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## Great Falls Magnetohydrodynamics (MHD) Task Force Meeting

Max S. Baucus

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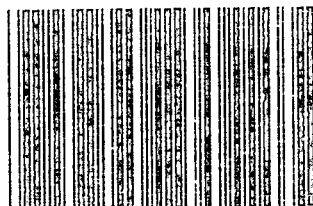
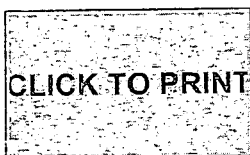
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(2) Subject\* Speech on MHD

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BAUCUS

REMARKS BY  
REPRESENTATIVE MAX BAUCUS  
BEFORE THE  
GREAT FALLS MHD TASK FORCE MEETING  
AT THE SAILBOAT  
FRIDAY, DECEMBER 16, 1977

IT IS A PLEASURE FOR ME TO HAVE THIS OPPORTUNITY TO SPEAK TO YOU ABOUT A SUBJECT WITH AN IMPRESSIVE AND HIGHLY-TECHNICAL SOUNDING NAME: MAGNETOHYDRODYNAMICS, OR MHD AS IT IS CALLED FOR SHORT. (THOSE OF YOU WHO THOUGHT MY TOPIC WAS GOING TO BE LSD MAY LEAVE IF YOU WISH!)

IT IS A BIG WORD WITH IMPORTANT IMPLICATIONS FOR MONTANA. MANY OF YOU ALREADY MAY KNOW QUITE A LOT ABOUT IT. BUT LET ME REVIEW A BIT THE FULL MEANING OF MHD. ONLY THEN CAN WE ALL UNDERSTAND ITS SIGNIFICANCE.

WHEN COUPLED WITH STEAM OR GAS TURBINE CYCLES, MHD OFFERS A PRACTICAL AND USEFUL TECHNOLOGY FOR MORE EFFICIENT USE OF COAL AND OTHER FOSSIL FUELS. IT SHOULD LOWER ELECTRICITY COSTS, AND IMPROVE CONTROL OF ENVIRONMENTAL POLLUTION. THE IMPORTANCE TO MONTANA IS ALREADY EVIDENT.

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HOW MUCH MORE EFFICIENT? WELL, CONVENTIONAL AND NUCLEAR POWER PLANTS CONVERT RESPECTIVELY 40% AND 33% OF THE ENERGY CONTAINED IN THE FUEL INTO ELECTRICITY. FOR MHD, THE COMPARABLE FIGURE IS 52%.

BECAUSE OF THIS EFFICIENCY, LESS FUEL IS USED. ALSO, LESS HEAT IS REJECTED INTO THE ATMOSPHERE, AND THERMAL POLLUTION DROPS.

SINCE HEAT IS USUALLY REJECTED INTO WATER, ONE CAN READILY SEE THAT IN WATER-SCARCE AREAS, MHD CONTRIBUTES SUBSTANTIALLY TO EFFICIENT AND NON-POLLUTING USES OF THAT RESOURCE. WATER CAN BE USED FOR OTHER THAN COOLING PURPOSES.

SIMILARLY, AIR POLLUTION IS LESSENER. EXPERIMENTAL WORK INDICATES THAT SEED PARTICLES USED IN THE MHD SYSTEM REACT WITH SULFUR FOUND IN COAL TO FORM POTASSIUM SULFATE OR SIMILAR COMPOUNDS, WHICH ARE READILY RECOVERABLE THROUGH TRAPS OR PRECIPITATORS.

NITRIC OXIDE LEVELS ALSO CAN BE REDUCED WITH PROPER COMBUSTION CONTROL AND COOLING; CONCEIVABLY, NITROGEN OXIDES COULD BE CONVERTED TO FERTILIZER, FURTHER IMPROVING THE EFFICIENCY OF MHD SYSTEMS. I WISH WE COULD GET GOVERNMENT TO BE AS EFFICIENT!

HOW IS ALL THIS DONE? JUST HOW DOES MHD WORK?

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CONVENTIONAL AND NUCLEAR POWER REQUIRE A THREE STEP PROCESS TO CREATE ELECTRICITY. FUEL AND AIR ARE BURNED TO CREATE HEAT WHICH IN TURN MAKES STEAM WHICH IS EXPANDED IN A TURBINE TO DRIVE A TURBINE SHAFT WHICH DRIVES THE ELECTRIC GENERATOR.

IN MHD THIS PROCESS IS COMBINED INTO ONE. THE HEAT PRODUCED BY BURNING FUEL AND AIR IS MADE TO CONDUCT ELECTRICITY BY THE ADDITION OF SMALL AMOUNTS OF SEED SUCH AS POTASSIUM OR CESIUM. THE COMBUSTION GASES BECOME THE ARMATURE OF THE MHD GENERATOR AND MOVE THE SEED AT VERY HIGH SPEEDS THROUGH A MAGNETIC FIELD WHERE ELECTRIC POWER IS GENERATED DIRECTLY.

SEVERAL DIFFERENT POWER SYSTEMS HAVE BEEN DEVELOPED TO USE MHD. THE MOST IS KNOWN ABOUT AN OPEN-CYCLE SYSTEM, BUT A CLOSED CYCLE SYSTEM, WHICH OPERATES AT LOWER TEMPERATURES IS ALSO UNDER DEVELOPMENT. MORE EXPERIMENTAL IS A LIQUID-METAL CLOSED-CYCLE SYSTEM WHICH EVEN COULD BE USED WITH A NUCLEAR REACTOR. HOWEVER, THIS IS VERY COMPLEX AND CONSIDERABLY FURTHER DOWN THE LINE.

IT SOUNDS VERY COMPLICATED AND TECHNICAL. IT IS. SO LET ME SAY ONLY ONE MORE THING ABOUT THE TECHNICAL ASPECT: IN APRIL OF 1977, THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION ISSUED A STUDY ON ENERGY CONVERSION ALTERNATIVES. NASA ANALYZED AT LEAST TEN DIFFERENT EXPERIMENTAL SYSTEMS, INCLUDING SUCH THINGS AS GAS TURBINE/STEAM COMBINED CYCLE SYSTEMS. IT WAS THE CONCLUSION OF THE NASA STUDY THAT MHD WAS THE OVERALL MOST EFFICIENT SYSTEM!

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IF YOU ALSO INCLUDED SIDE BENEFITS, SUCH AS ENVIRONMENTAL PROTECTION AND LESSENER POLLUTION, THE EFFICIENCY OF MHD REALLY BECAME APPARENT.

IT WAS A BIG BOOST TO COUNTER ARGUMENTS OF SKEPTICS.

CERTAINLY FOREIGN COUNTRIES ARE INCREASINGLY INTERESTED IN MHD. AS MANY OF YOU KNOW, THE SOVIET UNION HAS BECOME A LEADER IN RESEARCH ON MHD, TO THE POINT WHERE THEY COULD WELL OUTDISTANCE US IN A CRITICAL TECHNOLOGY. WE HAVE A COOPERATIVE ARRANGEMENT WITH THEM TO SHARE INFORMATION AND SOME TEST EQUIPMENT. WE ARE LIKEWISE COOPERATING WITH THE JAPANESE. I BELIEVE WE SHOULD CONTINUE THESE COOPERATIVE EFFORTS SINCE THERE IS MUCH WE CAN LEARN FROM THE EXPERIMENTATION OF OTHERS. THE SOVIET UNION HAS ALREADY TESTED MHD FOR LONG PERIODS AND HAS SHOWN IT TO BE WORKABLE; IT IS ALSO WORKING ON <sup>PRELIMINARY PLANS FOR</sup> A LARGE MHD GENERATOR FOR INTEGRATION INTO EXISTING POWER GRIDS. SINCE THE SOVIET SYSTEM USES DIFFERENT APPROACHES (SUCH AS GAS RATHER THAN COAL FOR ENERGY), WE WILL TEST SOME OF OUR MATERIALS AND COMPONENTS IN THEIR ENVIRONMENT, THEREBY AVOIDING COSTLY DUPLICATION OF EFFORT. WE HAVE ALREADY DISCOVERED THAT COAL OFFERS CERTAIN ADVANTAGES OVER GAS IN MHD. IT COULD ALSO SHORTEN THE TIME NEEDED BEFORE MHD BECOMES COMMERCIALY FEASIBLE.

LET ME NOW TELL YOU A BIT ABOUT WHERE WE STAND ON MHD, HOW WE GOT THERE, AND WHERE WE ARE GOING.

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IN THE LATE 1950'S, A NUMBER OF MHD GENERATORS WERE BUILT THAT DEMONSTRATED THE TECHNICAL FEASIBILITY OF DIRECT GENERATION OF ELECTRIC POWER. THE AVCO RESEARCH LABORATORY IN EVERETT, MASSACHUSETTS, WAS A LEADER IN THE EARLY RESEARCH.

THE DEPARTMENT OF DEFENSE PROVIDED MODEST RESEARCH ASSISTANCE IN THE 1960'S. IN 1968 THE OFFICE OF SCIENCE AND TECHNOLOGY COMMISSIONED A STUDY OF MHD, PARTICULARLY WITH EMPHASIS ON COAL AS A SOURCE OF ENERGY. THE RESULT WAS A RECOMMENDATION THAT FURTHER WORK BE ENCOURAGED.

IN 1973, THE DEPARTMENT OF INTERIOR'S OFFICE OF COAL RESEARCH, AMONG OTHERS, WAS CHARGED WITH FURTHER RESEARCH AND TO PROPOSE ACTION. THE CONCLUSION EVENTUALLY REACHED WAS THAT A 50-100 MEGAWATT THERMAL COMPONENT TEST AND INTEGRATION FACILITY SHOULD BE DESIGNED, BUILT, AND CHECKED-OUT.

MONEY WAS APPROPRIATED, ALTHOUGH FEDERAL AGENCIES PROVED SLOW TO FOLLOW-UP. IN FACT, IT WAS NOT UNTIL 1975, DESPITE REGULAR CONGRESSIONAL APPROPRIATIONS, THAT THE PROJECT REALLY GOT GOING. IN AN EFFORT TO ACHIEVE A VIGOROUS PROGRAM, SENATOR MANSFIELD INTRODUCED IN THE SENATE AND I IN THE HOUSE THE MHD RESEARCH, DEVELOPMENT AND DEMONSTRATION ACT. THIS LEGISLATION SOUGHT TO ACHIEVE A COMMERCIALLY SIZED DEMONSTRATION PLANT BY THE MID-1980'S. ALSO APPROVED BY THE CONGRESS WAS A REQUIREMENT THAT THE NEXT GENERATION OF TEST FACILITY BE IN MONTANA.

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SO THE PROGRAM BEGAN TO PICK UP MOMENTUM. BY FY 1978, THE CURRENT FISCAL YEAR, APPROXIMATELY \$70 MILLION WERE BEING ALLOCATED TO THE MHD PROJECT. THESE FUNDS WERE TO BE SPENT IN A VARIETY OF WAYS, INCLUDING RESEARCH ON SMALL SCALE MHD FACILITIES. SOME EXPERIMENTS ARE TAKING PLACE IN TENNESSEE AND ELSEWHERE IN THE UNITED STATES.

BUT IT WAS IN MONTANA THAT THE COMPONENT DEVELOPMENT AND INTEGRATION FACILITY, OR CDIF, WAS LOCATED. ITS PRIMARY GOAL IS TO TEST VARIOUS COMPONENTS WHICH WILL THEN BE INSTALLED IN A LARGE SCALE -- MHD TEST FACILITY. THE PROJECT IS, AS MANY OF YOU KNOW, COORDINATED WITH THE MONTANA ENERGY RESEARCH AND DEVELOPMENT INSTITUTE (MERDI) IN BUTTE.

I AM PLEASED TO SAY THAT THE CDIF IS MORE THAN 25% COMPLETED NOW - AND SO FAR IT IS BELOW ESTIMATED COSTS. WHEN COMPLETED, IT WILL BE AT THE 50 MEGAWATTS THERMAL ENERGY INPUT POWER LEVEL.

WHILE CONSTRUCTION CONTINUES FOR THE CDIF, PLANNING IS WELL UNDERWAY FOR THE NEXT STAGE - THE ENGINEERING TEST FACILITY.

THE ETF WILL BE AT THE 250 MEGAWATTS THERMAL ENERGY INPUT POWER LEVEL. IT WILL BE A MINIATURE POWER PLANT WITH STEAM BOTTOMING EQUIPMENT.

THE ETF WILL BE A CRITICALLY IMPORTANT EXPERIMENTAL FACILITY. AS A RESULT OF THESE FURTHER EXPERIMENTS, ONE COULD ALSO CONSIDER EFFECTIVELY USING THE HEAT BY-PRODUCT FOR HEATING HOMES OR OTHER LOWER TEMPERATURE USES.

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AS PLANS FOR THE ETF CONSTRUCTION MOVE FORWARD, TECHNICAL STUDIES WILL BE CARRIED OUT TO DETERMINE THE BEST SITE FOR THE FACILITY WITHIN THE STATE. THESE HAVE NOT YET BEEN COMPLETED.

THE TIMETABLE CALLS FOR RAPID ACTION. BY 1978, THE CDIF SHOULD BE COMPLETED. IN 1979, DESIGN SHOULD BEGIN ON THE ETF. BY 1980, CONSTRUCTION SHOULD START IF THE ETF IS TO BE COMPLETED BY THE MID-1980'S AS ORIGINALLY PLANNED. TO MAINTAIN THIS SCHEDULE, FUNDING WILL HAVE TO BE INCREASED.

THIS UNFORTUNATELY IS A STUMBLING BLOCK. THE BUDGET FOR FY 78 SHOULD HAVE BEEN AROUND \$125 MILLION; INSTEAD, ONLY AROUND \$70 MILLION HAVE BEEN APPROPRIATED. THIS REPRESENTS A SLOW-DOWN TO THE PROJECT. WE MUST TRY TO REVERSE THIS DECISION AND OBTAIN ALL THE FUNDING NECESSARY TO KEEP MHD DEVELOPMENT ON SCHEDULE.

SINCE THE PROJECT APPEARS SO GOOD, YOU MIGHT ASK WHY IS FUNDING A PROBLEM. IT IS DIFFICULT TO EXPLAIN. HOWEVER, OPPONENTS CITE THE FOLLOWING.

FIRST, MHD IS EXPERIMENTAL. AS SUCH, IT IS IN COMPETITION WITH MANY OTHER EXPERIMENTAL SYSTEMS. THAT PUTS OBVIOUS PRESSURE ON THE FINITE NUMBER OF DOLLARS AVAILABLE FOR RESEARCH.

SECONDLY, INITIAL RESEARCH SUGGESTED THAT MHD MIGHT ONLY BE APPLICABLE FOR VERY LARGE SCALE PLANTS. THIS IS BEING DISPROVED, BUT NONETHELESS, THIS VIEW MAY HAVE INHIBITED DEVELOPMENT.

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THIRDLY, TECHNICAL PROBLEMS DO EXIST: THE VERY HIGH HEAT PRODUCED BY THE SYSTEM CREATES A STRESS PROBLEM ON COMPONENTS. HOWEVER, THE CDIF IS EXPERIMENTING WITH THIS AND SHOULD PROVIDE US WITH ANSWERS. THE TECHNOLOGY IS THERE. ONLY REFINEMENT IS NEEDED TO MAKE MHD COMMERCIALY VIABLE.

ALL THESE PROBLEMS ARE MANAGEABLE. I REMAIN CONVINCED THAT MHD OFFERS OUR COUNTRY IN GENERAL, AND MONTANA SPECIFICALLY, AN EFFECTIVE SOLUTION TO PART OF THE ENERGY PROBLEM. IT IS MY STATED GOAL TO SEEK CONTINUED SUFFICIENT FUNDING FOR THE PROJECT TO ASSURE THE FUTURE OF MHD RESEARCH. I AM PLEASED WITH THE ROLE MONTANA IS PLAYING IN MHD DEVELOPMENT, AND LOOK FORWARD TO ITS CONTINUATION.

LASTLY, LET ME SAY ONE THING: WHEN A COUNTRY IN THE THIRD WORLD IS SLOW, WE CALL IT BACKWARD OR UNDERDEVELOPED. WHEN WE ARE SLOW, WE CALL IT "JUDICIOUS." WELL, I MUST SAY CONGRESS HAS BEEN "JUDICIOUS" TO AN EXTREME IN THIS MATTER!

I WOULD LIKE TO SUMMARIZE AND CONCLUDE BY SAYING THAT MY FAITH IN MHD REMAINS; I BELIEVE THAT IT PROMISES US CHEAPER AND CLEANER ENERGY, USING ONE OF MONTANA'S PRIMARY RESOURCES: COAL. FURTHER EXPERIMENTATION IS FULLY JUSTIFIED AND IT SHOULD CONTINUE IN MONTANA.

THERE ARE PROBLEMS TO BE WORKED OUT, BUT THAT IS WHAT THESE TEST FACILITIES ARE FOR.

WE WILL HAVE OUR WORK CUT OUT FOR US TO KEEP APPROPRIATIONS AT AN ADEQUATE LEVEL, BUT WE CERTAINLY WILL CONTINUE TO DO OUR BEST.

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I AM SURE THAT ONCE THE FULL VALUE OF MHD IS REALIZED,  
IT WILL BECOME A KEY PART OF OUR PRESIDENT'S PROGRAM FOR ENERGY  
CONSERVATION.

THANK YOU.

ADDITIONAL INFORMATION ON EIF SITE SELECTION (FOR MAX'S SPEECH  
ON MHD)

INSERT AT END OF PARAGRAPH ONE, PAGE 7

MANY CRITERIA MUST BE CONSIDERED FOR SITE SELECTION. MERDI IS CURRENTLY CHARGED WITH ESTABLISHING PROCEDURES FOR THE SELECTION OF POSSIBLE SITES IN MONTANA. AMONG THOSE CRITERIA ARE SUCH FACTORS AS: 1) ECOLOGICAL IMPACT OF A FACILITY; 2) POSSIBILITY OF HOOKING INTO EXISTING STEAM PLANT FACILITIES; 3) AVAILABILITY OF COAL; 4) TRANSPORTATION FACILITIES; 5) DISTANCE TO TRANSMISSION LINES, AND CAPACITY OF THOSE LINES TO CARRY ADDITIONAL LOADS; 6) ECONOMIC FACTORS, SUCH AS EMPLOYMENT RATES, IMPACT ON LOCAL MARKETS AND THE LIKE.

AFTER REVIEWING THESE CRITERIA, MERDI WILL USE COMPUTER MODELING AND MAP-OVERLAYS TO DETERMINE WHICH ARE THE BEST SITES. THE FINAL FEW WILL THEN BE SUBMITTED TO HIGHER AUTHORITY FOR SELECTION OF THE SITE.

BUT LET'S NOT KID OURSELVES. THIS IS A BIG PROJECT. A LOT OF THINGS ARE INVOLVED, ESPECIALLY MONEY. OTHER STATES WOULD LIKE TO SEE THE EIF LOCATED ELSEWHERE THAN MONTANA, DESPITE THE FACT THAT THE LAW CALLS FOR IT TO BE HERE. WE CANNOT BE NON-CHALANT IF WE WANT TO KEEP THE PROJECT HERE.