NORTHERN ARIZONA UNIVERSITY

Peer Critique – Technical Brief #1
Cover Sheet

EGR 186
Spring 2015

Staple this cover sheet to the front of the technical brief you are reviewing. Make additional marks on the paper.

After completing the critique, give the author points for each category in the table provided.

Reviewer's Name: Fahad Alhazza

Author's Name: Bray Moll

	Points Possible	Points Earned
Format	50	
Grammar & Spelling	75	
Organization & Clarity	75	
Technical accuracy	50	
TOTAL	**250**	

1. Consult with the author for 5 minutes. Have the author identify his/her concerns about the paper. Record those concerns here:

   Organization

   Spelling

   over flow

   over words

2. Quickly read through the paper, paying attention to the overall flow. If a passage does not make sense, make yourself a mark for you to focus on that section later.
   a. Does the paper flow? Explain.

   b. Briefly, summarize the main point of the paper (in your own words). According to the author:
      i. what is the need?
      ii. what compare/contrast points does the author make?

3. Look at the entire paper for organizational headings and evaluate the figures and tables.
    a. Do headings provide details about each section? Explain.

    b. Are the figures and tables easy to understand? Explain.

    c. Do the figures and tables help clarify and make the paper more concise? Explain.

4. Reread the entire paper. Focus on the details, such as grammar, spelling, active verbs, sentence structure, vague words (or phrases), consistency, clarity, citations (in-text with footnotes or reference list), etc.
    a. Mark the actual paper.
    b. Make constructive suggestions for ways to improve the paper.
    c. Provide any additional concerns here:

5. Check for plagiarism by using the web to search key phrases. Alternatively, search Google for "check for plagiarism" to find web tools. If you find plagiarism, mark the passage and document the web link here:

6. List the two most important things the author should do to improve this paper during revision. Be specific.

7. What are the strengths of this paper? What did the writer do well?

Bray Moll

Egr 186-6

February 17, 2015

Insulation of Superconducting Magnets

What if we could harness the endless supply of energy stored in every atom? Eliminating any worry about when our power source's may run out. The benefits of harnessing this energy is why the National Academy of Engineering has put this as one of the grand challenges of engineering. One of the first steps to solving this complex problem is the development of superconducting magnets. These magnets provide a field that is required for the initiation of high temperature plasma. [1] There are also other properties of a strong magnetic field that is required in all of the fusion techniques that are being worked on today. However there are problems concerning the insulation of these magnets.

The majority of large superconducting magnets are insulated by injecting a glass based insulator into a tooling mold. The process of Vacuum Pressure Impregnation, (VIP) which is a form of Vacuum Assisted Resin Transfer Moulding (VARTM) is the process of doing this that is commonly used today. [2] VARTM was created to solve the problem of inconsistent voids caused from the manufacturing process of Resin Transfer Moulding (RTM). Initially RTM used high pressure to insert a glass fabric into a metal tool at room temperature. This process however would trap air bubbles, which then formed inconsistencies and unwanted properties. This process was eventually modified to the VARTM. VARTM symplified the tooling involved in order to reduce the void formation.[3] The article by D. Evans, J. Knaser, and H. Rajainmaki, "Vacuum Pressure Impregnation Process in Superconducting Coils; Best Practice" discusses this process in detail. The first of three processes that can be used in the VIP process is flood filling, a process that only needs a vacuum enclosure and a

containment system. [3] The second is using a closed tool within a vacuum chamber. A sealed tool that eliminates the need for a tight vacuum. In this process the glass resin is introduced directly into the tool, unlike the Flood filling technique[3]. The third process is using a vacuum sealed tool. This process eliminates the need for a vacuum chamber. This process works if you are able to successfully able to eliminate vacuum leaks throughout the complex tooling. [3] While there are other variables, such as the degassing technique that need to be considered, the VPI process is being used to create the insulation for superconducting coils, but it has some downfalls.

The article by Hannu Rajainmaki, David Evans, Juan KNaster, and Marcello Losasso, titled The Electrical Insulation of Large Superconducting Magnets addresses some of these downfalls. The first downfall is that we do not have much experience with this style of insulation in extremely low temperature, or cryogenic applications. They also experience a great deal of stress in the heating and cooling of this insulation. [2] One problem faced by insulating these superconducting magnets is caused by partial discharge. This occurs then the gas trapped inside the insulation is electrolyzed. This creates an electronic chain reaction that that moves from one electron to a free electron trapped. As the process continues until enough electrons are energized to create a spark. When a discharge is reached an improbable reaction occurs. In order to reduce the effect of this happening the process of creating the insulator still needs to be optimized to reduce the size and frequency of these air pockets. [2]

These articles both address the problem of creating an insulator that can withstand the effects of the superconducting magnets. They both discuss the pros and cons with a variety of techniques that are used to manufacture this insulation, as well as where the problems lie. In the end they both stress the need for quality and clean manufacturing in every method in order to reduce the amount of contaminants allowed into the molding process.

[1] Joseph V. Minervini1 , Leslie Bromberg1 , Peter J. Lee2 , David C. Larbalestier. 2015, February 16. Superconducting Magnets Research for a Viable US Fusion Program pdf. Available:http://fire.pppl.gov/FESAC_WP_SCMagnets_Minervini.pdf

[2]D. Evans, J.Knaser, and H.Rajainmaki, "Vacuum Pressure Impregnation Process in Superconducting Coils: Best Practice" IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY, VOL. 22, NO. 3, JUNE 2012 Feb 2015

[3] Hannu Rajainmaki, David Evans, Juan Knaser, and Marcello Losasso, "The Electrical Insulation of Large Superconducting Magnets" IEEE TRANSACTIONS ON APPLIED SUPERCNDUCTIVIT, VOL 23 JUNE 2013 Feb 2015