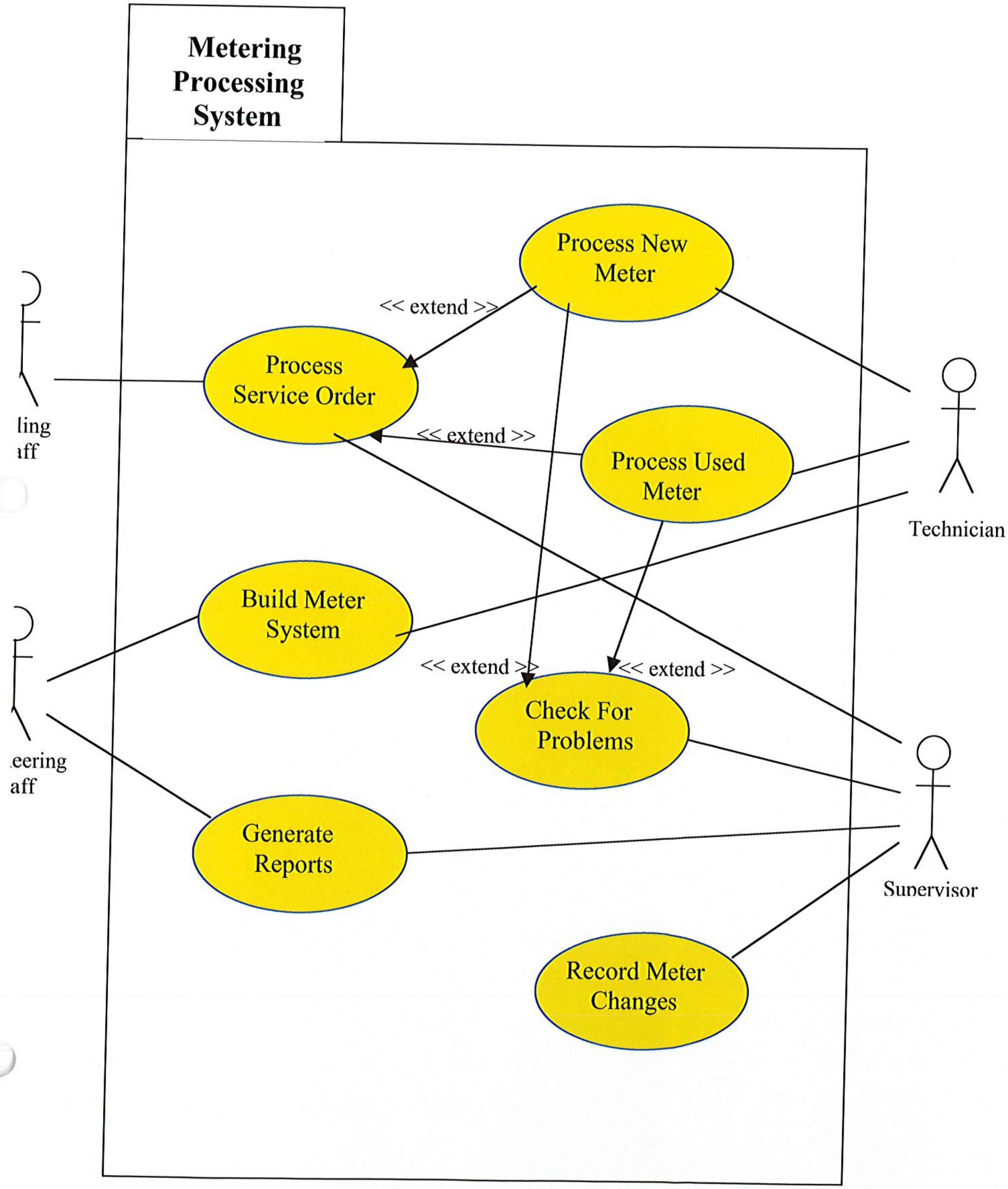
S2 – Replace Turtle

1. **Test meter if possible.**
2. **Remove turtle.**
3. **Install new turtle.**
4. **Reset meter register to zero.**
5. **Program turtle.**
6. **Test meter and make out test card.**
7. **Place meter on ready for field installation rack.**

S3 – Trash Meter

1. **Test meter if possible.**
2. **Make out retired meter card.**
3. **Remove turtle for replacement.**
4. **Delete meter from turtle database.**
5. **Throw meter away.**

Appendix B: Use Case Diagram



Appendix C: CRC Cards

Front:

Class Name: Technician **ID:** 1 **Type:** Concrete

Description: An individual that processes meters within the metering department

Associated Use Cases: 1, 2, 6

Responsibilities	Collaborators
Test meters	
Enter data	
Test turtles	
Install turtles	
Build metering systems	

Back:

Attributes:
Name (text)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:
Meter record
Meter test record

Front:

Class Name: Meter Test Record	**ID:** 2	**Type:** Concrete
Description: A record of a meter test		**Associated Use Cases:** 1, 2, 3, 4, 6

Responsibilities	**Collaborators**
Record condition of meter	

Back:

Attributes:

Reading (integer) Number (text) Calibration (double) Turtle (integer)
Date (date) Recorder (text)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:

Technician

Front:

Class Name: Meter Record **ID:** 3 **Type:** Concrete

Description: A record of a meter's identification

Associated Use Cases: 1, 2

Responsibilities	Collaborators
Record number	
Record serial number	

Back:

Attributes:

Number (text)

Serial number (text)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:

Technician

Front:

Class Name: Operations Staff	**ID:** 4	**Type:** Concrete
Description: Field employee who Requests meters		**Associated Use Cases:** 1, 2

Responsibilities	**Collaborators**
Request meters	
Return meters	

Back:

Attributes:
Name (text)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:
Meter request

Front:

Class Name: Repair Record	**ID:** 5	**Type:** Concrete
Description: Record of how a damaged meter was repaired		**Associated Use Cases:** 2

Responsibilities	**Collaborators**
Record number	
Record condition	
Record action to repair	

Back:

Attributes:

Number (text)

Serial number (integer)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:

Technician

Front:

Class Name: Billing Personnel	**ID:** 6	**Type:** Concrete
Description: Person who handles billing problems		**Associated Use Cases:** 3, 4

Responsibilities	**Collaborators**
Detect problems	
Submit requests	

Back:

Attributes:
Name(text)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:
Service order

Front:

Class Name: Service Order	**ID:** 7	**Type:** Concrete
Description: Request for action regarding a problem		**Associated Use Cases:** 2, 3

Responsibilities	**Collaborators**
Record problem information	
Record device in question	
Date problem	

Back:

Attributes:

Number (integer) Author (text) Date (date) Problem (text)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:

Billing personnel

Technician

Front:

Class Name: Trouble Report	**ID:** 8	**Type:** Concrete
Description: Report of problems with turtle meters		**Associated Use Cases:** 1, 2, 4

Responsibilities	**Collaborators**
Record problem device	
Indicate problem	
Indicate location	

Back:

Attributes:

Meter (text) Problem (text) Date (date) Values (integer)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:

Supervisor

Turtle record

Front:

Class Name: Turtle Meter Record **ID:** 9 **Type:** Concrete

Description: Record containing historical Information about turtles

Associated Use Cases: 1, 2, 3, 4, 5, 6

Responsibilities	**Collaborators**
Record turtle status	
Record turtle history	

Back:

Attributes:

Meter (text) Turtle (integer) Date (date) Values (integer)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:

Supervisor Technician

Trouble report Billing personnel

Front:

Class Name: Meter Location Record	**ID:** 10	**Type:** Concrete
Description: Information about present meter status		**Associated Use Cases:** 1, 2, 3, 4, 5, 6

Responsibilities	**Collaborators**
Record meter location	
Record meter type	
Record install date	
Record meter identification	

Back:

Attributes:
Number (text) Location (text) Date (date) Name (text)
Status (text)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:
Supervisor
Status report

Front:

Class Name: Status Report	**ID:** 11	**Type:** Concrete
Description: Report from Access query		**Associated Use Cases:** 3, 4, 5, 6

Responsibilities	Collaborators
Record date	
Record status information	

Back:

Attributes:

Information (text) Date (date)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:

Supervisor Location record

Repair record Turtle record

Front:

Class Name: Engineering Staff	**ID:** 12	**Type:** Concrete
Description: Employees in engineering department who request reports		**Associated Use Cases:** 5, 6

Responsibilities	Collaborators
Submit report requests	

Back:

Attributes:
Name (text)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:
Status report
System request

Front:

Class Name: System Request	**ID:** 13	**Type:** Concrete
Description: Request for metering system to be built		**Associated Use Cases:** 1, 2, 6

Responsibilities	Collaborators
Record system location	
Record system type	
Record system date	

Back:

Attributes:
Number (integer) Requester (text) Date (date) Diagram (graphic)
Details (text)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:
Technician
Engineering staff

Front:

Class Name: Supervisor	**ID:** 14	**Type:** Concrete
Description: Person in charge of metering department		**Associated Use Cases:** 1, 2, 3, 4, 5, 6

Responsibilities	**Collaborators**
Receive requests	
Assign tasks	
Generate reports	
Execute queries	

Back:

Attributes:
Name (text)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:

Turtle record	Status report	Service Order
Trouble report	Location record	

Front:

Class Name: Meter Request	**ID:** 15	**Type:** Concrete
Description: Request for field ready meter by operations staff		**Associated Use Cases:** 1, 2

Responsibilities	**Collaborators**
Submit requests	
Record substation	
Record type	
Record number	

Back:

Attributes:
Substation (text) Type (text) Number (integer)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:
Technician
Operations staff

Front:

Class Name: Work Ticket	**ID:** 16	**Type:** Concrete
Description: Record of field work done on meters		**Associated Use Cases:** 7

Responsibilities	**Collaborators**
Record meter details	
Record location	
Record reason for work	

Back:

Attributes:

Location (text)	Meter (text)	Number (integer)
Details (text)	Work (text)	

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:

Supervisor

Front:

Class Name: Service Card	**ID:** 17	**Type:** Concrete
Description: Record of metering service field information		**Associated Use Cases:** 1, 2

Responsibilities	**Collaborators**
Record meter details	
Record service details	
Send to billing staff	

Back:

Attributes:

Location (text) Meter (text) Number (integer)

Details (text)

Relationships:

Generalization:

Aggregation (has-parts):

Other Associations:

Billing staff

Front:

Class Name: Status Card	**ID:** 18	**Type:** Concrete
Description: Record of meter test Information		**Associated Use Cases:** 1, 2

Responsibilities	**Collaborators**
Record meter details	
Send to billing staff	

Back:

Attributes:

Meter (text) Number (integer) Details (text)

Relationships:

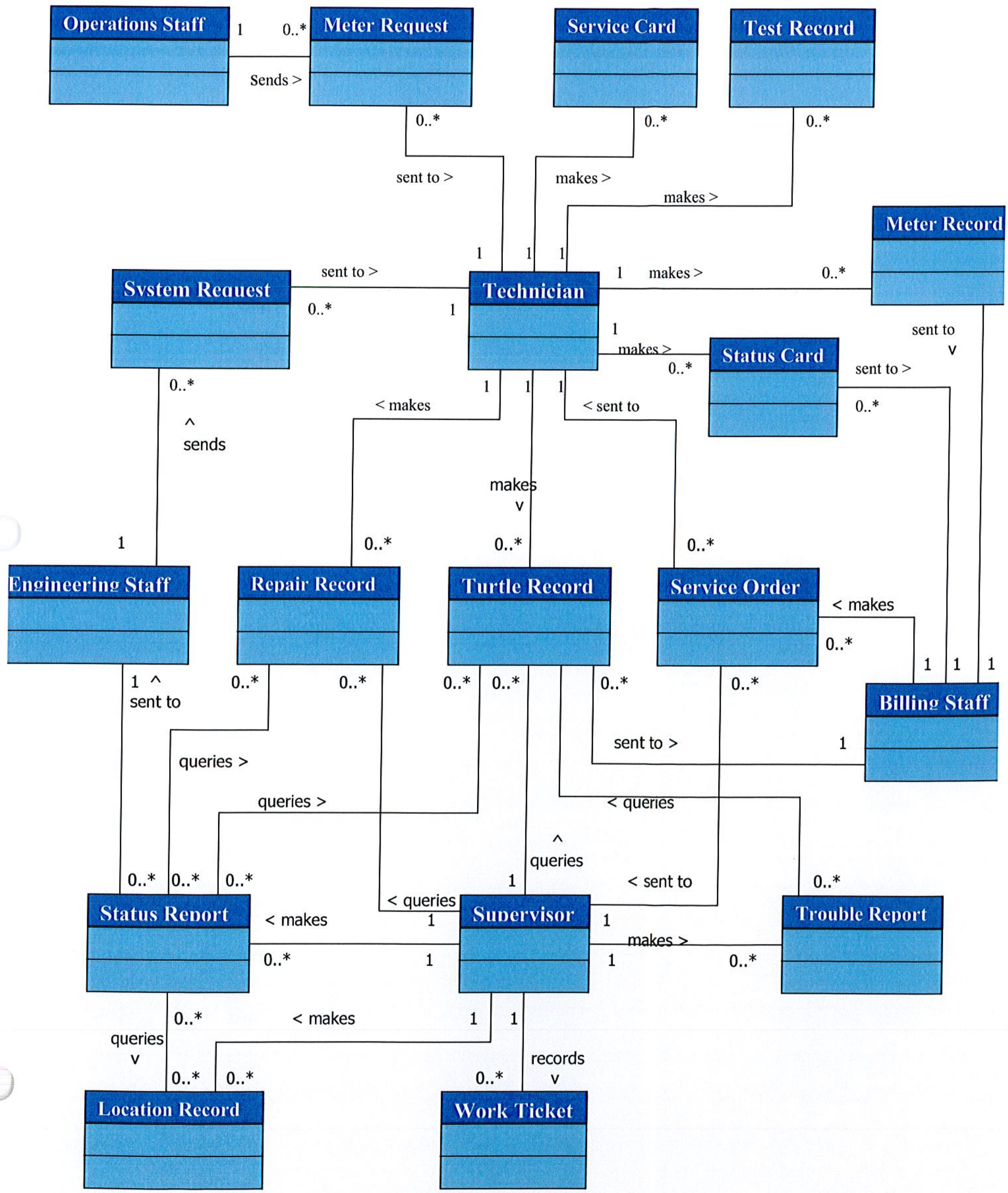
Generalization:

Aggregation (has-parts):

Other Associations:

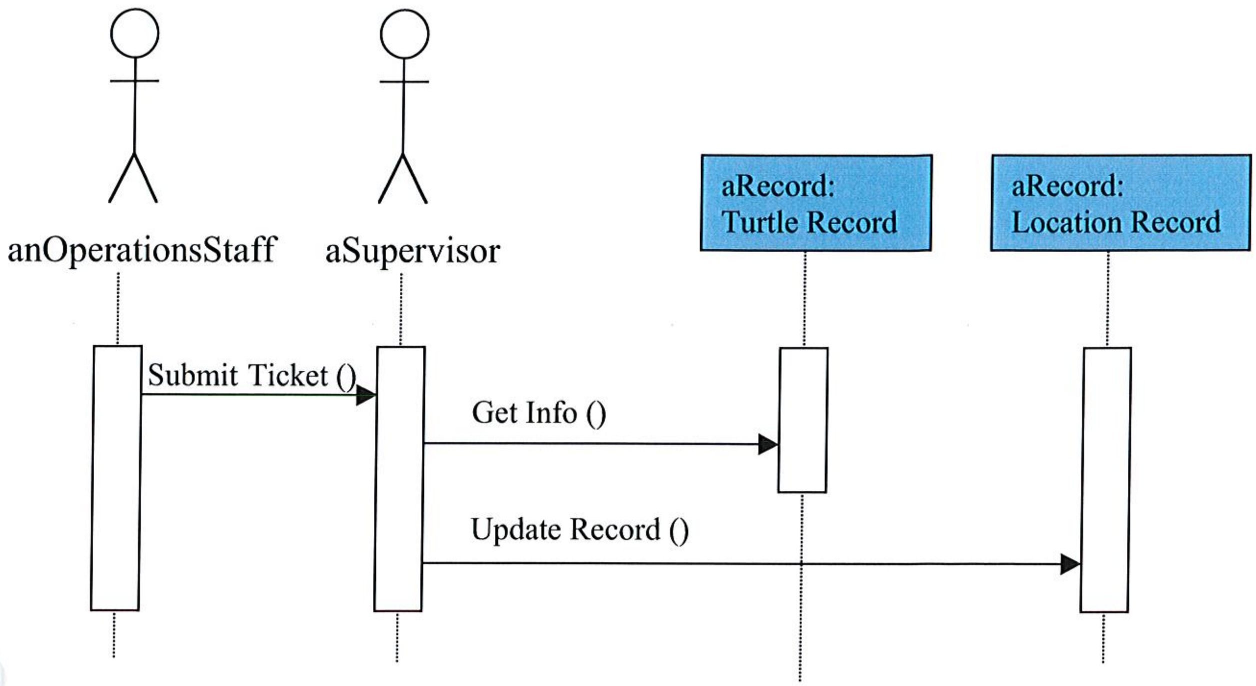
Billing staff

Appendix D: Class Diagram

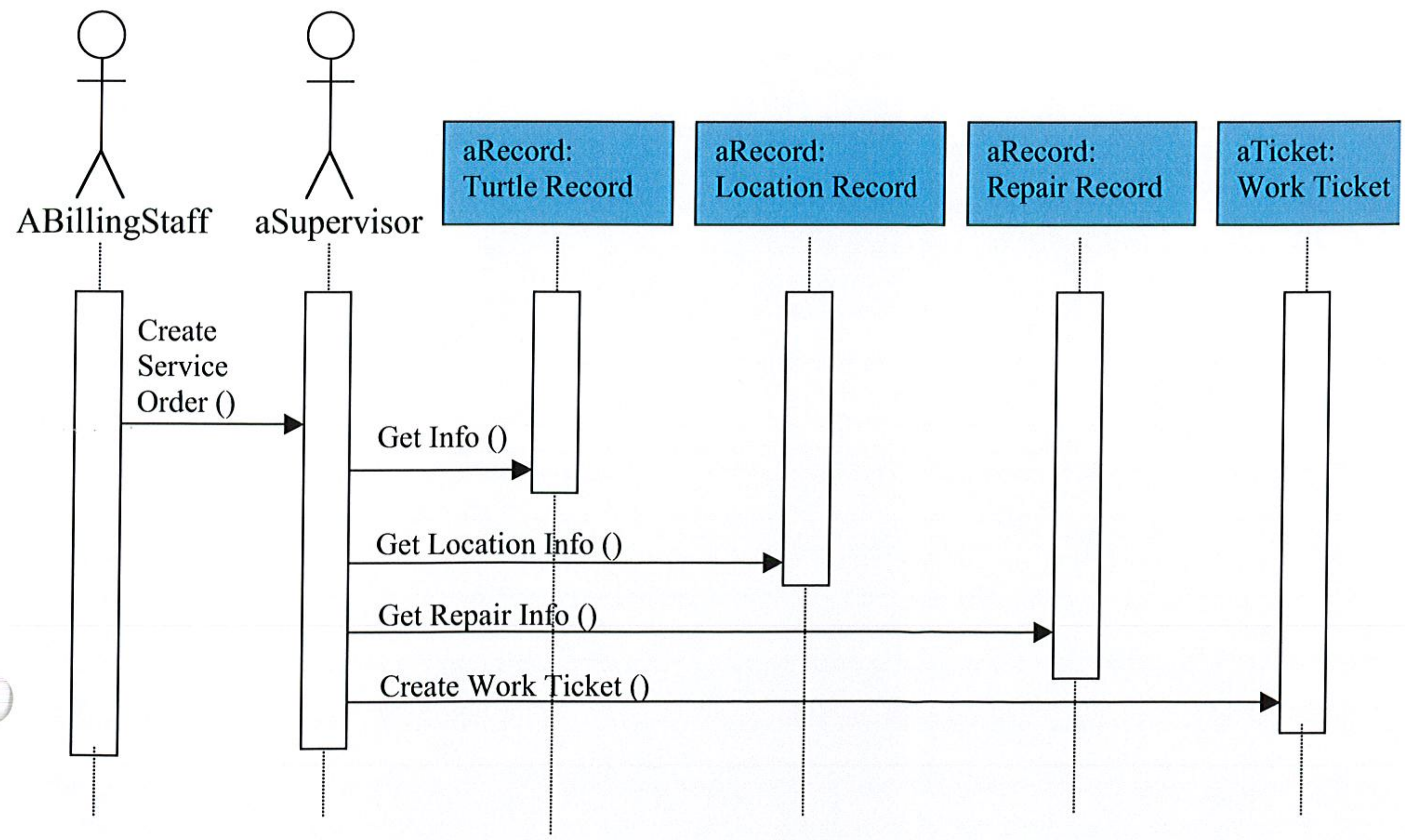


Appendix E: Sequence Diagrams

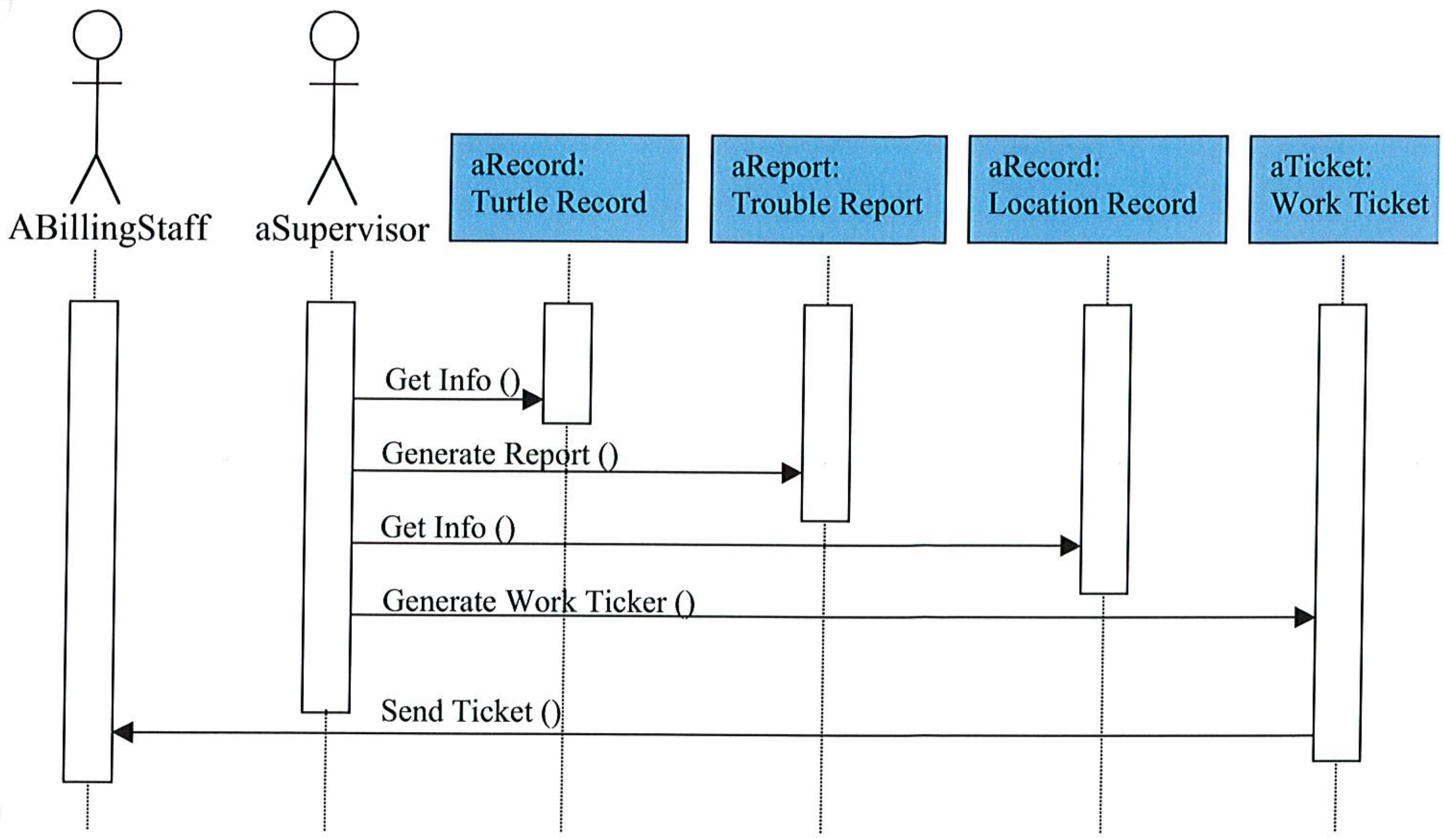
Use Case #1: Record Meter Changes



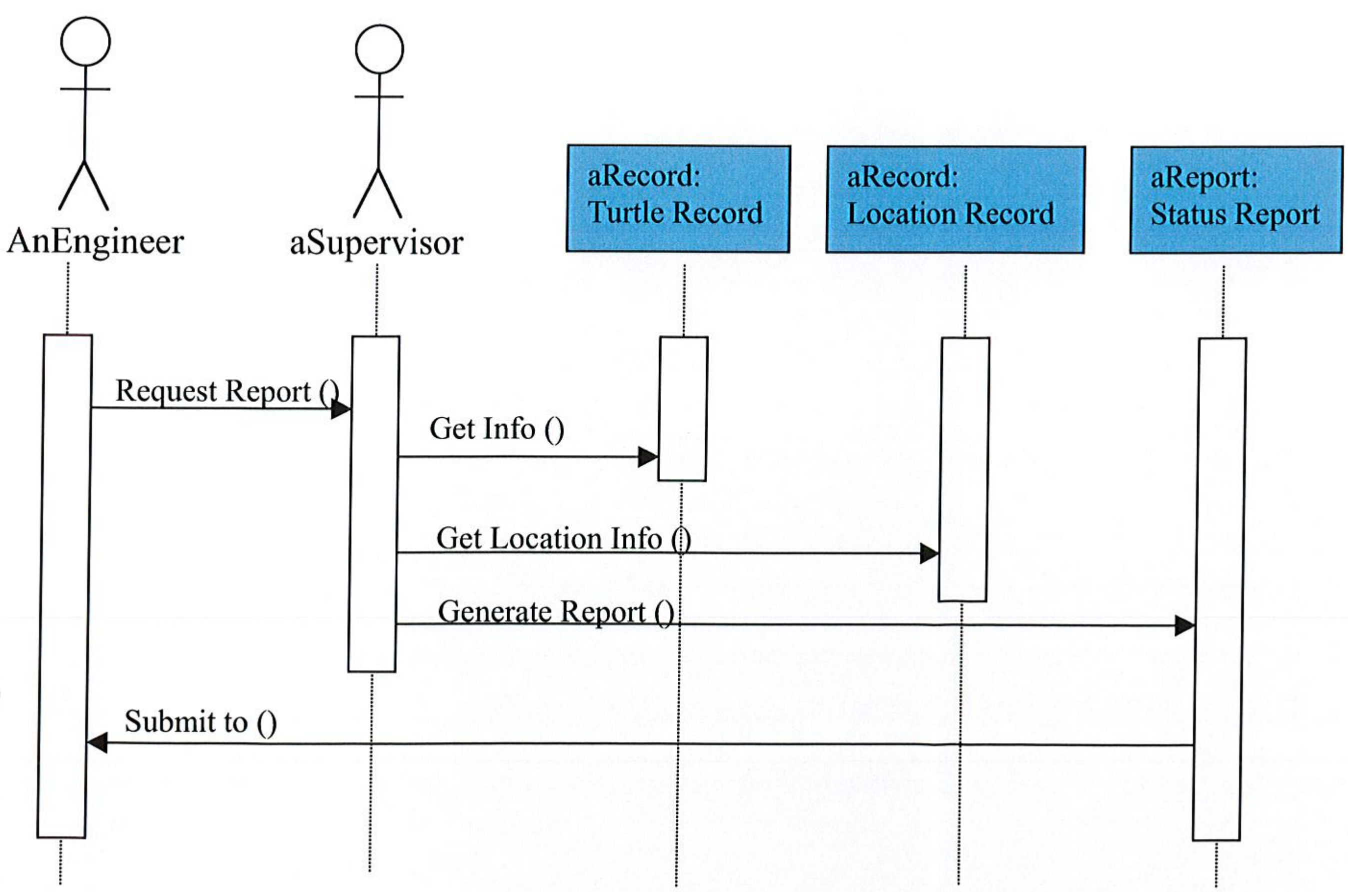
Use Case #2: Process Service Order



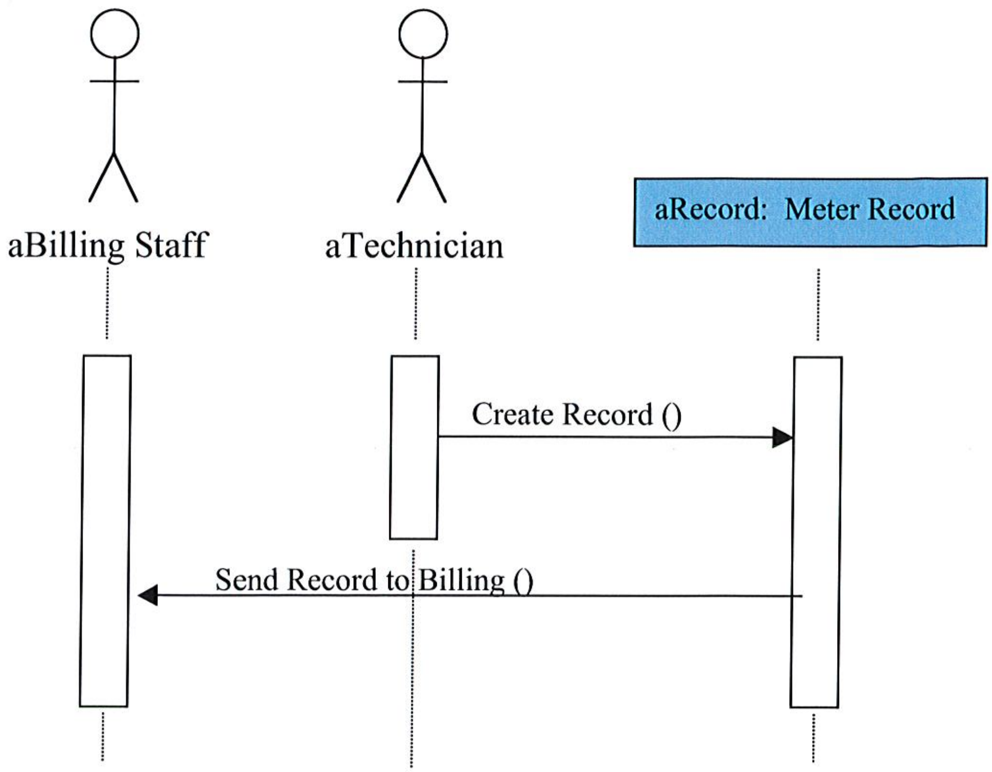
Use Case #3: Check for Problems



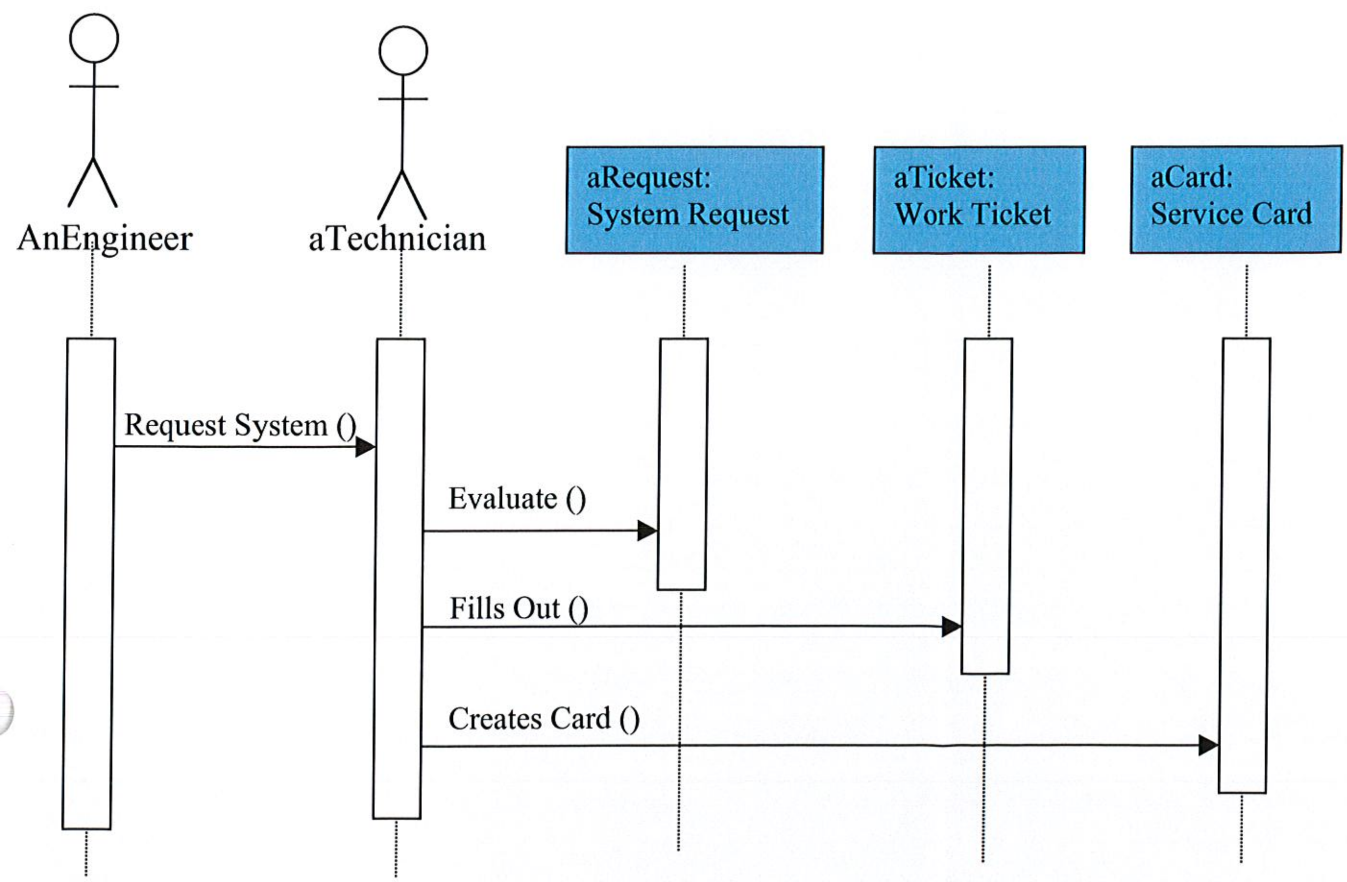
Use Case #4: Generate Reports



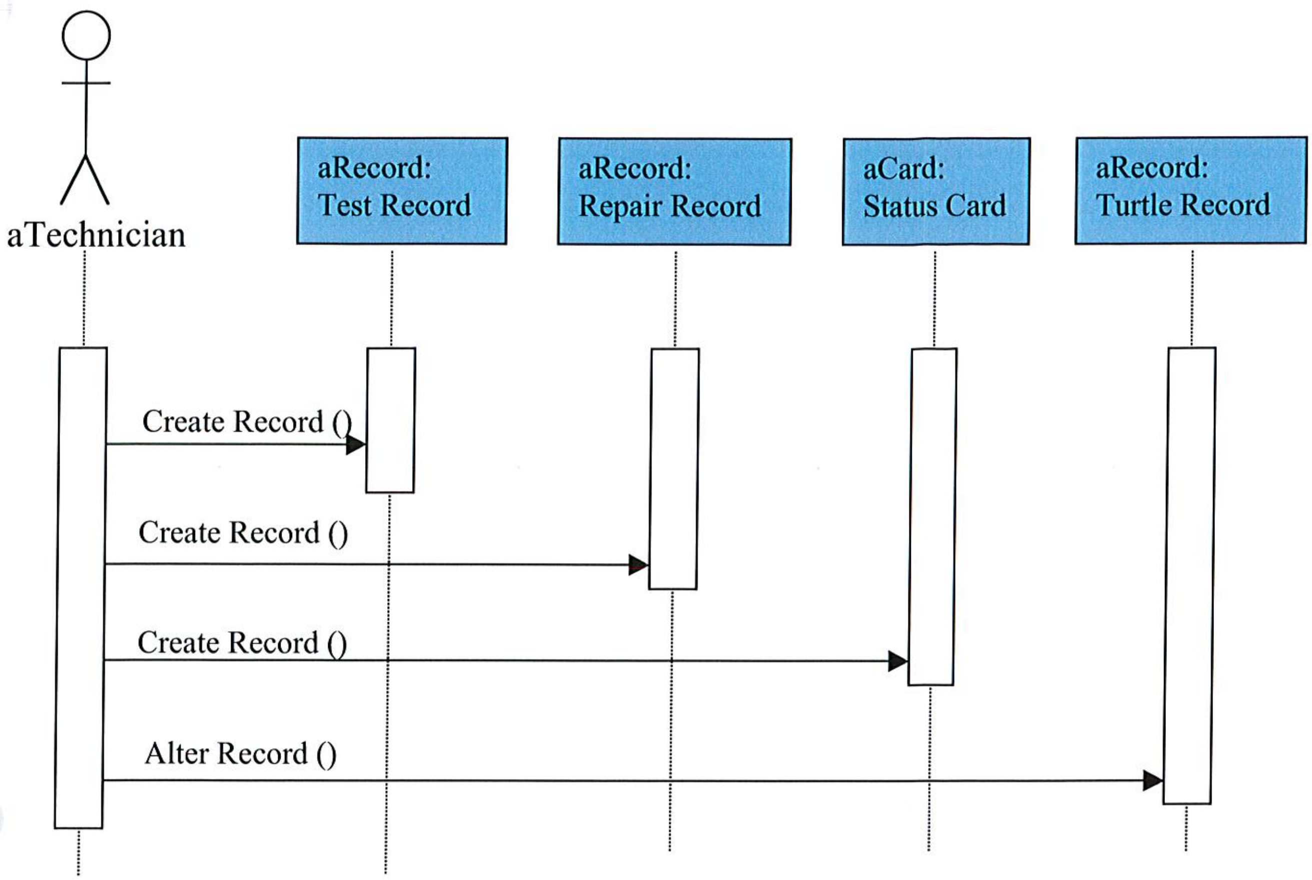
Use Case #5: Process New Meter



Use Case #6: Build Meter System



Use Case #7: Process Used Meter



Appendix F: System Constraints & Assumptions

Constraints:

1. Implementation will commence immediately after presentation.
2. There will be no new facilities created as part of this project.
3. One new server purchase is allowed.
4. One new test station purchase is allowed.
5. The architecture is client/server.
6. Budget:

   Ongoing operations: $155,000/year

   Capital Budget: $40,000
7. Web presence will cost $100/month or $1,200/year.
8. There will be one additional personnel for this project. Position scope or duties may change as a result of the project.

ASSUMPTIONS

1. There are four employees in this department.
2. Expenses will be $40,000.
3. Facilities already accommodate a LAN. (All the wiring is in place.)
4. There is an internet connection established.
5. There is one production database.
6. The compatibility of computers already exists.
7. There is no server in place yet, only 3 PC's.
8. A server will run the integrated database software.
9. The average salary of one employee is $50,000.

Appendix G: Hardware and Software Specifications

SERVER

MINIMUM REQUIREMENTS:

- Pentium IV Processor
- 512 MB of RAM
- 40 GB Hard Drive
- CD-ROM drive
- Tape drive
- Monitor

NUMBER NEEDED:

1

SOFTWARE REQUIREMENTS:

- Windows XP Professional

OTHER ACQUISITIONS INFORMATION:

- Extended warranties should be purchased for server.
- Employees who will be using the server should be trained.

DELL Computer Information

PowerEdge™ 2600 = $4,149 ("PowerEdge")

Processor:	Intel® Xeon® 2.40GHz
Memory:	1GB DDR SDRAM (2X512MB)
	512K Cache, 533MHz Front Side Bus
Operating System:	Windows Server 2003 Standard Edition with 5 Client Licenses
Keyboard:	Logitech Keyboard
Monitor:	Dell E172FP,Digital Flat Panel Monitor, 17 inch
Hard Drive:	73GB 15K RPM Ultra 320 SCSI Hard Drive
Floppy Drive:	3.5 inch 1.44MB Floppy Drive
Operating System:	Microsoft® Windows® XP Professional
Mouse:	Logitech Mouse, Gray
CD ROM, DVD:	24X IDE CD-RW/DVD ROM Drive for PowerEdge Servers
Productivity Software:	Microsoft Office XP Small Business and ADOBE ACROBAT 5.0
Hardware Support Services:	3Yr Same Day 4Hr Response Parts + Onsite Labor
Security Software:	Symantec Antivirus CorpEd

Glossary of Terms

Meter – A device which measures the electrical power being consumed at a business or residence in kilowatts used per hour (kwh).

AMR – "Automatic Meter Reading", a system that electronically reads the electrical power meter at a residence or business and periodically transmits that reading to a receiving computer at the utility supplying the power.

BEC – "Beltrami Electric Cooperative", a rural electrical cooperative supplying electrical power to the area surrounding Bemidji.

NISC – "National Information Solutions Cooperative", a cooperative of companies of which Beltrami Electric Cooperative is a member, whose business purpose it is to find information system solutions for its members.

Turtle – This is a specific automatic meter reading device which is manufactured by Hunt Technologies in Pequot Lakes, MN. It is installed inside each electrical meter deployed by Beltrami Electric.

Meter status terms:

"Ready" – this denotes a meter that has been given a BEC number designation and can now be prepared for use in the field.

"Turtle-ready" – means that a meter has had a programmed turtle AMR device installed in it, has been calibrated for accuracy and is now ready for field use.

"Active non-turtle meter" – means a "ready" meter that has been installed on site in the field and is actually measuring power consumption, but does not have a turtle in it.

"Active turtle meter" - means a "turtle-ready" meter that has been installed on site in the field and is actually measuring power consumption.

"Inactive turtle meter" – this is a turtle meter which has been brought into the shop from the field.

"Crippled meter" – this is a meter that has sustained some damage and so needs to be either repaired or scrapped.

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