APEGM Progress Report for:

Period beginning: **Jun 24, 2010** and ending: **Dec 24, 2010. (6 months)**

Submission Date: Feb 24, 2011
Supervisor: .Eng. , Submitted on Mar 3, 2011
Period Employer:
Job Title: System Integrator (EIT)

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1. Give a description of the Engineering work experience you have obtained during this reporting period. Include information supporting the rest of your answers.

During this reporting period I have applied engineering theory and obtained experience through the following projects and tasks:

Hair Sample Spectral Imaging System:
Our company was contracted to design, build and test an imaging system for collecting spectral data from hair samples. I was required to design a mechanical frame to support the hyperspectral camera, line light and table scanner. In my design I needed to allow for adjustability of some of the components, make the system as rigid as possible and also make the system easy to use. Before the design and building process, my colleague and I created a system specifications document which was used to guide the design and also to verify the constructed system at the conclusion of the project. A meeting was held with the team to discuss the specifications of the system and also what special features could be included. Using a previous stand design as a basic template and the specifications document, I designed the new stand to meet the requirements of our application. I created an embedded calibration and focus target that would allow the system to automate calibration during the scanning process. I also designed the table scanner and the line light assembly to have specific directions of adjustability. I designed a spring loaded lock mechanism to allow the user of the system to easily select a specific working distance for the camera. My colleague and I needed to coordinate the use of the imaging hardware during the build process and we also needed to work together to solve some of the technical issues that were faced during the build. In the early phase of the design, it was discovered that the light source had a defective component. Though the source was required for testing purposes of the system, my colleague and I temporarily adjusted our schedules to continue the build process without the light. A few of the specific design problems that were encountered was determining how to work with different hair bundle sample heights, how to provide a target to focus the lens, how to make the entire system rigid and how to control the working distance of the camera. Using a functionality and quality checklist I reviewed the application software and tested the scanning process of the system. I provided suggestions on how to improve the software interface to my colleague. In order to explain the functionality and setup of the imaging system, I wrote a hardware chapter for the user manual. I also created a video showing visually the setup of the imaging stand and scanning procedure.

Electroscan Instrument:
Our company was contracted to design, build and test an instrument for determining the resistance in a soil sample. The goal of the instrument was to be able determine the size and position of objects buried in a section of soil using a grid of electrical probes. I discussed some preliminary design ideas with my manager and the project team. We had a relatively short window of time to design and construct the system as we had hoped to perform outdoor testing with the instrument before late fall. The specification

document created in conjunction with the client was used to guide the design of the instrument.

The instrument consisted of three major components being the electronic r ·surement system, the excitation and measurement probes and the probe placement grid. Some of ·ssues I needed to incorporate into my design was that the system needed to be robust, portable and at minimum functional. As this was a prototype based on provided theory, we were to build the device and make modifications to improve it in future revisions.

I designed the electronic measurement system to be a self contained mechanical frame comprised of individual layers that fit into a portable case. Each layer required different mounting to adapt to the embedded LCD display, power supplies, electronic I/O boards and the embedded computer. The individual layers allowed for ease in both assembling and modifying the system during the build process. I chose a set of pre-built electronic relay boards that provided the number of inputs and outputs we required and could easily be implemented with the rest of the hardware. I chose to design and mount the embedded computer in a custom implementation rather then a pre-built case in order to conserve space and also more easily work with my mechanical frame. I designed specialized cable clamps for supporting the cable bundles that ran from the relay boards to the physical sensor probes.

For the measurement probes, I designed the 256 sensor probes in order to address several key issues. I required them to be easy to insert and extract from the probe placement grid, they needed to be easily recognized as to the type of probe, they needed to have a maximum depth penetration and the body of the probes needed to be non conductive and scratch proof. In order to build the probes I designed a series of jigs to allow for the most efficient production. I designed and built a test rig for verifying the functionality of individual probes where the user could easily insert a set of probes into the jig and obtain a known result.

For the probe placement grid, I met with the project team and discussed options as to creating the 1600 hole grid in the most efficient way. Using their advice I designed a method of stacking sections of the grid, I prepared a template for marking the hole positions and chose a specialized tool for the drilling process. To assist in the construction of both the grid and the probes, I supervised an assistant to perform the more repetitive tasks. I provided advice to him during his involvement and modified the process to increase his efficiency.

At an early stage of the build process, the client requested a change to the scope of the measurement probe layout that required that I modify my design and provide an altered solution. Other requests also needed to be considered and compared to the specifications document.

During the construction and testing of the instrument we addressed several weaknesses discovered in the system. The electrical connectors for the probes and the small gauge probe wiring turned out to be unreliable. The original choice for the probe wiring required a choice between strength and manageability of the wires. To resolve the electrical connector issue, I considered and discussed several options of alteration with my colleagues and the best option was chosen.

During the testing process we discovered that the soil resistance was much greater then had been anticipated. Upon testing different probe types, we found that the probe size, shape and interface with the soil had a profound effect on the acquired results. To address this issue we designed a procedure to help alleviate the higher resistances and in turn allow for better results. We also tested methods of increasing the signal to noise values. As this was a prototype, we made recommendations to the client on how future revisions could be improved.

Another issue we encountered was that the theoretical method we used for measuring soil resistance as was suggested to us had the effect of building up charge in the soil sample. In order to address this issue I designed a method of producing an oscillating excitation signal which corrected the problem.

During my testing of the electronic measurement system, I discovered that additional heat dissipation was necessary for the embedded computer so I modified the case design to include additional cooling vents and a fan. I then re-tested the system and verified that the unit ran within specification.

I learned several important lessons from this project. In particular I now see the importance of the initial specifications document and what effect scope creep can have on the schedule of a project. In future projects such as this, I will know to put more emphasis on testing provided theory before moving ahead with a design. This project has given me valuable experience in negotiations and business decision making in the engineering process.

Spectral Camera Calibrations:
During this period I was required to perform spectral calibrations on two hyperspectral imaging systems for our clients. As we had a small window of opportunity to perform the calibrations I prepared by researching the details of the procedure. The first spectral camera required a series of functionality tests to be performed. The second spectral camera required an additional calibration process specific to the technology. I prepared a careful setup of the lighting and camera settings with advice from my colleagues in order to obtain the best possible results. Once I combined both cameras with their spectrographs, I performed the final calibration, data collection and analysis of the results. Extra effort was needed to interpret the results for the second spectral camera and then produce the required mathematical equation.

Engineering Sales:
Changes within our organization provided an opportunity for me to become more involved in the Engineering sales side of the company during this period. I now had greater exposure to designing imaging systems for a broader range of applications.

I performed system testing on the color imaging system that I designed for a Canadian University in the last reporting period. The testing of the system revealed some of the limitations caused by my choice of lighting and optics. Though the functionality of the system would meet the customer's needs, what I learnt from the tests of this hardware will provide a reference for my future designs.

I recommended two infrared imaging cameras to a Canadian University for specialized work in inspecting light from waveguides. As the customer had specific noise and sensitivity requirements, I needed to become familiar with the low level details of the imaging sensor in order to suggest the correct hardware for their application. I managed this smaller project from the initial contact with the client to the delivery and follow up of the hardware.

I became the technical advisor for an ongoing rock core imaging project during this period. As the new technical contact person for this project, I was required to manage the customer's requests and coordinate the delivery and schedule of the project with the manufacturer. I finalized a secondary quotation for additional hardware after addressing the customer's concerns with the manufacturer.

Our company was approached by a client interested in having a custom light source designed for an industrial adhesive curing application. I discussed with the customer what their requirements for the source would be and provided a possible solution. I worked along side one of our lighting partner companies to develop a plan for a possible design. I created some preliminary mechanical schematics and submitted a proposal for the initial project.

Our company was approached by a Canadian partnership of two industrial companies interested in using our hyperspectal and tunable filter hardware for specialized meat inspection. After providing an estimate

for the hardware, I coordinated with our manufacturer to obtain specific hardware for the customer to evaluate. I provided advice to my colleague to create a data acquisition application for the provided imaging system. My colleague and I worked with the client to assist them in obtaining their required data.

The Doorstopper Underground Data Logger Repair:
The repair of the Doorstopper data logger was completed in this period. I chose to apply a moisture resistant coating to the new signal conditioning boards to help protect them from future damage. I attempted to improve the mechanical strength of the wiring and connectors by applying additional adhesive to the connector mounts and contacts. I prepared a series of extensive tests to determine the repeatability and validity of the obtained data from the doorstopper. Initial results indicated a problem with one of the input strain gauges. After the problem was resolved, I again verified the data. The doorstopper was returned back to the customer for future drilling tests.

Digital Cerenkov Viewing Device Construction:
The Digital Cerenkov Viewing Device (DCVD) is a custom imaging system that Channel Systems builds and supports as part of the Nuclear Safeguards program. This program which is enforced at many nuclear fuel storage facilities around the world uses the imaging system in the verification of stored fuel assemblies. During this period I was given the responsibility of performing the mechanical upgrades and modifications to two existing DCVD cameras and also the completion of one new DCVD camera.

The build of the new DCVD camera was started during the last period. Majority of the machining had already been completed for this project. To ensure the quality of the product I spent additional time and implemented new procedures to verify the construction of this camera. One design issue I needed to solve was implementing a method of restricting the camera head extension. I selected and implemented a simple fix to accomplish this. Testing of the camera head by my colleague revealed a fault in the camera optics. I worked with my colleague to test and verify the cause of the failure.

The two DCVD camera upgrades required implementing a pre-determined set of upgrades and also addressing several key issues that had been discovered during the functional in field testing of the camera. I was responsible for the creation and modification of the parts required for the updates. Specific part upgrades included taking the existing laser pointer holder and modifying its design to allow for better adjustability and electrical insulation. In order to simplify the case design of the electronics box, the project manager and myself made the decision to switch the top plate to a single panel in order to reduce edges and bolts that could be contaminated. I improved the design of the battery mounting plate to allow for additional clearance for the electrical connectors. The second DVD upgrade required pre-building as much of the upgrade parts before receiving the camera system in order to shorten the upgrade time at our location. Through out the upgrade process we met with the project team to discuss the schedule and any issues that were discovered.

LabView Training:
During this period I spent time completing my training for my LabView CLAD certification. I spent time learning about design patterns and extended features of the LabView language. I modified code for the Electroscan project to assist me in more efficiently troubleshooting aspects of the measurement system.

Supervisor Agrees: In this reporting period, Chris has been immersed in a wide variety of engineering tasks that continue to build his base of experience. Chris was responsible for many projects that included conceptual design, detailed design, integration, verification, and documentation. He has been exposed to

many technical areas such as electrical design, software design, mechanical design and project management.

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2. Please check the following options that apply:

2.1: During this reporting period, I have applied theory in:

- ✓ Analysis/Interpretation
- ✓ Project Design/Synthesis
- ✓ Testing/Verification
- ✓ Implementation

Supervisor Agrees: Chris has been involved in all phases of product development: theory, design, testing, integraion and documentation. He gained new experience developing a multi-channel soil resistance data logger. He has been successful at taking a theory or concept and applying it to a real design.

2.2: I have obtained experience by:

- ✓ Studying or being exposed to existing Engineering works
- ✓ Applying Designs as part of larger systems
- ✓ Experiencing the limitations of Engineering designs
- ✓ Experiencing time as a factor in the Engineering process

Supervisor Agrees: This past reporing period provided tremendous experience for Chris in understanding and managing the limitations of a design. Designing and integrating a real system based on text book theory gave him excellent learning opportunities. Chris also experienced the challenge of managing multiple projects and balancing the ever-present time challenge while undertaking design/build projects.

2.3: I was exposed to the following areas of Engineering management:

- ✓ Planning
- ✓ Scheduling
- ✓ Budgeting
- ✓ Supervision
- ✓ Project Management
- ✓ Risk Assessment

Supervisor Agrees: Chris has taken on the responsibility of managing this own projects. This has exposed him to project management fundamentals. He was required to supervise a co-worker during the construction phase of one project.

2.4: I was required to make decisions based on professional and ethical responsibilities to:

- ✓ The Public
- ✓ The Profession
- ✓ The Client and/or Employer
- ✓ Co-Workers
- ✓ The Environment

Supervisor Agrees: Chris has a high degree of professionalism and thoughfully considers all parties involved in and affected by his work.

3. Describe any activities that have improved your Communication, Teamwork, or Interpersonal Skills in the following areas:

Oral Presentations:
I have had the following opportunities to practice my oral communication skills:

I have an opportunity each week and at special project status meetings to orally update my managers and colleagues regarding the details and schedules of any projects I am involved in. I have improved my communication in these meetings by taking additional time to prepare and make notes. I had an opportunity to attend and communicate with potential partners and clients at the Manitoba Mining and Minerals Convention. I used this opportunity to ask questions about the mining industry and how our products could be used in their applications. I regularly have the opportunity to present our companies products and services and interpret client's needs both in person and over phone.

Written Documents:
During this period I reviewed the final edition of the Calibration Light Source report and applied minor modifications that were suggested by my peers.

I worked with a colleague to develop a specifications document for the Hair Sample Spectral Imaging System. Near the completion of the project I wrote and illustrated the hardware section of the manual which described the functionality of the imaging hardware and also the setup procedure. I created an assembly and scan procedure video for the system. I reviewed my colleague's written work in the user manual and made suggestions for improvement.

For the Electroscan project, I wrote and illustrated the hardware section for the user manual. The hardware portion included a section for the description of the hardware and also the disassembly process of the instrument. I reviewed my colleague's written work in the document.

I updated the DCVD maintenance stand setup and functionality manual.

Interaction with Others:
I was responsible to 3 separate managers during the majority of this period and I was involved in several projects at once. It is important that I meet with my managers regularly to discuss the details of my projects and seek advice when needed. During this period I had the opportunity to broadened my expertise in our imaging hardware and provide advice to a greater number of potential clients. I have interacted with clients and suppliers regularly via phone/email and have provided project proposals and technical advice. I have organized tasks with my co-workers in order to complete projects such as the Electroscan instrument. I have been involved in several project initiation meetings during this period that allowed me to prepare for and discuss the details of upcoming projects. I have had to coordinate with my colleagues to review the various documents I and our team have worked on during this period.

Other:

Supervisor Agrees: Chris does a good job with writing and reviewing documents. He is gaining an appreciation of how important communication is in the workplace and with clients. He is able to effectively explain ideas verbally. I encourange Chris to use his peers as sounding boards for ideas and to increase his face to face communication time with company management.

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4. During this period, I had to consider the social implications of my work in the following areas:

The design of the Hair Sample Spectral Imaging System required that I consider how the calibration of the instrument would affect the acquired results and also how the ability of the researchers to easily use the system would affect the instrument's usefulness. The data obtained from the instrument could directly affect the quality of the hair products produced by the company.

The Electroscan instrument could be used for a wide range of applications including land mine detection and medical applications where intrusive forms of material detection may not be done easily.

The DCVD camera is an important tool used in the Nuclear Safeguards program which works to improve nuclear fuel storage security around the world. The DCVD allows nuclear inspectors to be able to effectively verify the status of spent nuclear fuel which helps to ensure that no spent nuclear fuel is unaccounted. The design upgrades we performed help to allow the DCVD to become a more effective tool.

Supervisor Agrees: Chris has the benefit of working on several engineering projects that have huge social implications.

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5. Examples of my ability to work effectively as part of a team, during this period, include:

In several of my projects including the Hair Sample Spectral Imaging System and the Electroscan Instrument, I needed to work closely with my colleagues to discuss design ideas, purchase components, manage the available tools and hardware and also manage our time schedules. In our design projects, our company makes an effort to make use of the individual skills of each member of the team.

In developing designs for new projects for customers, I would regularly approach my managers to discuss possible solutions and details of a design.

With the DCVD upgrades, the project team met to discuss the plan and schedule for the construction process periodically. I and a colleague were directly responsible for building the camera systems. We coordinated our time and resources as effectively as possible and reviewed each others work.
Any significant issues that were discovered during the building process were brought to the team's attention and a solution was determined.

Supervisor Agrees: Chris is a good team player and his colleagues respect his ideas and excellent work ethic.

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6. Examples of my ability to assume responsibility include:

The design and hardware selection of the majority of the Electroscan project was my responsibility. I made several decisions during the course of the project as to the best method of implementing the system such as the embedded computer, cable clamps and wiring. I also made several decisions as to the modifications of the original design in order to address unforeseen issues and changes in scope.

In preparing project proposals for different clients, I was responsible for understanding the technology, addressing the client's needs and ensuring correct time and financial estimates.

The two DCVD upgrade projects required that I assume responsibility for the quality and schedule of the

mechanical construction. The team was given specific time deadlines and we were expected to meet these time limits.

I have been responsible for managing and recording my time when I have been involved in many projects at over the same time period.

Supervisor Agrees: Chris has continued to take on more responsibility and has done a good job.

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7. I have shown progress since the last report (where applicable) as follows:

I continue to grow my design, construction and testing abilities. With each new project I have become more confident and have made more independent decisions as to the best design options.

The research I have done into our imaging hardware has allowed me to become more confident in my understanding of optics, lighting and cameras. I have become more efficient in producing proposals, organizing myself and communicating with customers. Since becoming responsible for the majority of the companies imaging system sales, I have needed to quickly become proficient in many new types of imaging systems.

At the tradeshow I attended in November, I found that I was more confident and aggressive in speaking to potential partners and clients about our products and engineering services.

Each new project I work on has given me a better feel for project time and financial requirements.

I have furthered my LabView programming experience and have become Labview CLAD certified.

Supervisor Agrees: Chris continues to grow professionally. His is a valuable team member and is trusted to take on more responsibility in the future.

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8. I feel myself to be lacking in exposure to, or requiring improvement in, the following areas:

I continue to develop my software programming skills in LabView. As I have now completed the first certification level I look forward to applying my skills in more significant projects. As I have been more involved in designing imaging systems and preparing proposals, I hope to have the opportunity to design a larger variety of electronic and mechanical projects in the future. I hope to further improve my background in optics and also my abilities in negotiating with clients. I have had some experience managing others during this period but I would like to have more opportunities in the future.

Supervisor Agrees: It will benefit Chris to take training in application areas like spectroscopy, optics and imaging. He should also continue to develop his time management and project management skills. It is important to continue to grow his software development skills.

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9. I would like to provide the following additional, relevant information:

Supervisor: P.Eng. First Registered:)

I make the following evaluation and recommendation regarding the progress report for this MIT:

Chris is developing into a very good engineer. He makes significant progress each year and continues to take on more responsibility.

In my opinion, during this reporting period, (Jun 24, 2010 - Dec 24, 2010) (6 months), Chris has completed an equivalent of *6* months full time experience.

Please show my comments to the MIT.
