INTERNATIONAL PIPELINE RESEARCH DIRECTIONS

George W. Tenley, Jr.* President
Pipeline Research Council International, Incorporated

* Mr. Tenley is President of Pipeline Research Council International, Inc. (PRCI), a not-for-profit corporation comprised of energy transmission pipeline companies in the United States, Canada, Europe, and the Middle East that provide annual funding for technology development to address the design, construction, inspection, testing, and operating issues facing the industry. From 1990 to 1995, he served as the head of the pipeline safety program in the U.S. Department of Transportation. The views expressed here are his own, and do not necessarily reflect the views of PRCI or its individual members.

It is an honor to appear before this important, leading-edge organization and a pleasure to be in this indescribably wonderful country. I think it is every American's dream to come to Australia, and now I can say that I have done it. I can only hope this visit is not my last.

Although the title of my remarks focuses on "research", I would like at the outset to change that reference to "technology development." I do this here, and am doing it consistently in my dealings with PRCI members and the industry at large, because the word "research" is, for many pipeline industry executives, reflective of expensive, time consuming endeavors with indistinct outcomes. This perception I believe has led to the now entrenched view of research as a cost and not an investment. I will say more about this later.

I would like to talk a little about change and briefly note how the challenges and opportunities facing the industry will affect, and be influenced by, technology development. It is technology, after all, that will provide the foundation for the continuing viability of the pipe now in the ground and the pipe and related facilities that will have to be constructed to meet growing and changing demand. I pause here to note that any discussion of change – in the pipeline industry or anywhere else in the global community – will necessarily be influenced by the enormity of the horror the world suffered on September 11, and the thousands of responses we make – large and small – to minimize the likelihood that it will ever happen again. Certainly, one of the responses in the pipeline industry will be a heightened awareness of, and commitment to, strengthened facility, system, and human security.

As is the case with all "mature" industries, the energy industry is in the midst of sea changes in how it does business and how it positions itself for a future very different from its past. The economic realities of need and opportunity have led to an ongoing "shaking out" in the industry, including the pipeline sector.

- On the business side, the pipeline asset is under constant pressure to continue to be the cash cow for the stimulation of new opportunities for energy, both within the traditional roles of service and capacity provider, and outside those roles in pursuit of new returns from the asset such as use of rights of way for laying fiber optic cable. There is a robust market in pipeline assets as companies seek the means to provide service to new and shifting markets and thereby enhance asset productivity and shareholder value. This need for capacity, coupled with a near-term (at least) strain on supply, brings focus on the pipeline infrastructure – the existing pipe in the ground and the pipe that will have to be laid to relieve bottle-necks, replace aging pipe, and bring new gas supply to market.

- On the operating side, the industry must constantly find ways to extend the life of the infrastructure and thereby sustain and enhance its value. The ability of the industry to make the case to the public and the regulator that pipelines, if properly maintained, have a substantially unlimited life will be a critical success factor for the economic viability of pipelines.

- And, on the legislative and regulatory side, the industry is facing unprecedented interest in pipelines under the glare of legislative, regulatory, and public concern as to its commitment to safety. This concern in many countries is driving impending legislation and subsequent regulation that will require the industry to raise the bar on integrity management.

As is increasingly clear, these challenges, and the realities from which they spring, are tightly interwoven such that to pursue one to the exclusion of the others is neither doable nor desirable. Consequently, if these challenges are to translate into opportunities and opportunities into success, the industry must look for ways to leverage what it is currently doing, and must do in the future, into a consolidated whole that produces not only sustainable value but a new, more favorable, consideration by those who increasingly see themselves as having a stake in the industry.

This background greatly influences the direction for future technology development in the pipeline industry. The direction of pipeline technology development, particularly with respect to system integrity and reliability will, as suggested above, be determined largely by the interplay of two key considerations:

- First, responding to, and managing, the increasing scrutiny from the public and governments who are demanding a greater, more informed role in the management of pipeline risks; and,

- Second, assuring the most efficient, credible, cost-effective, and productive means to identify, prioritize, and fund technology needs and opportunities for enhanced pipeline integrity and reliability.

I would like to discuss each of these in more detail and then put them in the context of a technology development model that works on a national, regional, and global scale.

The Role and Impact of Government and the Public

It is as certain as the rip at Cheviot Beach, that accidents drive both the public's view of the pipeline industry and a government's regulatory oversight. In my tenure as head of the U.S. pipeline safety program I experienced this reality first hand. From a hazardous liquid rupture and fatal fire in 1986, through the dramatic, though fortunately non-fatal, explosion in Edison, New Jersey in 1994 the slowly evolving interest in pipeline safety has came insistently to a head. By the time the refined products pipeline blew in Bellingham, Washington in 1999, and the high-pressure natural gas transmission line ruptured killing 12 near Carlsbad, New Mexico in August 2000, legislators, regulators, and the public had already begun to change the pipeline safety debate.

As the pipeline industry and regulators have struggled to find a consensus on just what is needed to both assure the integrity and reliability of these economic lifelines and the public's confidence in their operation, increasingly the focus is turning to technology for solutions and opportunities. This focus, while certainly timely, is not new; what is new, is the sense of urgency in the development of both better understanding and

control of the risks posed by pipelines and the means and the message for conveying those risks and what the industry is doing to address them.

An increasingly important element in the government relationship with the industry is the role of government funding for technology development. The United States government is really just beginning to play a role in its industry's technology development, something that is much more prevalent elsewhere in the world. Whether this government involvement is a traditional role or is seen as radically new, and despite its potential value to the ultimate goal of safer, more efficient and reliable pipelines, I believe it does present a challenge for the pipeline industry and the future of technology development. The challenge is the ability of the industry to obtain, and be aggressive in playing, a key role in the development and execution of the technology development agenda. For example, for the first time in the U.S., a technology agenda not wholly of the industry's making will attempt to determine what is needed to assure the integrity and reliability of an increasingly dynamic infrastructure. In 2001, the U.S. Department of Transportation (DOT) and the U.S. Department of Energy (DOE) are spending nearly $5.0MM for improvements in pipeline integrity and reliability, and DOT's pipeline technology budget may more than double in 2002. For its part, DOE is likely to realize a significant increase in its overall budget for infrastructure-related technology development in 2002.

With these government funds would come a commitment to include other agencies and stakeholders among those setting and overseeing the technology development agenda. Increased government funding means that its portion of the overall technology agenda will have the potential to predominate. Consequently, the industry must gain a key role in any government-industry cooperative technology development agenda not just in helping to determine what work should be undertaken, but, more importantly, determining whether the actual technology deliverables can be applied to pipelines in an effective – including cost-effective – way. This strongly suggests that a substantial portion of technology development conducted under a cooperative government-industry agenda be managed by the industry. However, as with all aspects of the pipeline industry today, its ability to gain this role to the fullest extent necessary to fully represent and advance its interests, will depend largely on its image in the eyes of citizens and those who represent them.

Translating Needs and Opportunities into Solutions

In considering the worldwide pipeline infrastructure, it is apparent that there is among many similarities, one significant difference between the pipeline systems in the United States, and to a lesser extent, Canada, - and those of Europe, Asia, and Australia; namely, the age of the pipe in the ground. With more than 50% of U.S. pipelines more than 50 years old the issue of the integrity of these lines is a major regulatory and economic driver. As important new supplies come on line to meet demand, the existing infrastructure will need to be as reliable as the systems that will have to be built if the pipeline grid is to provide the energy to meet the expected dramatic increase in demand over the next 20 years. However, this need to continue to build new infrastructure upon existing pipe, is common to all regions of the world, and it is this fact that enables a

truly world view of technology development – the why, the what, and, perhaps most importantly, the how.

In the realm of pipeline technology development, the U.S. is also different from most of the rest of the world, particularly Australia, in that technology devebpment has traditionally followed pipeline operations rather than leading them. Fortunately, for many countries in the world, the vast U.S. technology resource has provided the foundation on which to build their systems. I know that Australia particularly has benefited from technologies developed in the U.S., particularly those developed by PRCI. But, the essential question is "What is the future of pipeline technology development"; and the question and its answers are essential regardless of whether one attempts to answer it nationally, regionally, or globally. Accordingly, I invite you to use whatever lens you choose to view the balance of my remarks today, which, as I just suggested, will look at the Why, the What, and the How. I will also look at the "How Much", and its inherent component, "From What Sources."

Why

As I suggested previously, technology development can no longer exist, if it ever really did, apart from the business drivers facing today's pipeline companies. Whether in a country with a well-established pipeline industry, or one with an industry just emerging, the technology that is seen as necessary and worthy of expenditures is the technology that enables the pipeline asset to fulfill its essential function. In countries where the pipeline asset is the cash cow for a larger energy enterprise, its essential function is to provide capacity and deliverability to further market penetration and predominance. These countries are characterized by deregulation and the separation of the merchant and transportation functions. In countries just developing a pipeline infrastructure the essential driver is broader economic and social development so there is typically greater government control and direction.

However, regardless of the motivations underlying the operation of the asset, there are certain universal drivers to which technology can, and should, respond. I see the following as particularly critical:

- *The growing need for system flexibility* to address changing demand profiles and markets. Increasingly pipelines will be seen as transporters of the full range of energy products, with the distinction between natural gas transport and oil and petroleum product transport lapsing into memory. In natural gas, the changing demand profile is increasingly reflecting the huge increase in natural gas for electricity generation.

- *Strategic interconnects* to enable new supply to come on line to meet growing demand and to relieve and avoid bottlenecks. In countries like the U.S. and Australia, and regions like Europe, a critical goal is to realize the full benefits of the existing grid, including its ability to facilitate and address the ongoing need for adequate and new supplies. This will require a near-constant installation of more finite connections both within the existing grid and between the old grid and the new supply chains.

- *Speeding up operations to keep pace with faster transactions*. The dichotomy between the speed of transactions and the speed of operations, always present, is now increasingly important. Whether the merchant and transportation functions have been separated or not, the need for reliability and deliverability will only grow in order to meet the demands of the marketplace. As is clear in the U.S., and I suspect is in play everywhere, the old notion of a predictable "construction and repair season", when demand flows dissipate, is rapidly becoming a thing of the past as heating seasons and cooling seasons and transitional seasons merge into one "energy season". This coalescence of the speed of operations and the speed of transactions drives the need for faster, better, cheaper pipeline inspection and repair to avoid loss of service.

- *Developing better pipeline design and construction practices to enable faster permitting of new facilities.* If strategic interconnects and new construction are critical drivers of technology development, then assuring that they actually are put in place suggests that the means to do so continually evolve. In many cases the technology advances in this area follow, and build off of, technologies advancing elsewhere in the fields of computing, electronics, and robotics. Design and construction form a critical technical synapse with the non-technical, but essential, driver of public acceptance of pipeline facilities. This acceptance can only be achieved if the public is confident in the safety of the pipeline's operation and it understanding of how and why pipelines operate.

- *Building or increasing public confidence* in the pipeline infrastructure is fundamental to the success of every pipeline endeavor, and technology is a unique means to help establish it. Among all aspects of pipeline operation, technology is the one that is substantially free of bias, is forward-focused, and its application and impacts capable of assessment. These three attributes are essential to the building blocks of public confidence; namely, knowledge, credibility, and understanding. Amazingly, these same three components are essential to technology development and deployment.

What

By the "what of technology development" I mean not only the work the needs to be done, but the context in which it takes place; the key opportunities for its application, and where the payoff is of particular significance. Overall, the context is integrity and reliability. By integrity, I mean something different than safety. From my initial understanding of pipelines, obtained while in a government regulatory program, I learned that regulatory compliance is a surrogate for safety, and as such, is fairly static and too far removed from something as dynamic as risk. On the other hand, the integrity of an operating pipeline system is the sum total of risk and the means to understand, assess, and manage it. An integrity focus drives the creation of risk solutions, and enables the prioritization of how and when those solutions come on line. In other words, an integrity focus is essential to the successful development and deployment of risk assessment and risk management, endeavors that require the

application of tools that are technically justified, feasible, and capable of cost-effective application on a pipeline.

As for the work that needs to be done, the agendas of the pipeline industry's leading technology development organizations are remarkably similar, largely because they are all heavily weighted toward system integrity. In addition, they all more or less utilize the same three-phase paradigm for all or the vast majority of the work they do; namely, find the problem, assess and understand the problem, and prevent or control the problem. Under this paradigm, the following are the key areas for the near and mid-term:

- *Materials*: focused on lighter, stronger steels with higher design factors yielding greater defect and damage resistance, and enabling higher pressure design and richer gas compositions; and the means to join and repair existing and new steels more cost-effectively, including while the pipe remains in service.

- *Damage prevention*: focused on predicting, preventing, and limiting the damage caused by external activities around the pipe. This problem, which is rampant in the United States, despite broad-based efforts in recent years, will be a problem for pipeline-developing nations as the public and industries who are the intended beneficiaries of pipeline expansion will come in increasingly closer proximity to those pipelines. Key efforts in this area are looking at both in the ditch techniques using ultrasound and acoustics, and off the pipe techniques including satellite monitoring for encroachment and ground movement.

- *Corrosion prevention and control*: focused on better, more damage resistant coatings, both internal and external; improved cathodic protection design; and a growing attention to internal corrosion and the means to address it.

- *Improved inspection techniques*: focused on multiple-capability in-line inspection to locate, characterize, and size all defects and damage; and tools for above-ground detection and assessment.

- *Improved pipeline design*: focused on validating reliability-based design methodologies such as limit-states design that take advantage of new, more powerful and diverse computing capabilities.

How Much

Before concluding with the "How" of technology development, I would like to look briefly at the future of technology development funding – the "How Much." In the U.S., and I suspect elsewhere, this issue is really two issues – the appropriate funding level and the sources of the funding. Organizations like PRCI have learned the painful lesson that the new generation of pipeline CEOs, with their marketing and business development backgrounds and biases, will not hear of an overall funding target as framing the technology development undertaking. While I generally do not advocate conducting technology development in pursuit of a fixed funding target, even a cursory examination of past funding and the essential work it produced suggests that a funding

level in the U.S. in the range of $12-18MM annually will be necessary to sustain the outstanding integrity and reliability record of the industry regarding the pipe in the ground, while constantly improving the means and techniques for laying the new pipe that will be necessary to optimize the value of emerging supplies and new markets.

Increasingly, because technology development is seen as a cost rather than an investment, it must compete with all other cost elements on the balance sheet. While this has led in the near-term to uncertainty in the levels of funding, I believe that rationalizing technology cost is not inherently a bad thing as it assures that technology, like all other expenditures, must respond to the relevant business drivers facing a company and the industry that I highlighted previously. However, when one examines opportunity, need, and cost it is apparent that individual companies are not likely to make the requisite commitment to technology due to the impact of the business drivers they face. This strongly suggests that only through a leveraging mechanism – where the whole far exceeds its component parts – will the essential technology developments be achieved and their benefits of focused solutions and time to application maximized.

Certainly, it would benefit the industry and the public interest if the industry had incentives to aggressively pursue an essential and expansive technology agenda. These could take the form of a rate of return acknowledging cost-effective pipeline operations, or less prescriptive operating oversight. Both of these would emanate in government policy and regulation, and as such are enmeshed in the broader political agenda of a nation. Consequently, while industry should, and will, constantly endeavor to influence the political agenda it is not realistic to assume that a technology agenda and the funds to achieve it can be built upon so speculative a foundation. That being the case, how should essential technology development for the pipeline industry be pursued?

How

I believe strongly that the answer is one word – collaboratively. And, in that word, and the opportunity it envisions, lie the future of the industry. I hold this belief because I have seen the benefits of collaborative technology development, and I believe the model of collaborative technology development enables optimized solutions that will assure the integrity and reliability of the pipe in the ground and foster development of the facilities that will have to be built to bring new supplies to new and changing markets.

The model of collaborative technology development has been a success in the United States, Europe, Asia, and here in Australia. Whether the collaboration is only among a single industry – PRCI's operating pipeline company membership, a combination of closely related industries – the linkage of operating pipeline companies and the steel and pipe manufacturers that supply them in the European Pipeline Research Group (EPRG), or the broader membership of the APIA comprised of pipeline companies, steel manufacturers, vendors, and service providers, the model works. And, the model works across regional, national, and international boundaries. Our challenge, the APIA's, EPRG's, and PRCI's is to continue to expand and diversify the collaboration.

So, what are the key features of the collaborative model? I believe the following are the most critical:

- Members' voluntary contributions of resources – money, in-kind services and facilities, and expertise.

- The leveraging of the available resources among all members to produce a whole greater than the sum of its parts, recognizing that any given project will have a small-to-moderate payoff to most of the members and a large payoff to relatively few members .

- A consensus approach where every interest is heard, debated, and considered, and the rule of the majority sets the policies and makes the decisions.

- An association of interests and a diversity of perspectives as broad as possible while maintaining focus and relevance to the work to be done.

- An efficient and timely return on the investment where the technology developed is available first to the member company.

The collaborative models currently in practice produce several key and indispensable benefits. For example, the following benefits delivered by the PRCI program to its member companies are in addition to the positive benefit-to-cost ratios achieved by our members:

- Setting the technology agenda and the prioritization for its achievement.

- Providing technical foundation for the voluntary industry standards that will underpin the growing reliance on integrity management as both an operating focus and a regulatory mandate.

- Focusing and leveraging available resources on the most pressing integrity and reliability needs the industry identifies. Key to the realization of this benefit is the elimination of duplication and overlaps in the work that is undertaken.

- Gaining first access to the technologies developed by the collaboration.

- Increasing the knowledge base of the industry, companies, and individuals.

- Providing a forum and resource base and expertise for attacking fast-emerging problems.

- Providing a credible basis for improving the image of the industry by demonstrating pro-activity.

One of the most exciting, emerging versions of the model is the cooperation among collaborative technology development organizations, stimulated by the value and power of globalization. It is this version of the model that is enabling the growing relationship between APIA, EPRG, and PRCI. This relationship is building toward formal recognition and structure, having first been tested through the bilateral relationships of EPRG and PRCI expressed in our 26 years of biennial joint technical meetings, and

APIA and PRCI expressed through our exchange of experts for specific technology inquiries.

I am very excited that our three organizations are building a formal, interactive, and credible tripartite relationship that will enable information sharing, joint planning, and, where appropriate, co-funding. As to the latter, we will be joining with APIA to fund a project for 2002 to be conducted by the Edison Welding Institute on the factors associated with hydrogen cracking in in-service welds. Beginning with the successful EPRG-PRCI Joint Technical Meeting in May of this year, where Max Kimber made a wonderful presentation, APIA is now participating in the Joint Meetings. I am pleased to note that the APIA will be hosting the Joint Meeting in 2007. The next meeting is in Berlin in 2003 and my EPRG counterpart, Dr. Gerhard Knauf, and I invite APIA to broaden its participation in that meeting. And, in order to formalize this new three-way relationship, I am meeting during my visit this week with Brian Rochford to work out the details of a Memorandum of Understanding that would set out terms of how the relationship would operate.

In conclusion, the pipeline industry is in the midst of great change and rapidly evolving challenges and opportunities. Technology must be at the heart of the industry's efforts to harness, manage, and derive benefit from these opportunities. In the realm of system integrity and reliability, the changes we are experiencing and the drivers they create for pipeline companies strongly suggest that it is not feasible from a funding or knowledge standpoint for individual companies to confront the operating issues they face on a one-on-one basis. Rather, by pooling funding and expertise and sharing a range of perspectives on needs and solutions, collaboration offers the greatest opportunity for success and the widest benefits. I am honored to be a part of the technology endeavor, and excited at the prospects of joining forces with an organization of the stature and influence of the Australia Pipeline Industry Association.

Thank you very much.