REMARKS BY BILL THUNBERG

first international hydrail conference

Good morning and welcome the first international hydrail conference. I'm Bill Thunberg, Economic development VP at the Mooresville-South Iredell Chamber of Commerce.

This week *Site Selection Magazine* ranked us as "one the ten best economic development organizations in the nation," noting our creative approach to economic development. Our early commitment to the hydrogen economy plays a major role in that approach.

This conference plays a major role in Mooresville's hydrogen strategy as well as North Carolina's and Charlotte's. It has a definite objective: to *jump-start the development and deployment of hydrogen rail technology*. In ten years, when hydrail trains are familiar, we'll be able to say it all came together here first. And you can say, "I was there."

The identities of the funding sponsor tell a lot about the conference's objectives. Let's start with the US EPA. Dr. Linda Rimer offered to help make hydrail possible and she's been better that her word, having us present about it at three conferences - one national - last year.

The NC State Energy Office moves NC toward energy independence and clean, renewable alternative. The SEO's Director, Larry Shirley, has helped us network with fuel cell and hydrogen interests and he was one to the first to help get this conference going.

The NC Department of Commerce believes the getting our state in a hydrogen leadership position is urgent business. Bob van Brederode and NC trade presence in Japan, Sumio Shabata, got Dr. Kondo to come here from Japan to address us today.

The Charlotte Chamber of Commerce's President, Cathy Bessant, of Bank of America brought their valued resources and sponsorship to the conference with Tom Lannin's and Doug Fowler's help.

The Centralina Council of Governments addresses air quality, transportation and alternative fuels, issues helped by hydrail; Al sharp and Becky Yarbrough bring regional collaboration to the Conference.

Finally, Appalachian State's Energy Center - Dr. Dennis Grady and Jason Hoyle made all the arrangements, booked the venue, built the web site, placed the ads and registered you all to attend. They made it happen! Our thanks go to them and to *all* the enabling sponsors.

Opening Remarks

David Carol - Senior Project Manager,
Charlotte Area Transit System - "CATS"

This is Indeed a historic day for Mooresville and also for Charlotte.

This morning Jena Dorn, Senator Dole, David King, Mayor McCrory, other dignitaries are signing the Full Funding Grant Agreement for the South Corridor Light Rail Line, Charlotte's first of six transit programs that will shape the region's growth and development in the coming decades

Welcome to the nation's - and the world's - first-ever hydrail conference. Today we'll explore the potential and, I'm willing to say, the likelihood of using hydrogen to power the nation's commuter rail fleet.

I'd like to thank Stan Thompson for pulling this all together. Stan is a tireless warrior for this exciting technology and he is certainly the reason I and my organization are here today.

I wasn't on the job for two weeks before Stan Thompson tracked me down with what I thought was a really far-fetched idea: hydrogen powered commuter trains. In my job at Amtrak, I've been approached by advocates of vacuum-tube trains; 150 mile-long monorails; and even nuclear-powered trains. Despite these visionary ideas, we're still using diesel.

Not only did he want to use them on our North Corridor commuter rail line, but he wanted to use the line as a laboratory for testing! Our North Corridor line runs from Charlotte 30 miles north to Mooresville and is planned for operation in the 2009 time frame.

The knee-jerk reaction of any good planner like me is to say NO. Yet after thinking it over, we found lots of merit.

Public transportation improves air quality, yet still generates its own share of bad gas. Diesel powered trains are no exception. Frankly, they get poor mileage and emit fumes. A "greener" fuel for transit can only help enhance the argument for, and merits of, public transportation.

Our trains likely will only require occasional fueling from a single location.
Our trains will be relatively short – probably 2-3 bi-level cars to start – and operate at up to 80 mph over a generally flat rail line. So why *not* use hydrogen?
So, I'm happy to say that we signed on--with some caveats:

With public transportation comes public safety – that is Number 1 – so we need to be assured – and FRA and FTA will need to be assured – that hydrogen is safe in a number of circumstances: fueling; while being jostled over a rail line; in

all weather extremes; and in the event of head-on accidents with automobiles or other trains.

We also need performance – particularly acceleration – that *at least* matches existing diesel-electric characteristics. In our case, with a single track railroad, we have placed passing sidings at specific locations based on train speed, schedule and locomotive performance. If acceleration is slower, not only do we end up with longer schedules, but our sidings will no longer be in the correct locations.

And, we need the approval of the FRA and FTA to use this new technology.

How these issues will be addressed -- and how we get our hands on a hydrogen-powered locomotive for our commuter rail line – is the focus of this conference today. We'll be hearing from some the experts in the field on efforts and progress in hydrogen rail in the US, Japan and Denmark.

Let me just conclude with a warm appreciation to Stan and Bill, who have tirelessly advocated for this exciting new technology and helped to put Mooresville on the map for more than its great NASCAR history. Behind every great idea, there are the tireless advocates and these are them.

I look forward to hearing more about hydrogen today and in working with all of you to bring the technology to fruition.

The Case for Rail Conversion to Hydrogen-Powered Fuel Cells

Alistair I. Miller, Senior Scientific Associate, Office of the Principal Scientist, Atomic Energy of Canada Limited, Chalk River, ON K0J 1P0 millera@aecl.ca

Since I presented a paper on this topic in Ottawa in late 1999, the concentration of CO_2 in the Earth's atmosphere has risen from 367 to 380 ppm, the price of oil has more than doubled, the cost of new nuclear-generated electricity has continued to fall, and the "Hydrogen Economy" has entered popular consciousness. Alongside the mounting evidence of global warming, there is a new appreciation of the calamitous effect of CO_2 build-up in the oceans if atmospheric concentration is not checked short of 550 to 600 ppm CO_2. Given the expectations and likely energy demands of the Developing Countries (e.g. China and India), efficiency and conservation cannot achieve the 60% reduction in CO_2 emissions needed to stabilize the CO_2 atmospheric concentration.

"Hydrail" looked good in 1999 but now, surely, its time has arrived. The alternative of track electrification is much more expensive.

Hydrail was not a new concept in 1999 but its attractions seemed little appreciated then. Its attributes include:

- Few operators
- Operation is not too dispersed
- Volume of liquid H_2 (LH_2) is unimportant
- LH_2 fuel is easily controlled in a few trained hands
- Will likely cause minimal public anxiety over a new fuel

It all adds up to hydrail being an obvious place to launch the Hydrogen Age. On top of this there is the leverage of rail being much more fuel-efficient than trucks and having much scope for expansion. Of course, the LH_2 must come from primary energy sources that do not emit CO_2 or other greenhouse gases. Nuclear power producing a mixture of electricity (1) for dispatch to the grid at times of high demand (and price) and (2) for electrolysis to produce hydrogen at other times is the best way to do this.

The Mooresville Initiative would eclipse other demonstrations of fuel cell powered buses. I would have liked it to have been in Canada but I'm delighted it's in North America.

The Hydrogen Fuel Cell Locomotives as National Energy Policy Insurance

Dr. Max Wyman

Although the hydrogen fuel cell offers the rail locomotive a substantial increase in engineering efficiency, the utmost benefit stems from what the railroad offers the fledgling fuel cell. The greatest cost of starting a new fuel economy is not the technology, but the establishment of the distribution and support infrastructure. The rail network offers three unique levers to build a hydrogen allocation system without substantial economic commitment:

- Trains travel several thousand miles between fuel stops. Tenders add additional range without degrading field performance. Fuel distribution for the rail system may be satisfied through a very simple allocation network.
- There are existing supplies of low-cost hydrogen that could meet the discrete and limited needs of rail transportation during its development towards autonomy. These sources include refinery venting and chemical industry byproducts. There is also a great potential to weave together utility off-peak load-leveling schemes.
- The rail industry is a small part of the national transportation system, yet could assume the lion's share of duty if necessary. A small national investment could have major benefits in terms of policy flexibility.

The national highway network is currently serviced by 200,000 established gasoline stations. These existing facilities present a substantial barrier to entry for any alternate fuel start ups, despite increases in the cost of oil. To the contrary, the few fueling facilities required by rail offers the golden key to avoid these barriers. The fundamental question the railroads and its suppliers must ask is whether their simplified energy distribution network and immediate engineering benefits would provide opportunity to themselves and society in terms of:

- A complete and fully functional alternative fuel cycle.
- An avenue to establish a fuel cell operating history for further policy development.
- The creation of a manageable and supportable demand for a new energy industry.
- A no-impact economic demonstration for established energy firms to evaluate. An insured ability to meet national transportation needs in the event fossil fuel supplies are lost.

Rail's greatest advantage is its small representation within the entire fossil fuel picture, while also representing a discrete, yet complete, national transportation segment. The marriage of rail and the hydrogen fuel cell offers the greatest opportunity to pierce the trenches and economic castles long dominated by the global fossil fuel market.

FUELCELL RAIL

Arnold R. Miller, PhD, Vehicle Projects LLC
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Fuelcell rail transportation can provide increased energy and time efficiency, enhanced energy security, and improved environmental quality for the transportation sector. Fuel costs are one of the largest costs of transportation, and some railroads spend on the order of $1 billion annually on diesel fuel. High-speed rail – even without the benefits of fuelcell power – is about four times the energy efficiency of air transport, and fuelcells are expected to be more efficient than any present motive power: diesel-electric or electric catenary. The rail system in the United States is largely based on diesel-electric locomotives and depends on imported oil. In contrast, locomotives powered by fuelcells will use renewable fuels. Conventional locomotives significantly contribute to air and noise pollution, whereas fuelcell-based systems can be pollution-free and nearly silent.

An international industry-government consortium, led by Vehicle Projects LLC, is developing the world's largest fuelcell land vehicle, a 109-tonne, 1.2-MW road-switcher locomotive for commercial and military railway applications. Vehicle Projects and its consortia have developed a fuelcell-powered underground mine locomotive, completed in 2002, and in June 2005, expects to complete a fuelcell-battery hybrid mine loader.

The seven-year locomotive development and demonstration project, funded by the US Department of Defense and which commenced in May 2003, has completed a comprehensive feasibility analysis and the conceptual design of the onboard fuel storage, refueling system, fuelcell powerplant, and locomotive layout, and it is presently executing the powerplant engineering design. Because it will be the largest fuelcell vehicle to-date, the project will contribute to the development and demonstration of other large commercial and defense vehicles such as ships. Besides serving as switchers, fuelcell locomotives serving as mobile backup powerplants on military bases will enhance base capabilities and security. Commercial demonstration of the locomotive is planned for the city of Reno, Nevada. Potential commercialization paths and follow-on development and demonstration projects include subway utility locomotives, switchers, commuter rail, subway trains, light rail, heavy freight, and high-speed rail.

For the future of fuelcell rail transportation, we believe the following are likely technical characteristics: The primary energy source will be nuclear power, from which hydrogen will be produced by electrolytic or thermal water splitting. Derived from the nuclear primary energy, two renewable onboard fuels appear promising, namely, hydrogen stored as an advanced metal hydride and anhydrous ammonia. As is the case for current rail vehicles, a single fuel for all applications appears unlikely. Some applications, such as subway transit and light rail, will prefer metal-hydride storage, while others, such as line-haul freight and high-speed rail, may use ammonia.

DR. LINDA RIMER - MODERATOR,
HYDRAIL ENERGY AND THE ENVIRONMENT

My name is Linda Rimer and I'm the Liaison to North and South Carolina from the US Environmental Protection Agency's Region IV, the Southeast Region. I work with organizations such as the Centralina Council of Governments where Becky Yarbrough, or first panelist, is Regional Initiatives Administrator.

We've learned a lot about hydrail technology and the hydrogen economy today. But those of us in government have also learned some important things about the information economy. We came together because a team of citizen volunteers took to heart President Bush's 2003 State of the Union comments on hydrogen's potential. They didn't wait for government to spark change. They didn't wait for public funding to become available. They got on the phone and on the Internet and made this happen, and a lot more.

I am proud, and I'm sure Becky is proud, that the EPA and the Centralina Council of Governments have been able to leverage the work of these volunteers through a suite of sustainable environmental projects called, SEQL Sustainable Environment - Quality Of Life. The Mooresville hydrail initiative that prompted the *first international hydrail conference* is part of the SEQL suite of initiatives.

The role of government in fostering change by funding innovation is pretty well understood. But we in government are learning to wield better a resource that requires no budget. It's the information resource. When we use our internal networking to make our colleague across the country aware of promising innovations here, we forward our agency policies and priorities. Volunteer organizations can only pay their members with the awareness that their accomplishments are understood, appreciated, and supported by those charged with implementing national policies.

The country gets a lot of mileage out of this kind of collaboration. I hope we'll see a lot more of it.

William Chernicoff
Hydrogen Engineer, US DOT Research and Innovative Technology Administration (RITA)

The Research and Innovative Technology Administration (RITA) advances the Department of Transportation's priorities for innovation and research in transportation technologies and concepts. We pursue innovations that improve mobility, promote economic growth, provide environmental and energy security, and deliver a better integrated national transportation system.

As a focused research and technology agency, RITA will allow the Department of Transportation to generate greater collaboration, information sharing, coordination, support, and advocacy for transportation research efforts. RITA is designed to be, in Secretary Mineta's words, "part university research lab and part Silicon Valley entrepreneurial company." The agency fosters the exchange of ideas and information in a high-priority incubator. Our goal is to get these innovative ideas from the laboratory into the field.

RITA takes the lead in research within DOT and works with all of the operating administration in developing modal technologies. In the area of Hydrogen Rail, this means working closely with the Federal Railroad Administration.

When we look at the state of the art of Hydrogen Rail we look at all parts of a hydrogen-based locomotive as a system. To ensure public trust in this new technology, industry and government need to develop hydrogen rail that promises: operational reliability, fuel-system integrity, vehicle and infrastructure safety and cost-effective performance. All involved will need to be able to answer whether hydrogen rail can conform to the requirements and standards of the current rail system. Answering these questions will gain pubic confidence in this new technology as well as develop the standards for hydrogen rail technology.

Hydrogen as the main source of fuel for U.S. railroads poses interesting challenges compared with automotive applications of hydrogen, including the work environment railroads present for a hydrogen-based system, shock vibration and duty-cycle issues. DOT is engaged with industry to ensure that any new technology is as safe and reliable as or safer than the today's existing rail technologies.

We can see how these challenges are addressed and understand where the technology stands in meeting the users needs. We also look forward to a continued relationship with this and other groups in the hope of bringing on track the promise of hydrogen in the U.S. railway system of tomorrow.