My TARGET Internship

Miguel Mendez

Supervisor: Fred Lewis

26 July 2024

Miguel Mendez

Walter Payton College Preparatory High School - Chicago, IL

Class of 2026

Areas of Interest:

Physics, Mechanical Engineering, Quantum Engineering, & Aerospace Engineering

Introduction to the Test & Instrumentation CIS Team

Fred Lewis

Supervisor

Miguel Mendez

TARGET Intern

Cubicle Buddies

David, Bill, Alexander, Brianna, & Junko

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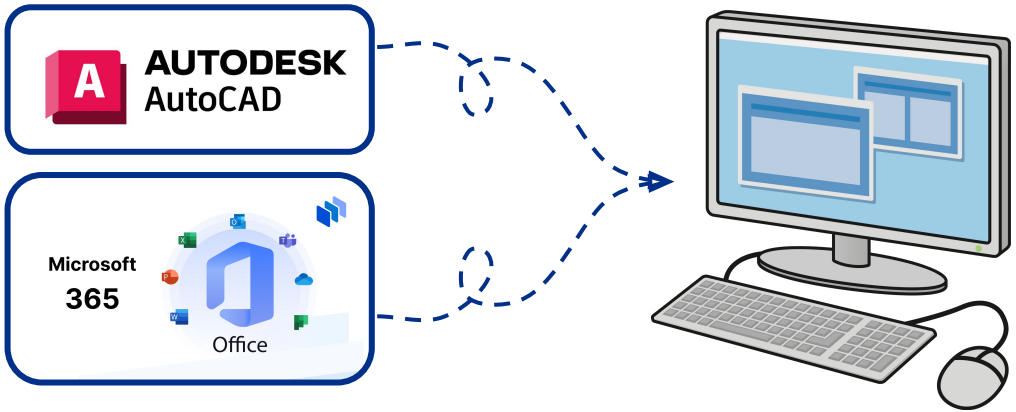
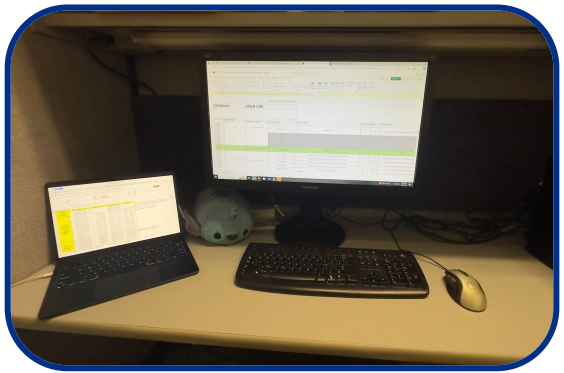
Week 1 - Settling In

My very first task of the internship was to get myself settled in by installing the necessary software I would need for the following 5 weeks.





My workspace in Industrial Building 4

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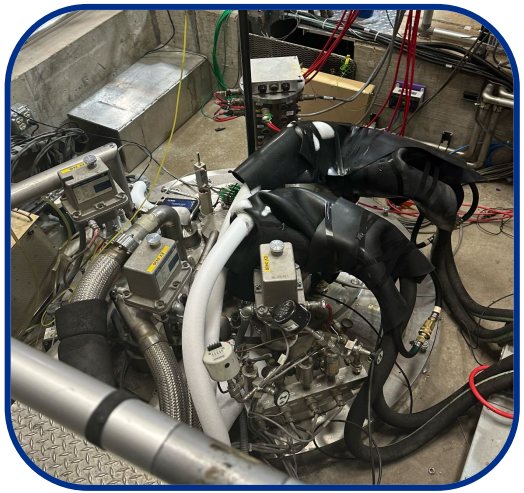
Week 2 - Connection of Test Stand 7 to VMTF



Vertical Magnet Test Facility (VMTF)

Introducing…

Test Stand 7

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Week 2 - Connection of Test Stand 7 to VMTF

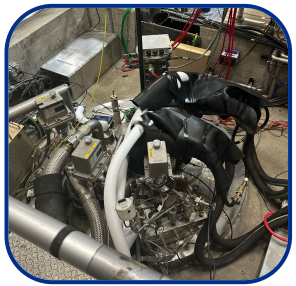
VMTF vs. Test Stand 7

Similarities

Both test the performance of **superconducting magnets**. Unlike conventional magnets which work in room temperature, superconducting magnets must be at a temperature of about 4° Kelvin (-452° F) to function.

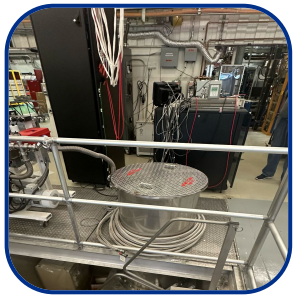
VMTF

- Uses liquid helium
- Dewar is 20 ft deep.
- Ability to test large magnets.



Test Stand 7

- Uses cryocooling
- Dewar is 6 ft deep.
- Allows for small magnets to be tested without the need of VMTF



Week 2 - Connection of Test Stand 7 to VMTF

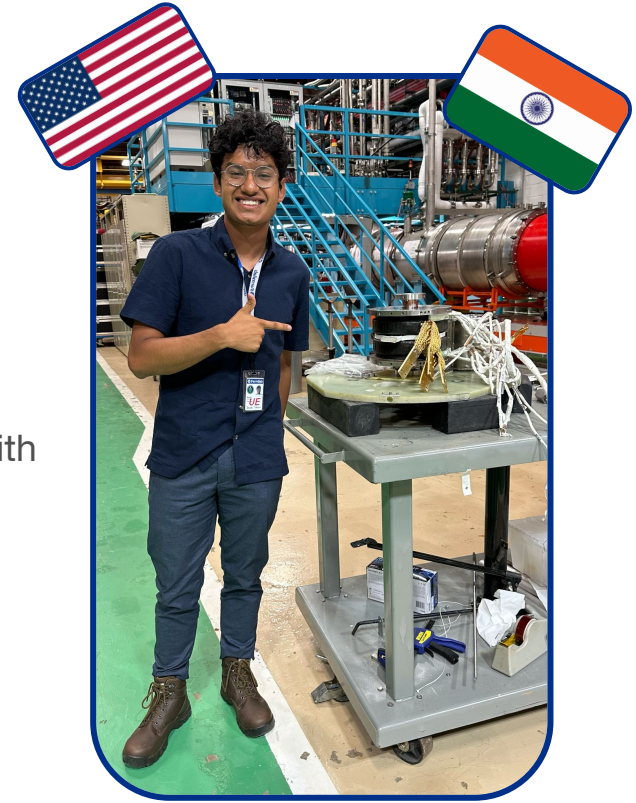
Outlining the task:

Provide a physical connection of the instrumentation & power supply from Test Stand 7 to VMTF in order to use VMTF with Test Stand 7 infrastructure

In short, this would involve creating **electrical schematics** for a visual block diagram, cable specifications, and power supply specifications with the use of **AutoCAD**.

The goals:

- Allow for the flexibility of utilizing VMTF with Test Stand 7 infrastructure.
- Conduct a performance test of India's BARC 1 and 007 superconducting magnets with this new available option.



Me standing beside the BARC magnets. India will use these in one of their BARC facility by submerging them in liquid helium and thus removing any temperature concerns.

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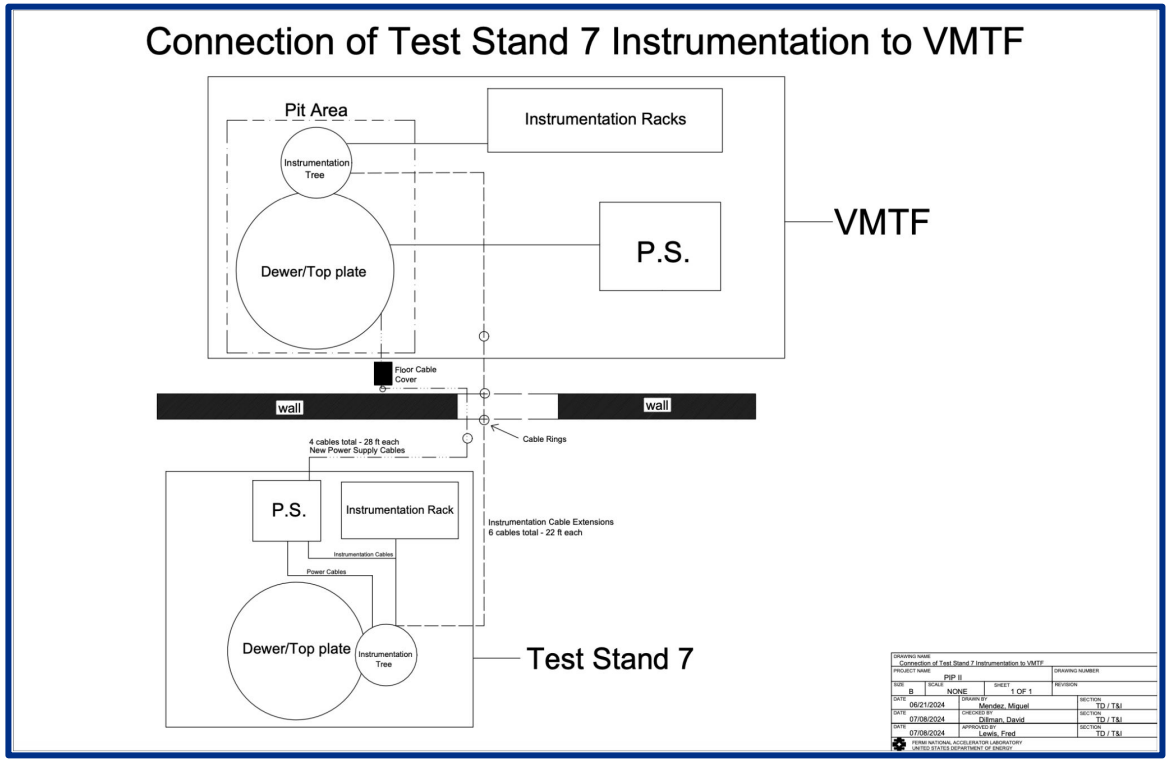
Week 2 - Connection of Test Stand 7 to VMTF

Delving into the details:

- 6 instrumentation extension cables connect stand 7 to VMTF
- 4 new power supply cables from stand 7 provide power to VMTF
- Visualizing floor layout and possible obstacles



The Final Block Diagram I Would Make

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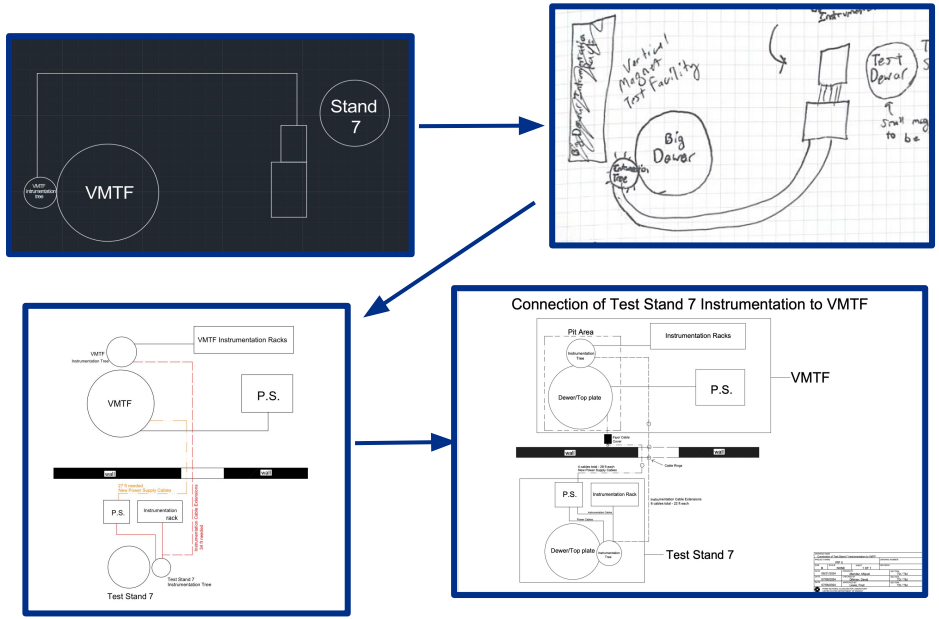
Week 3/4 - Schematics

Visual Block Diagram Timeline

Although making schematics sounds fairly simple… It is truly a complicated and time consuming endeavor.

Shown on this slide is only a small portion of the many versions I made of only the block diagram.



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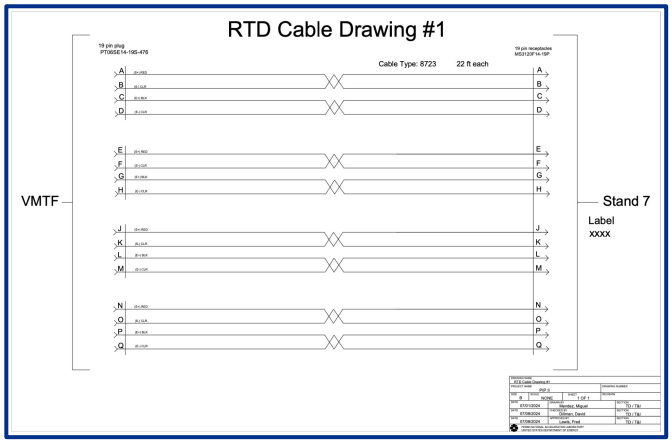
Week 3/4 - Schematics

Instrumentation Cable Specification Schematics

Why are they needed?

These ensure that an electrical technician can correctly make a cable with a proper length, wiring, and connectors.

Here's what one looks like!



The block with many connection ports is the instrumentation tree. That is where all instrumentation cables connect to

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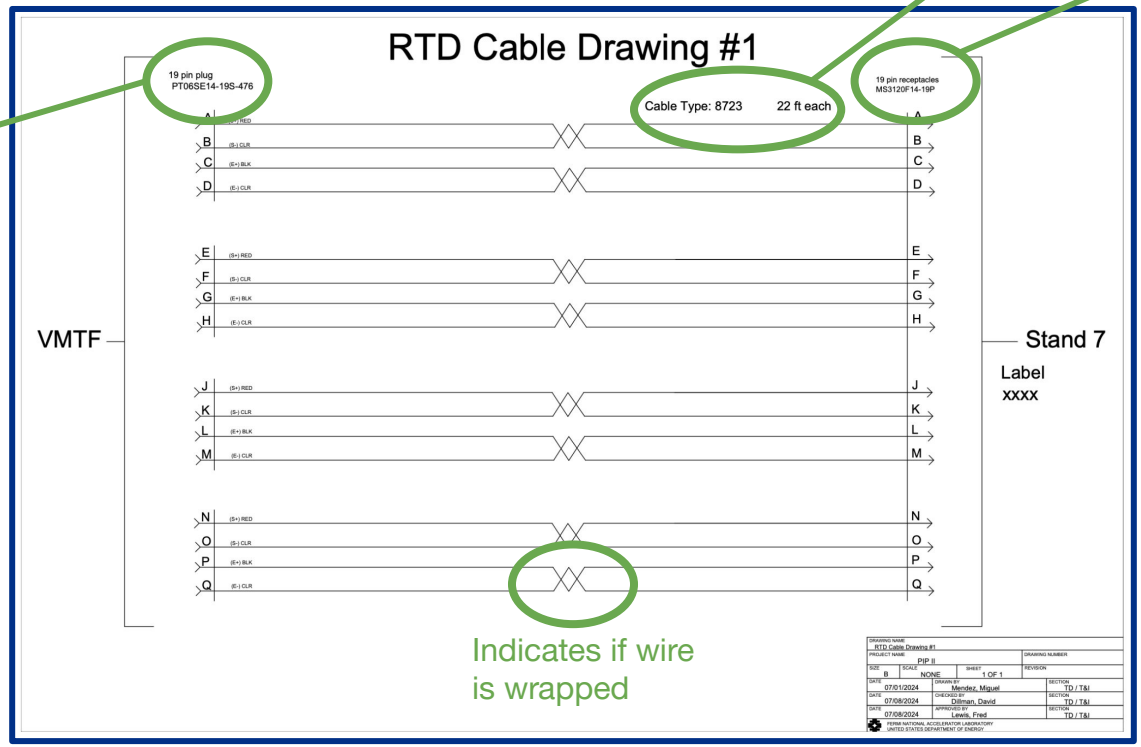
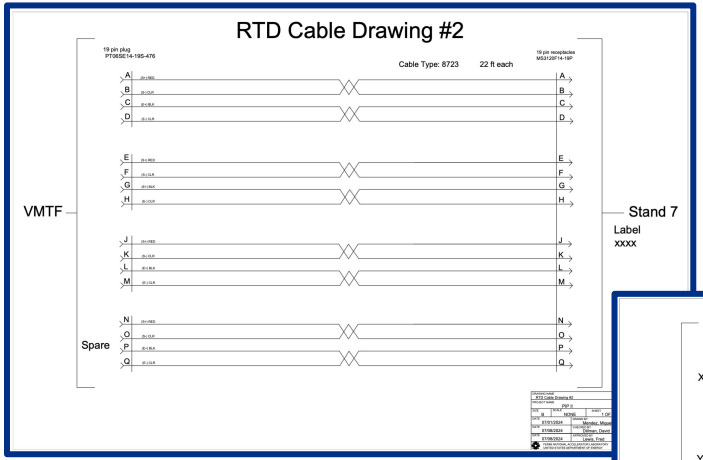
Week 3/4 - Schematics

Overview: Instrumentation Cable Specification Schematics

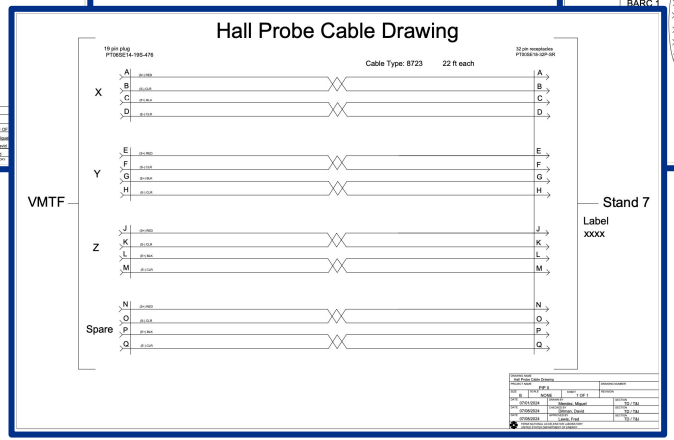


Week 3/4 - Schematics

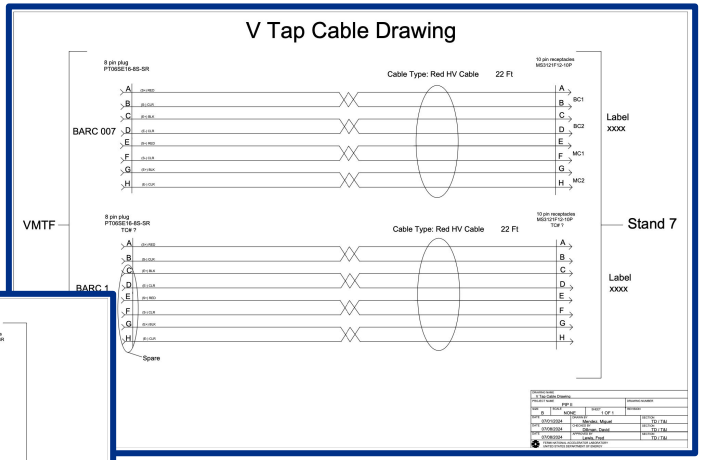
The Rest of Instrumentation Cable Specification Schematics



Resisttance Thermal Device (RTD) measure the resistance of the magnet and thus correlate with the temperature



Hall probe tests the strength of the magnet's magnetic field



Detects drops in voltage within a magnet, thus stopping the run of electricity through so that there is no magnet damage

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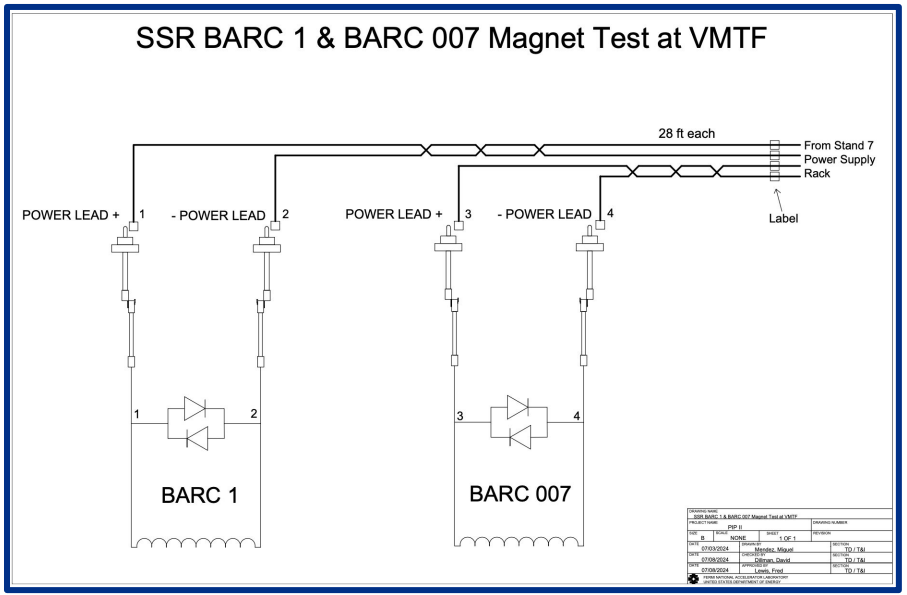
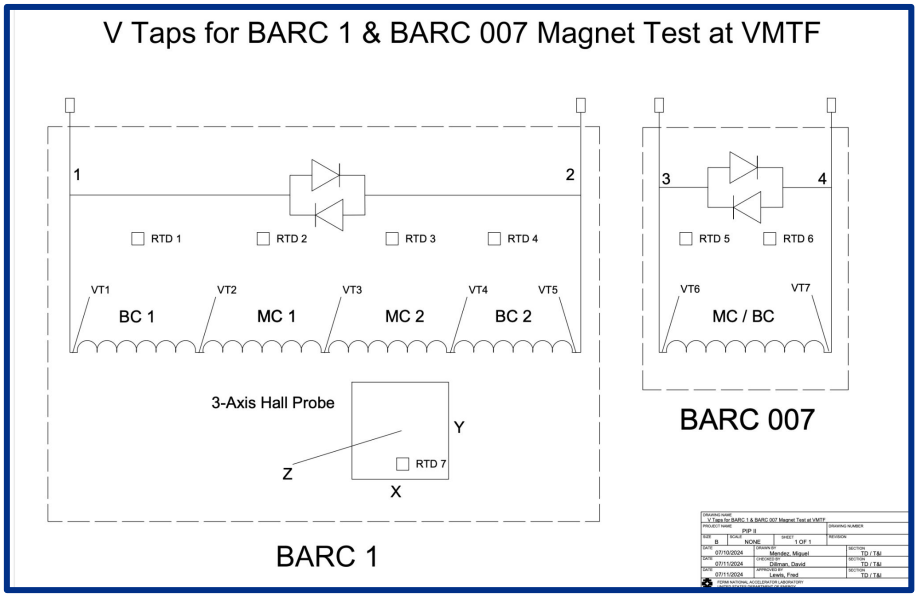
Week 3/4 - Schematics

The Power Supply Schematics For The BARC Magnets

These provide an electrical technician the sufficient information necessary to link up magnets with electricity to conduct a performance test at VMTF.





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Week 5/6 - Labeling PIP-II Cyromodules LB650

What is a Cryomodule?

A section of a particle accelerator composed of superconducting RF cavities. Those RF cavities take in radio-frequency power and convert it into acceleration for the particle beam.

A cyromodule being shipped to California

LCLS-II Cyromodule

Week 5/6 - Labeling PIP-II Cyromodules LB650

Why is labeling Important?

Although it is quite a small task, labeling is extremely critical and important to do correctly. If anything of the smallest scale goes wrong, it can have very long and expensive consequeces.

Labeling tells a technician exactly where a device must be connected. Without those labels, it would be impossible to know where connection is meant to take place.

An RTD cable with an extension cable beside it. Labeling is shown.

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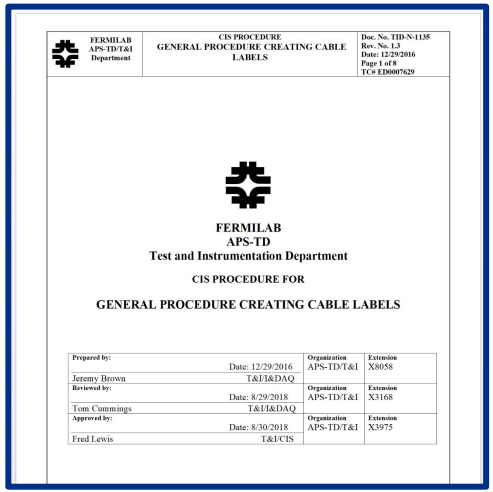
Week 5/6 - Labeling PIP-II Cyromodules LB650

Reviewing Labeling Procedures

I was given procedures used by all instrumentation employees here at Fermilab and with all of our foreign partners. Upon reading over every detail, I was encouraged to recommend any changes I deemed necessary.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CIS PROCEDURE
GENERAL PROCEDURE CREATING CABLE LABELS

Doc. No. TID-N-1135
Rev. No. 1.3
Date: 12/29/2016
Page 1 of 8
TC# ED0007629

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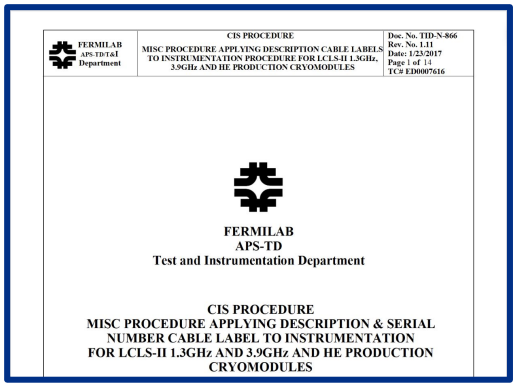
Test and Instrumentation Department

CIS PROCEDURE FOR

GENERAL PROCEDURE CREATING CABLE LABELS

Prepared by:	Date: 12/29/2016	Organization	Extension
Jeremy Brown	T&I/I&DAQ	APS-TD/T&I	X8058
Reviewed by:	Date: 8/29/2018	Organization	Extension
Tom Cummings	T&I/I&DAQ	APS-TD/T&I	X3168
Approved by:	Date: 8/30/2018	Organization	Extension
Fred Lewis	T&I/CIS	APS-TD/T&I	X3975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CIS PROCEDURE
MISC PROCEDURE APPLYING DESCRIPTION CABLE LABELS TO INSTRUMENTATION PROCEDURE FOR LCLS-II 1.3GHz, 3.9GHz AND HE PRODUCTION CRYOMODULES

Doc. No. TID-N-866
Rev. No. 1.11
Date: 1/23/2017
Page 1 of 14
TC# ED0007616

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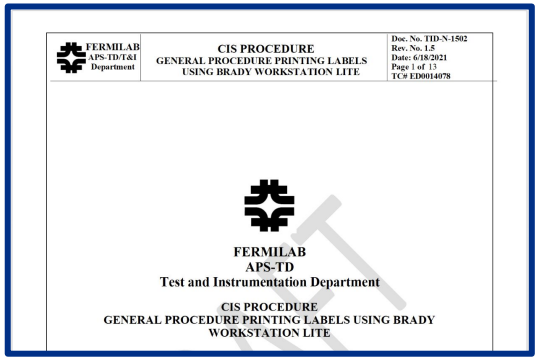
CIS PROCEDURE
MISC PROCEDURE APPLYING DESCRIPTION & SERIAL NUMBER CABLE LABEL TO INSTRUMENTATION FOR LCLS-II 1.3GHz AND 3.9GHz AND HE PRODUCTION CRYOMODULES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CIS PROCEDURE
GENERAL PROCEDURE PRINTING LABELS USING BRADY WORKSTATION LITE

Doc. No. TID-N-1502
Rev. No. 1.5
Date: 6/18/2021
Page 1 of 13
TC# ED0014078

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CIS PROCEDURE
GENERAL PROCEDURE PRINTING LABELS USING BRADY WORKSTATION LITE

These are the front covers of the procedures which I received

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Week 5/6 - Labeling PIP-II Cyromodules LB650

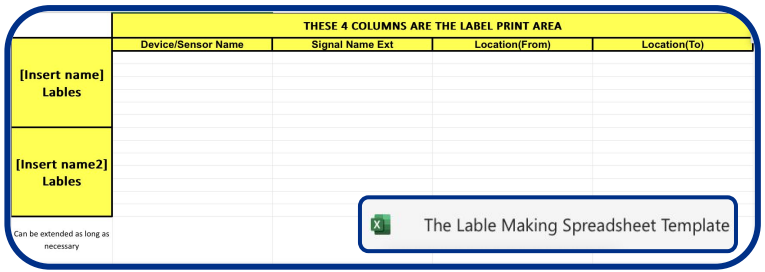
Making Recommendations For The Procedures

I made several recommendations including adding procedural requirements such as an excel spreadsheet and implementing references and a visuals to make the procedure a bit easier to understand.

Revision	Date	Section No.	Revision Description
1.0	12/29/2016	All	Initial Release
1.1	8/15/2017	All	Updated/ added label examples
1.2	5/7/2021	3	Updated number of characters per line from 16 to 18 MV
1.3	6/8/2022	All	Removed review history. Replaced TID-N-1098 with TID-N-1439 and added TID-N-1502 in Sec.2.2. Removed Note: There can also be a [continuation] of the destination of a cable and added the word square brackets on Sec.3.10. Fixed the Figure numbering. MV
1.4	07/16/2024	2 & 3	Added additional procedure requirements Sec.2.3. and Sec.2. 4.. Added Sec.3.6.1 to referring to using a point-to-point spreadsheet for obtaining label information. Incorporated an additional label example showing a label made up of 3 lines. MM

Printing LB650 Labels

I helped in the development of the spreadsheet that will be used to make all labelings for the LB650 cryomodules. Upon that completion, I printed those labels for use as they are prepared and later shipped to France to be used.



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Reflections

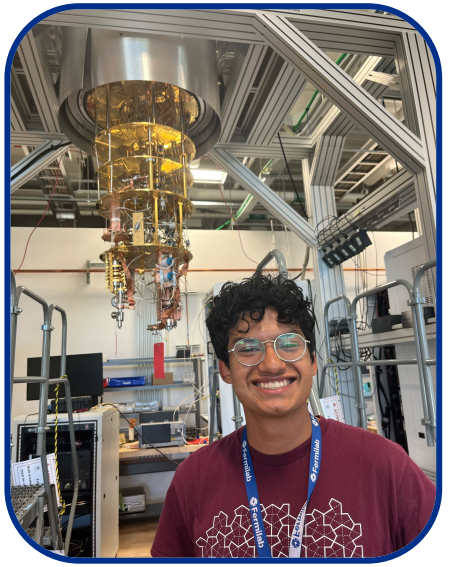
- Learning to utilize AutoDesk AutoCAD
- Exposure to electrical engineering
- Importance of taking time for quality control
- Learning is always a part of the job
- Everyone of all levels make mistakes

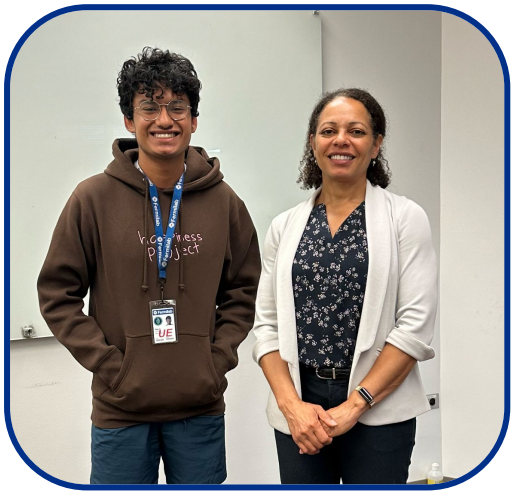
My Favorite Tour

While we got tour many amazing facilities at the Fermilab site, SQMS caught my attention the most.

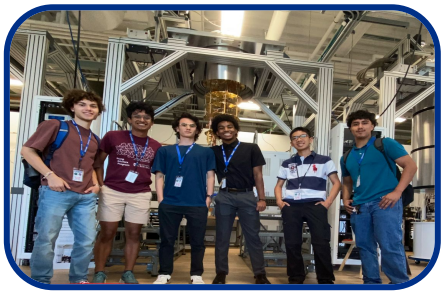
What I loved most about SQMS is their Quantum Garage. We got to see several dilution fridges!

As a result of this tour, I am now more heavily interested in pursuing a career in the Quantum field.





Not with the tour. I got to meet the uChicago Pritzker School of Molecular Engineering Dean Nadya Mason.



My Favorite Workshop

Python Workshop

Through this workshop, I was able to significantly improve my coding skillset which included learning the topics such as:

- Variables
- Functions
- Tuples
- Classes & Methods

Going forward, I will follow Mr. Mambelli's advice on continuing to learn python with Zed Shaw's ***Learn Python The Hard Way*** book.

```python
class counter_class:
    def __init__(self, initial_value=0):  # Optional argument with default at 0
        self.counter_var = initial_value
    def increment(self, increment_value):
        self.counter_var += increment_value
        print("The counter has been incremented to ", self.counter_var)
        return self.counter_var
    def double_increment(self, increment_value):
        multiplicator = 2  # this is a local variable
        self.counter_var += multiplicator * increment_value
        print("The counter has been incremented to ", self.counter_var)
        return self.counter_var
```

Acknowledgments

Anahi Ruiz Beltran - EDIA Office
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Fred Lewis - APS-TD / T&I / CIS
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David Dillman - APS-TD / T&I / CIS
Junko Og - APS-TD / T&I / CIS
Brianna Okengue - APS-TD / T&I / CIS
Bill Andrews - APS-TD / T&I / CIS
Philips George - Bus Driver

Recommenders

Mr. Bauer
Ms. Dao

Special Thanks

Cyriana Lara
Mrs. Smith

THANK YOU FERMILAB!