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Robert D. "Skip" Rung

(President and Executive Director, ONAMI)

Chairman Baird and members of the committee, I am honored by the opportunity to speak with you today on a subject of great passion for me and also, I believe, of great importance for the continued economic and social health of our nation.

Success at science-based innovation - the current cutting edge of which just happens to be called nanotechnology - is critical for U.S. economic competitiveness, for the supply of jobs with sufficiently high productivity to offer wage levels Americans have come to expect, and for the prosperity that pays for all the social goods, such as health and education, we would like to keep intact for future generations. Re-authorization of the Nanotechnology Research and Development Act presents the opportunity both to re-up on a vital investment, and at the same time be more intentional about reaping social and economic returns.

Oregon Nanoscience and Microtechnologies Institute, Oregon's first Signature Research Center, has so far received $37M from the Oregon Innovation Council because they know that success in the global competition for jobs and prosperity completely depends on a traded sector that wins through innovation – fueled by research and entrepreneurship. And that is the dual mission of ONAMI – growth in scientific research by means of deep inter-institutional and industry collaborations, and job growth at Oregon employers commercializing that research. I think we're an interesting case. We are a small state, but have arguably the world's most powerful collection of industrial "small tech" R&D assets – Intel and HP's top research sites, FEI, Invitrogen - Molecular Probes. But we have no wealthy private university and are not a traditional venture capital hot spot. Still, we know for certain that our research quality and creative ideas are competitive with anyone's, and therefore we should be able to grow our entrepreneurial sector.

Thus, one of ONAMI's core activities – coupled with our own set of user facilities - is a commercialization fund that makes grants to bridge the very real gap between what research agencies pay for and what "pencils out" for investors. We have so far enabled 3 very promising microtechnology spinout companies and 4 nanotechnology spinout companies. Time permitting at the end of my remarks, I'll say a little bit about our nano group. For now, I will just note that this support is

absolutely critical for these technologies to ever reach customers and create jobs. Whether it is going to be enough to get us to success remains to be seen.

Before addressing in detail the questions asked by the committee, I will state my overarching point: **Intentional federal investment in, and accountability measures for entrepreneurial startup company-driven commercialization of NNI research are just as necessary and important as the research itself, and therefore should be a prominent consideration in the re-authorization.**

It is interesting that today, in contrast to 30 years ago, most high-risk and disruptive innovation – not just technology research, but getting to market - takes place in small companies, many of them venture-backed startups. Venture money originating in pension funds, university endowments and the bank accounts of high net worth individuals turns out to be more patient and risk-tolerant than corporate cash, and large companies increasingly innovate by acquisition and open technology sourcing – from small companies. This is why there needs to be intense focus on making U.S. nanotechnology entrepreneurs successful; understanding and addressing the myriad hurdles and challenges they face. A $2M regulatory compliance cost that is easily absorbed by a Fortune 500 company is a deal killer for the entrepreneur who's inventing our future.

Specific to nanotechnology, then, what are the hurdles? They include the greater expense and time required for proof-of-concept demonstration, comparatively high capital requirements, the need for convenient access to specialized facilities and expertise, and often very complicated technology licensing situations. And this is not to mention the growing burden of regulatory compliance and related uncertainty. Investors see these things as risks and act accordingly. For all these reasons, the appetite of venture capital for nanotechnology has turned out to be less than many hoped and expected. This may not necessarily be the case overseas as hungry global competitors such as China place a higher relative value on economic development.

To address these hurdles, the Bayh-Dole Act has enabled universities to own and out-license federally funded research results, and in the process provide an incentive to faculty inventors. The NNI has established 13 user facilities at universities – with no recent additions, and the national labs have various access

mechanisms, though they are mostly geared for publishable research and expensive for business to use. SBIR and STTR are vital programs and a lifeline for many innovative small businesses, including for our own lead nanotechnology spinout, Crystal Clear Technologies. The new TIP program is very promising for companies past the seed stage.

All of these things are very good and should continue – if anything, they should be expanded. But they don't take as much advantage as they could of America's many local business and investor communities, so company and job creation still favor the already-successful technology communities around the major centers. I'd like to suggest two concepts, based on our experience with shared-user facilities and our gap fund, that I believe could increase the commercialization return on the NNI investment around the nation.

The first is to broaden the NNIN concept into what we call the "high tech extension service" – the logical modern analog of the invaluable land grant concept of 150 years ago. Starting too late to be part of the NNIN, Oregon bootstrapped federal and private equipment grants with university and state funds to create a network of shared user facilities – the Northwest NanoNet – which consolidate major instrument and equipment assets in well-utilized and maintained facilities open to all academic users from any campus on equal cost and access terms. They are also open for industry collaborations, and can provide leased experimental and office space to both large and small company partners. All 7 of our current gap companies make critical use of these facilities. Since Oregon is a rural state, and the distance between our sites is up to 110 miles, we have also implemented high-quality webcam and virtual network connections on major tools to enable a very satisfying remote user experience. This also works well cross-country, so we have clients as far away as Florida. But the key points here are that there are measurable objectives and business models tied to facility utilization by industry, that we share and coordinate acquisitions statewide to maximize unique capability, and that this approach does not need to be limited to the few NNIN sites, which are too far away for our companies to use on a regular basis. Our concept could conceivably "go viral" if other state and federal funding policies encouraged it.

We are very proud, by the way, to have opened our newest facility at the University of Oregon, on February 13. It is a 30,000 square foot underground

facility with just about the best vibration performance in the world, and therefore ideal for the latest SEM, microprobe, XRD, SIMS, FIB and TEM tools. And yes, we are bringing up the first of two FEI Titans! We'd love for our nanoscience user facilities to be part of the national network and database of nanoscience assets, with or without NNIN funding.

The second concept is dedicated funding for commercialization tied to research centers. As far as we know, we are the only state-funded research center with specific technology themes to have its own dedicated gap fund. This has been running for about 15 months, and if we are sure of anything at this point, it is that the response to this incentive from academics and entrepreneurs has exceeded our expectations and changed the culture and conversation around commercialization. The fund is actively advised by the leading venture capital partners actively investing in Oregon – including both large and small funds. The advisors get a well-screened (by ONAMI staff) heads-up look at potential deal flow, and our inventors and entrepreneurs get early time with the best possible investor audience. We ask the advisors one question: "If we fund this project and it meets its technical objectives, can the partner company raise capital within 12-18 months and go on to build a successful business in Oregon?" We get more insightful answers to this question than we could have come up with ourselves, and have always followed the advice. The gap fund has one success metric that the state measures us on: private capital $$ invested in our gap fund companies. This is a very unforgiving metric, and one that is impossible to fudge. Our four nano companies are very early stage and have excellent prospects, and we should have first results on our metric this year. I can assure you that it keeps me and our gap fund manager, Jay Lindquist, intensely focused.

So the suggested concept here is to have some portion of NNI funds – perhaps in association with large multi-year awards – tied to commercialization, perhaps in the form of a gap fund, with a short-term outcome measure of leveraged private capital investment.

As I mentioned at the beginning, we've so far funded 7 gap projects, of which four are nanotechnologies. These are:

1. A bifunctional-ligand nanocoating technology for low-cost drinking water purification in collaboration with Crystal Clear Technologies. CCT is an NSF Phase II SBIR awardee and also $100K California Clean Tech Open winner . They are sampling major corporate partners with breakthrough material that we hope will result in large orders and a very fundable company.
2. Dune Sciences is another outgrowth of our well-recognized green nanotechnology program. They are already supplying – to NIST and other customers - unique TEM analysis grids that are ideal for nanoparticle analysis, which helps to fund strategic development of their unique nanoparticle linking technology. Confidential partnerships addressing large markets are being set up.
3. NanoBits is yet another green nano company, this time from the point of view of highly efficient production of precision nanomaterials in low-cost, flexible microreactors. This is very early-to-market technology, so it is fortunate that there are also some opportunities to improve the efficiency and safety of specialty chemical manufacture for the pharmaceutical industry, among others.
4. Lastly, newly formed startup Inpria is our commercialization partner for breakthrough inorganic solution-processed nanomaterials for printed and transparent electronics. We think this could be big, and that is all the detail we can share at this time.

In summary, I believe that intentional focus – with targeted funds and incentives – on commercialization of National Nanotechnology Initiative research, can and should be a prominent feature of the second five years of the Nanotechnology Research and Development Act. A broader national network of shared user facilities and federally-assisted gap funds that leverage the business and investor communities across the nation – all managed according to the principle "what gets measured gets done" - are my key recommendations for maximizing NNI's social and economic returns.

Thank you again for the opportunity to speak with you today. I am submitting some additional written material that amplifies some of these points, and will also try to be as helpful as I can in answering any questions you may have.

Attachments:

1. Skip Rung biography
2. Additional written testimony regarding re-authorization of PL 108-153

Robert D. "Skip" Rung

President and Executive Director, Oregon Nanoscience and Microtechnologies Institute

Mr. Rung is a senior high technology R&D executive with over 25 years of R&D management experience in CMOS process technology, application-specific integrated circuit (ASIC) design and electronic design automation (EDA), IC packaging, MEMS, microfluidics, and inkjet printing.

Mr. Rung was asked in December 2003 to serve as the initial Executive Director of the Oregon Nanoscience and Microtechnologies Institute (ONAMI), Oregon's first "Signature Research Center" and an unprecedented collaboration among Oregon's research universities and the Pacific Northwest National Laboratory. ONAMI's dual mission is to grow "small tech" research in Oregon and commercialize technology in order to extend the success of Oregon's world-leading "Silicon Forest" technology cluster, which includes the most advanced R&D and manufacturing operations for leading companies such as Intel Corporation, Hewlett-Packard Company, FEI Company, Invitrogen, Electro Scientific Industries, Planar Systems, Xerox Office Products, Tektronix, ON Semiconductor and many dynamic smaller firms. ONAMI has so far received $37M in state investment and approximately doubled Oregon's annual federal and private research awards in the fields of nanoscience, green nanotechnology, nanoscale metrology, and microtechnology-based energy and chemical systems (MECS).

Following his retirement from Hewlett-Packard in 2001, Mr. Rung consulted in the areas of innovation management, technology business development, and intellectual property. He is a co-author of the 2004 Oregon Research Competencies study commissioned by the Oregon Economic and Comnunity Development Department and the author of the initial business plan for the Oregon Nanoscience and Microtechnologies Institute, successfully recommended for funding as Oregon's first Signature Research Center by the Oregon Council on Knowledge and Economic Development. OCKED's determination was aided and influenced by Mr. Rung's 2002 consulting study of Oregon's most commercially promising and industrially relevant research.

Mr. Rung was a member of the Oregon Engineering and Technology Industry Council from 1999-2003 and a co-founder of the New Economy Coalition. He is currently a technical advisor to Northwest Technology Ventures, an Oregon seed-stage venture capital firm, a director of the Oregon Entrepreneur's Forum, Vice-Chair of the Corvallis-Benton County Economic Development Partnership, and active in several other community development efforts.

From 1987 to 2001, Mr. Rung was the director of Research and Development at Hewlett-Packard's Corvallis, Ore. facility, responsible for the development of future generations of HP's world-leading thermal inkjet technology, and for developing future business opportunities enabled by HP's microelectronics, MEMS, and microfluidics competencies. During Mr. Rung's 14 years as R&D director, inkjet printing became HP's largest and most profitable business, maintaining worldwide technical leadership through several

major new generations of technology and holding market share nearly twice that of the next largest competitor. Prior to his work on inkjet, Mr. Rung was the R&D Manager for HP's Northwest Integrated Circuits Division in Corvallis, which achieved worldwide ASIC technology leadership in 1986 with a 1-micron process comparable to those used for DRAM. Mr. Rung's organization also developed novel and performance-leading in-house IC design automation systems and custom IC packaging technologies (hybrids, flat packs, TAB) to enable calculators and other HP products.

Mr. Rung began his industrial career in 1977 at Hewlett-Packard Laboratories in Palo Alto, CA, performing advanced research in the areas of CMOS process device isolation, latch-up, and comparison with alternative silicon and compound semiconductor technologies. In 1981-1982, Mr. Rung was selected by HP to be a technology exchange engineer with Toshiba Corp. in Kawasaki, Japan, where he continued his research inside the world's leading semiconductor memory engineering group. He is the holder of 2 US Patents, author or co-author of over 14 refereed journal or conference papers on IC technology, 4 invited papers (2 at leading international meetings), and 4 invited presentations on inkjet printing technology.

Mr. Rung received his BSEE and MSEE co-terminally in 1976 from Stanford University, where he was elected to both Phi Beta Kappa and Tau Beta Pi in his junior year. His master's thesis concerned the experimental determination of semiconductor doping profiles, and was part of the Stanford research on process simulation that was seminal for the rapid growth of computer simulation for solid state electronic processes and devices.