ADMINISTRATIVE INFORMATION

1. **Project Name:** Remote Automatic Material On-line Sensor

2. **Lead Organization:** Quantum Magnetics
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   San Diego, CA 92128-3401

3. **Principal Investigator:** Erik Magnuson
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4. **Project Partners:** Physics Solutions — Dr. David Newman
   Paprican — Thanh Trung

5. **Date Project Initiated:** April 15, 2000

6. **Expected Completion Date:** October 15, 2004

PROJECT RATIONALE AND STRATEGY

7. **Project Objective:** This project will develop and test low-cost NMR technology for the purpose of material property characterization, with the emphasis on moisture content of wood chips used for paper. The overall goal is to reduce process energy consumption by providing more accurate measurements of material properties.

8. **Technical Barrier(s) Being Addressed:** Current wood moisture content sensors offer good accuracy when the moisture content falls in the range of 5 to 25% (where moisture content is defined as the weight of the water divided by the weight dry wood). Freshly cut wood will have moisture contents ranging from 40 to 200%. Process control of pulping or drying can be improved if the moisture content can be measured accurately.

9. **Project Pathway:** The project involves developing a low cost NMR sensor that can be operated in an industrial environment and is optimized for measurement of solids. The project involved making use of existing QM technology for low cost NMR electronics, designing and building a low cost magnet, designing RF coils, developing automated data analysis software and developing a very low noise amplifier with short transient recovery times.

10. **Critical Technical Metrics:** Current wood moisture content sensors are accurate to 1% when the moisture content of the wood is between 5 and 25%. The target accuracy for the NMR sensor is 1% at a moisture content of 50%.

PROJECT PLANS AND PROGRESS

11. **Past Accomplishments:**
    Demonstrated the ability to measure moisture content of pine over a range of 5% to 140% and with combination of solid wood, shavings and sawdust.

Demonstrated the ability to measure changes in moisture content of CaO (quicklime), accuracy not determined due to a lack of independent means of accurately measuring moisture content

Designed and built a magnet suitable for low cost manufacture and compatible with powder/granular samples (e.g. wood chips) and lumber (up to 3 inch by 12 inch)

Designed an RF coil suitable for use with lumber and designed and built an RF coil for powder/granular samples

Developed software for automated data collection and analysis

In conjunction with other programs at QM, we developed a very low noise amplifier with switch-able gain and rapid recovery from transients.

12. **Future Plans:**

    1. Finish development and integration of very low noise amplifier. Final system integration. Planned completion date 5/31/04
    2. Perform beta testing at Paprican in Vancouver, BC. Planned completion date 10/15/04

13. **Project Changes:** The project schedule has slipped due to the unexpected difficulty in developing the very low noise amplifier. Instead of beta testing starting in late summer of 2003, beta testing is expected to start mid-summer of 2004.

14. **Commercialization Potential, Plans, and Activities:** The initial use of the sensor will be for moisture content measurement of wood chips used in the paper and pulp industry. This is being done with Paprican, where QM will retain the IP rights to NMR technology and Paprican will have the rights to the IP related to integrating the sensors with paper and pulp mills.

    The sensor would be adaptable to measure the moisture content of the wood fibers used in LDF and MDF engineered wood products.

    By using a different RF coil design, the sensor can be used for green sorting of lumber for drying and to monitor the drying of hardwoods.

    The sensor should be capable of assaying the cellulose content of biomass used as fuel or as feedstock for fuel production

15. **Patents, Publications, Presentations:**
    A preliminary disclosure was filed on “Applications of the Magic Echo Sequence”