COVER SHEET FOR GRANT PROPOSALS

State Board of Education

SBOE PROPOSAL NUMBER: (to be assigned by SBOE)	AMOUNT REQUESTED: $1,701,900

TITLE OF PROPOSED PROJECT:

Development of commercially-viable, accelerator-produced materials for medical and semiconductor industry applications

SPECIFIC PROJECT FOCUS: The development of an integrated research and economic development program in partnership with industry in the areas of medical isotope production and irradiation of semiconductor/electronic materials.

PROJECT START DATE: 07/01/2012	PROJECT END DATE: 06/30/2015
NAME OF INSTITUTION: Idaho State University	DEPARTMENT: Idaho Accelerator Center

ADDRESS:

Idaho State University 921 South 8TH Avenue, Stop 8263 Pocatello, ID 83209-8263	E-MAIL ADDRESS: wells@iac.isu.edu	PI PHONE NUMBER: 208-282-3986

	NAME:	TITLE:	SIGNATURE:
PROJECT DIRECTOR	Douglas P Wells	Professor and Director	
CO-PRINCIPAL INVESTIGATOR	Dr. Alan Hunt	Associate Professor and Deputy Director	
CO-PRINCIPAL INVESTIGATOR			
CO-PRINCIPAL INVESTIGATOR			

	NAME:	SIGNATURE:
Authorized Organizational Representative	Dianne Horrocks	

Development of commercially-viable, accelerator-produced materials for medical and semiconductor industry applications

(1) Name of Public Institution: Idaho State University

921 South 8th Street, Stop 8046

Pocatello, Idaho 83209-8046

(2) Principal Investigator: Dr. Douglas P. Wells,

208-282-3986,

wells@iac.isu.edu

(3) Project objective and Total Amount Requested: We have engaged three private sector partners, International Isotopes, Iotron Industries and ON Semiconductor to develop commercial applications of electron linear accelerators. This project has multiple objectives, in medical isotope production and in materials modification for the semiconductor and other industries:

1) Support the creation of proprietary and patentable intellectual property that improves the production and lowers the cost of the medical isotope ^{67}Cu,

2) Complete the equipment portfolio necessary for more efficient production of ^{67}Cu and follow-on medical isotopes in demand,

3) Research proprietary and patentable techniques for producing medical isotopes in demand,

4) Develop the accelerator produced medical isotope market by providing trial samples of isotopes to researchers,

5) Assemble a 20 MeV, 4 kW LINAC with a scanning output beam and characterize this system for use by commercial partners for semiconductor materials modification,

6) Build expertise within the University regarding commercialization of University Intellectual Property and foster a culture of entrepreneurship and innovation with commercialization as a goal. Total Amount Requested: $651,300 (for Year 1, years 2 and 3 are similar.)

(4) Resource Commitments and How the Project Reflects ISU's priorities: ISU's Research priorities are to advance the state of knowledge in medical and related sciences, invent novel intellectual properties (IP), and create economically viable licensing and commercial spin-offs. ISU is one of only a handful of universities operating an accelerator center in the US and has the largest operating number of accelerators of all North American universities. The IAC has developed a strong nucleus of accelerator expertise, successfully operating for more than a decade, while attracting over $7M/year in funding from private industry and government sources. As a result, the IAC is very well positioned to help grow Idaho industry using ISU nuclear expertise and commercializing its IP portfolio. Moreover, these projects directly tie to ISU's nuclear science research and the State of Idaho's Strategic Research plan by focusing on creation of novel materials with primary markets in biosciences and semiconductor manufacturing.

(5) Project Background and Specific Plan of Work: This proposal builds off of the work partially funded by a 2011 HERC grant. That grant funded tests of a commercially viable process for producing the medical isotope ^{67}Cu and the completion of an agreement with a private sector partner for commercialization of that isotope. We have made remarkable progress developing a method for generating the isotope in an accelerator and separating that isotope using two sequential separation processes. We also signed a development agreement with a private sector partner, International Isotopes, Inc. of Idaho Falls. Our private sector partner is making available significant capital including a $500K hot cell, at $300K analytical tool as well as expertise and know-how in best practices for manufacturing materials. In addition, our

partner will become the nationwide distributor of the produced ^{67}Cu. Our work has been laboratory scale and commercial production of ^{67}Cu requires additional investment for technology transfer. We intend to pursue funding through IGEMs Technology Transfer Budget (not this proposal) with our private sector partner to support full commercialization efforts of ^{67}Cu. However, we are convinced that further research will increase ISU's intellectual property portfolio in isotope production leading to additional license revenues in the future.

In addition to our medical isotope work, we have been contacted by two private sector companies (Iotron, Vancouver B.C. and ON Semiconductor, Pocatello, ID) requesting access to a 20 MeV scanned LINAC beam for development and use in production processes. Linear accelerators are used for creation of novel materials in the semiconductor and medical industries. The material modifications are created by the changes in material structure, such as lattice changes, from the impacting electrons. In the US, commercial facilities with linear accelerators have been used for some of the novel material work. However, commercial facilities are limited in energy to approximately 10 MeV by the FDA because the primary work of those facilities is food irradiation. Because of this energy limitation, higher energies, which may have significant advantages for material modification, are not routinely explored. The IAC has most of the equipment necessary to construct and commission a demonstration unit for development of processes with these commercial partners. We propose to use a small portion of this grant to acquire and install the additional equipment, test and partner with companies interested in this capability.

(6) Potential Economic Impact: This proposal will provide a portion of the support necessary to generate IAC intellectual property and technology for license and transfer to companies to support an Idaho based industry in isotope production and accelerator modified materials. As

well, this proposal supports development of equipment that can be contracted to private companies, supporting their growth and a revenue stream to the University.

(6.1) Manufacturing of medical isotopes: Our target isotopes of ^{67}Cu as well as ^{225}Ac, ^{149}Pm, ^{111}In, and ^{177}Lu will be used in cancer therapy. Therapy drugs are known to take some time for FDA approval and accelerators are a capital intensive investment. Therefore, we have built our isotope business model around a partnership with a private company and production using capital infrastructure at the IAC. This allows the isotope market to develop with low initial capital investment by the private company, yet provides a healthy contract and license revenue stream to the IAC with sufficient revenues to the private company to support future growth. In addition, the business model we envision will provide continued opportunities to train and utilize ISU students and assets. In support of this business model, we have successfully negotiated a Development Agreement and partnership with an Idaho based company, International Isotopes, Inc. “INIS”. INIS has invested approximately $1M in capital infrastructure at their site to be made available for isotope development. In addition, they are contributing know-how to support best practice manufacturing, distribution of isotopes and further development of isotope production. Investment in Isotope research will provide significant long term cash flow to ISU through both licensing of the intellectual property and contract fees for use of IAC facilities. A quick snapshot of one component of the isotope market, 67Cu, will help explain the potential. ^{67}Cu has been shown in clinical studies as a very effective radioisotope for treatment of Non-Hodgkins Lymphoma (NHL), ovarian cancer, colorectal cancer and bladder cancer. We believe that if reliable supplies of ^{67}Cu are made available to researchers, several new therapies will be released within a few years. An analog to ^{67}Cu is the radioimmunotherapy (RIT) drug Zevalin which is used to treat some cases of NHL. Zevalin is a drug that combines an antibody called ibritumomab with a chelator (the chemical which helps bind the radio-isotope) called tiuxetan.

To treat a patient with Zevalin, the patient receives a dose of drug for imaging using a radio-isotope (^{111}In) combined with the mAb and a treatment dose of the drug combined with ^{90}Y. Zevalin is one of the most expensive drugs on the market with a typical treatment reimbursed by Medicare at approximately $30,000. The pharmaceutical company providing Zevalin to the market reported revenues of $15M on Zevalin in 2009 and $26M on Zevalin in 2010 which we believe equates to approximately <1000 treatments annually of the roughly 65,000 case of NHL in the US per year. We believe that ^{67}Cu based drugs will provide improved procedures for treatment of NHL and other cancers because it combines both therapy and imaging at the same time giving the potential for thousands of ^{67}Cu doses per year.

As with most therapy drugs, the initial market is small, tens to hundreds of doses per year, essentially research quantities until trials are completed. The commercial partner and the IAC will produce ^{67}Cu for researchers at a few hundred doses per year. We anticipate that the material produced will be reimbursed by the NIH and researchers at an attractive rate ($3K-$5K/dose estimated based on reimbursement for ^{90}Y during development of Zevalin). Based on our modeling, we believe that ^{67}Cu has potential as a good revenue product for an Idaho radioisotope company and a potential total market (assuming 10,000 treatments/year) of greater than $30M dollars. Among the potential customers for the isotope are large pharmaceutical companies such as Nordion, Covidien, Lantheus, and GE as well as the current licensor of Zevalin, Spectrum Pharmaceutical. We anticipate sample deliveries to medical complexes conducting research and clinical trials such as City of Hope Research Institute, CA, and Fred Hutchinson Cancer Research Center, WA.

(6.2) Accelerator Modified Materials: Our business model for accelerator modified materials is based on providing a capability to our private sector partners for R&D and future contracting for manufacturing services. Two companies have approached us with requests to either develop the

process for or contract to irradiate materials to change their properties. This proposal, at modest cost, allows us to service their requests as well as increase our expertise and intellectual property into this market. We also believe that work in accelerator modified materials can lead to ISU intellectual property.

We believe that Idaho is the ideal location for commercialization of ^{67}Cu production and accelerator modified materials because of the expertise and accelerator capital infrastructure residing at the IAC, the proximity of INL, numerous businesses and professionals in Southeast Idaho with backgrounds in novel nuclear materials. We expect technology developed at the IAC will create a nucleus for both an isotope production and a material modification industry in Idaho and that business ramp-up will continue at the IAC site or in a nearby location.

An accelerator center for commercialization of accelerator produced radio-isotopes and modified materials will create significant future employment and capital investment in Idaho. The commercialization of developed IP will support approximately 5 full and part-time employees in a Pocatello at start-up, with the potential to grow significantly to over 20 highly skilled employees over the next 3-5 years. The following table presents our view of the potential jobs that will be supported by commercialization of only ^{67}Cu:

Job Type	Salary range	Required at initial commercialization	Required 3-6 years after commercialization
Engineers	70-100K	2	10
Scientists	60-100K	1	6
Operations	40-70K	1	16
Management	80-140K	1	4
Annual Payroll		~$400-$500K	~$2M-$3M

Our estimates are based only on the jobs created by the isotope production company and are based on the skills required to produce initial doses of isotope followed by a ramp to 5000 doses/year (less than 5% of the total available market). Production of isotopes will require additional infrastructure such as hot cells and screen rooms. Idaho companies, such as Premier Technologies, are providers of this infrastructure and we anticipate there is potential for multiplied economic impact. As an example, our private sector partner's investment of $1M in infrastructure to be used for this project was primarily spent with Idaho companies.

Accelerator modified materials represents a potentially new business area for Idaho. We believe that companies like ON Semiconductor will utilize these technologies and with R&D and production opportunities in Idaho, their business will likely grow here. We know from discussions with Iotron, that no 20 MeV facility is available in North America for commercially modifying materials and therefore customers are currently going overseas for production.

Investment in isotope research will provide significant long term cash flow to ISU through both licensing of the intellectual property and contract fees for use of IAC facilities. Our model for cash flow to ISU is the MURR center at University of Missouri, which generates over $10M/year through licensing and contracts with their isotope program. Conservatively, these programs should generate several hundred thousand dollars per year to ISU through license royalties and contract fees. Letters of collaborative support from INIS, ON Semiconductor and Iotron Industries are attached.

(7) Criteria for Measuring Success: Our goal is to invest in R&D in applications with demonstrated markets where our expertise can create novel and valuable solutions.. Both medical isotopes and modified materials are such markets. Our measurement criteria for outcome success are the classic success metrics of any business success-oriented research project:

a) Have we established a commercially viable method of producing an isotope or modifying a material that is of economic potential and/or heretofore unavailable?

b) Have we created a technology or method that allows the creation of an isotope or a novel material at a significant improvement in cost (either in direct material expense or capital requirements i.e. “fixed” costs)?

c) Are either a. or b. above proprietary, protectable and licensable to others with the objective of generating a positive return?

d) Have we trained a work force capable of advancing this industry and advancing our technology?

These criteria will be applied to each of the project plan areas discussed in the Project Plan above. In addition to measuring outcomes, we intend to measure our execution success of the Plan by measuring our performance to budget and our timeline for each phase of the project with the goal of improving efficiency in achieving our targeted outcomes.

(8) Budget Summary: The requested funding is $670,700 in year 1, and $515,600 in years 2 and 3. Year 1 requires some modest capital investment to enable the commercial successes in years 2 and 2. The total budget over three years is $1,701,900. The Year 1 Budget is:

SUMMARY PROPOSAL BUDGET – Year 1

Name of Institution:

Name of Project Director:

A. FACULTY AND STAFF

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
Dr. Douglas P. Wells	68.88/hr	2.3			27,600
Dr. Alan Hunt	67.44/hr	.57			6,700
Dr. Frank Harmon	81.00/hr	.72			10,100
Dr. Valeriia Starvoitova	25.00/hr	6			26,300
Dr. Lisa Goss	40.74/hr			1.44	10,200
% OF TOTAL BUDGET: 12				SUBTOTAL:	80,900

B. VISITING PROFESSORS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
% OF TOTAL BUDGET:				SUBTOTAL:	

C. POST DOCTORAL ASSOCIATES / OTHER PROFESSIONALS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
K.Folkman	$37.66/hr	4.5/mo			29,300
C.O'Neill	$36.53/hr	4.5/mo			28,500
M. Balzer	$29.18/hr	3.5/mo			17,700
Accelerator Technician	$19.00/hr	4/mo			13,200
Grants/Contracts Specialist	$18.18/hr	3.5/mo			9,500
Admin. Assistant	$11.81/hr	3.5/mo			6,100
% OF TOTAL BUDGET: 16				SUBTOTAL:	104,300

D. GRADUATE / UNDERGRADUATE STUDENTS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
Graduate Assistants (1) ($25K)					25,000
part-time undergrads					10,000
% OF TOTAL BUDGET: 7				SUBTOTAL:	35,000

E. FRINGE BENEFITS

Rate of Pay (%)	Salary Base	Dollar Amount Requested
12 month and AY employees and faculty (21%)	$ 175,100	36,700
Health Insurance for Faculty/Staff		23,700
Part Time Employees (8.9%)	$ 45,100	4,000
	SUBTOTAL:	64,400

F. EQUIPMENT: (List each item with a cost in excess of $1000.00.)

Item/Description	Dollar Amount Requested
Modulator/Klystron system to increase output power of isotope creation accelerator by 20%. This system includes power supplies, monitors and controllers (used equipment)	108,600
End Station - for holding targets during activation and delivery post activation. Includes titanium assembly, cooling jackets, ceramic assemblies, machining of assemblies, automation for remote target delivery, shielding around target and remote safety monitoring	22,400
Furnace - vacuum furnace with automation for research into improved technology for isotope separations	9,300
Chromatography separation system including ; chemical columns with automated chemical mixing and delivery for operation in a hot cell environment	4,800
Scan system power supply, computer interface, sweeping magnet supply, actuator controller	10,000
SUBTOTAL:	155,100

G. TRAVEL:

Dates of Travel (from/to)	No. of Persons	Total Days	Transportation	Lodging	Per Diem	Dollar Amount Requested
July, City of Hope Fred Hutchinson Cancer Institutes	2	3	$475/person	$225/person	$150/person	$7,500
					SUBTOTAL:	7,500

H. Participant Support Costs:

	Dollar Amount Requested
1. Stipends	
2. Travel (other than listed in section G)	
3. Subsistence	
4. Other	

SUBTOTAL:	

I. Other Direct Costs:	Dollar Amount Requested
1. Materials and Supplies and Raw target materials - isotopically pure precursers for activation experiments, 80 grams priced at $600/gram, operation supplies	58,300
2. Publication Costs/Page Charges	
3. Consultant Services (Include Travel Expenses)	56,500
4. Computer Services	
5. Subcontracts	
6. Tuition for Grad Student + 1 summer credit	8,800
7. Other (specify nature & breakdown if over $1000) Accelerator Beam Time @ $500/hour - 200 hours	100,000
SUBTOTAL:	223,600

J. Total Costs: (Add subtotals, sections A through I) TOTAL:	670,700

K. Amount Requested: TOTAL:	

Project Director's Signature:	Date:

SUMMARY PROPOSAL BUDGET – Year 2

Name of Institution:

Name of Project Director:

A. FACULTY AND STAFF

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
Dr. Douglas P. Wells	68.88/hr	2.3			27,600
Dr. Alan Hunt	67.44/hr	.57			6,700
Dr. Frank Harmon	81.00/hr	.72			10,100
Dr. Valeriia Starvoitova	25.00/hr	6			26,300
Dr. Lisa Goss	40.74/hr			1.44	10,200
% OF TOTAL BUDGET: 12				SUBTOTAL:	80,900

B. VISITING PROFESSORS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
% OF TOTAL BUDGET:				SUBTOTAL:	

C. POST DOCTORAL ASSOCIATES / OTHER PROFESSIONALS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
K.Folkman	$37.66/hr	4.5/mo			29,300
C.O'Neill	$36.53/hr	4.5/mo			28,500
M. Balzer	$29.18/hr	3.5/mo			17,700
Accelerator Technician	$19.00/hr	4/mo			13,200
Grants/Contracts Specialist	$18.18/hr	3.5/mo			9,500
Admin. Assistant	$11.81/hr	3.5/mo			6,100
% OF TOTAL BUDGET: 16				SUBTOTAL:	104,300

D. GRADUATE / UNDERGRADUATE STUDENTS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
Graduate Assistants (1) ($25K)					25,000
part-time undergrads					10,000
% OF TOTAL BUDGET: 7				SUBTOTAL:	35,000

E. FRINGE BENEFITS

Rate of Pay (%)	Salary Base	Dollar Amount Requested
12 month and AY employees and faculty (21%)	$ 175,100	36,700
Health Insurance for Faculty/Staff		23,700
Part Time Employees (8.9%)	$ 45,100	4,000
	SUBTOTAL:	64,400

F. EQUIPMENT: (List each item with a cost in excess of $1000.00.)

Item/Description	Dollar Amount Requested
SUBTOTAL:	

G. TRAVEL:

Dates of Travel (from/to)	No. of Persons	Total Days	Transportation	Lodging	Per Diem	Dollar Amount Requested
July, City of Hope Fred Hutchinson Cancer Institutes	2	3	$475/person	$225/person	$150/person	$7,500
			SUBTOTAL:			7,500

H. Participant Support Costs:

	Dollar Amount Requested
1. Stipends	
2. Travel (other than listed in section G)	
3. Subsistence	
4. Other	
SUBTOTAL:	

I. Other Direct Costs:	Dollar Amount Requested
1. Materials and Supplies and Raw target materials - isotopically pure precursers for activation experiments, 80 grams priced at $600/gram, operation supplies	58,300
2. Publication Costs/Page Charges	
3. Consultant Services (Include Travel Expenses)	56,500
4. Computer Services	
5. Subcontracts	
6. Tuition for Grad Student + 1 summer credit	8,800
7. Other (specify nature & breakdown if over $1000) Accelerator Beam Time @ $500/hour - 200 hours	100,000
SUBTOTAL:	223,600
J. Total Costs: (Add subtotals, sections A through I) TOTAL:	515,600
K. Amount Requested: TOTAL:	

Project Director's Signature:	Date:

SUMMARY PROPOSAL BUDGET – Year 3

Name of Institution:

Name of Project Director:

A. FACULTY AND STAFF

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
Dr. Douglas P. Wells	68.88/hr	2.3			27,600
Dr. Alan Hunt	67.44/hr	.57			6,700
Dr. Frank Harmon	81.00/hr	.72			10,100
Dr. Valeriia Starvoitova	25.00/hr	6			26,300
Dr. Lisa Goss	40.74/hr			1.44	10,200
% OF TOTAL BUDGET: 12				SUBTOTAL:	80,900

B. VISITING PROFESSORS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
% OF TOTAL BUDGET:				SUBTOTAL:	

C. POST DOCTORAL ASSOCIATES / OTHER PROFESSIONALS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
K.Folkman	$37.66/hr	4.5/mo			29,300
C.O'Neill	$36.53/hr	4.5/mo			28,500
M. Balzer	$29.18/hr	3.5/mo			17,700
Accelerator Technician	$19.00/hr	4/mo			13,200
Grants/Contracts Specialist	$18.18/hr	3.5/mo			9,500
Admin. Assistant	$11.81/hr	3.5/mo			6,100
% OF TOTAL BUDGET: 16				SUBTOTAL:	104,300

D. GRADUATE / UNDERGRADUATE STUDENTS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
Graduate Assistants (1) ($25K)					25,000
part-time undergrads					10,000
% OF TOTAL BUDGET: 7				SUBTOTAL:	35,000

E. FRINGE BENEFITS

Rate of Pay (%)	Salary Base	Dollar Amount Requested
12 month and AY employees and faculty (21%)	$ 175,100	36,700
Health Insurance for Faculty/Staff		23,700
Part Time Employees (8.9%)	$ 45,100	4,000
	SUBTOTAL:	64,400

F. EQUIPMENT: (List each item with a cost in excess of $1000.00.)

Item/Description	Dollar Amount Requested
SUBTOTAL:	

G. TRAVEL:

Dates of Travel (from/to)	No. of Persons	Total Days	Transportation	Lodging	Per Diem	Dollar Amount Requested
July, City of Hope Fred Hutchinson Cancer Institutes	2	3	$475/person	$225/person	$150/person	$7,500
			SUBTOTAL:			7,500

H. Participant Support Costs:

	Dollar Amount Requested
1. Stipends	
2. Travel (other than listed in section G)	
3. Subsistence	
4. Other	
SUBTOTAL:	

I. Other Direct Costs:	Dollar Amount Requested
1. Materials and Supplies and Raw target materials - isotopically pure precursers for activation experiments, 80 grams priced at $600/gram, operation supplies	58,300
2. Publication Costs/Page Charges	
3. Consultant Services (Include Travel Expenses)	56,500
4. Computer Services	
5. Subcontracts	
6. Tuition for Grad Student + 1 summer credit	8,800
7. Other (specify nature & breakdown if over $1000) Accelerator Beam Time @ $500/hour - 200 hours	100,000
SUBTOTAL:	223,600
J. Total Costs: (Add subtotals, sections A through I) TOTAL:	515,600
K. Amount Requested: TOTAL:	
Project Director's Signature:	Date:

(9) Budget Justification: The PI and other scientists on this proposal direct all scientific investigations. They are charging at standard ISU rates. Engineering support will complete, test and upgrade the production accelerator as well as operate equipment for all activation experiments. Consultants for a Business and Materials Scientist and Radiochemistry will direct the separations and radiochemistry of the project, the furnace separation techniques and provide overall business management, including managing the business interface with investors, the private sector partner and the customers. Graduate students will aid in all investigations. The part-time assistants will manage procurement, acquisition of materials and assist in information

management. This budget will cover travel to customer sites and conferences to promote developed products and IP. The accelerator upgrades budget includes additional equipment to increase the capability of the key production system by 20%. This enables higher efficiency of the system for research and production of samples. Funds for an End Station includes the materials and machining of the target to allow creation of new isotopes and increase production efficiency. The Furnace costs includes the upgraded vacuum furnace with automation for research into separation methods. Chromatography equipment includes equipment to automate and investigate chromatographic separation techniques. Beam Time costs are the operation cost of the production accelerator times the estimated hours to run experiments and testing. Lastly, Raw Target Materials costs are the costs of pure isotopic samples of target materials needed as precursors for isotope generation.

(10) Additional Support: ISU and the IAC are contributing the use of a newly commissioned linear accelerator and a recently completed chemical laboratory. The equipment to upgrade the accelerator is significantly reduced in cost (by 50%) by using major components from the IAC's accumulated used equipment. Our private sector partner is donating the use of over $1M in capital equipment including a hot cell, analysis using their production ICP-MS analytical equipment, specialty isotope transportation fixtures, and support from their Analytical chemist, Radiation Safety Engineer and hot cell technicians. Private Sector Partners are International Isotopes, Incorporated, ON Semiconductor Corporation and IOTRON Industries, Incorporated. Our partners will provide in-kind contributions as described in their support letters (Append. C)

INSTITUTIONAL AND OTHER SECTOR SUPPORT

(add additional pages as necessary)

A. INSTITUTIONAL / OTHER SECTOR DOLLARS

Source / Description	Amount

B. FACULTY / STAFF POSITIONS

Description

Dr. Doug Wells, the PI, will provide overall project direction. He will also lead the effort in the medical isotope production part of this project, which he has led since the IAC began to work in this area.

Dr. Alan Hunt will lead the effort in materials/semiconductor irradiation, which has led at the IAC since we began to pursue this avenue of research.

C. CAPITAL EQUIPMENT

Description

See Appendix A's detailed description of equipment.

D. FACILITIES & INSTRUMENTATION

Description

See Appendix A's detailed description of facilities and instrumentation.

Appendix A – Facilities and Equipment Resources

Introduction

The Idaho Accelerator Center (IAC) was created by the Idaho State Board of Education in 1994; the IAC is charged with undergraduate and graduate education, conducting applied physics research, creating new applications of accelerator physics and supporting the economic development of Idaho. The IAC has 10 operating accelerators in 5 research facilities with over 30,000 sq. ft. of laboratory space; we believe this is the most operating accelerators of any university in North America. This includes the IAC facility at the Pocatello airport, which has a 20,000 sq. ft. high-bay space for large scale systems testing and 15 acres of open area for field testing. The operation personnel at these facilities consists of 12 scientists (many of whom are PIs, Co-PIs or senior personnel on this project), 10 engineers and 3 administrative assistants.

Main IAC "Campus"-Accelerator Laboratory #1:

Figure 1: Layout of the main IAC campus.

The main IAC campus, which is shown is shown in Figure 1, was constructed in 1999 and initially consisted of office space and Accelerator Laboratory #1. This accelerator lab was built into the hills that surround Pocatello Idaho and the 2,010 sq. ft. hall is 20 feet underground providing ample radiation shielding. This accelerator hall houses a 44 MeV Short Pulsed LINAC and a 25 MeV LINAC. In addition, this accelerator hall has a well shielded experimental cell that is separated by a six foot wall from the accelerator hall. This wall has four penetrations allowing collimated bremsstrahlung beams to be delivered to a "low" radiation environment, which is critical for precise photonuclear measurements.

The 44 MeV Short Pulsed LINAC is an L-band traveling wave radio frequency accelerator operating at ~1.3 GHz. It is capable of delivering electron pulses with operator selectable widths between 50 ps to 4 μs at a repetition rate up to 120 Hz. The maximum charge per pulse ranges from 5 nC for 50 ps pulses to 2 μC for 4 μs pulses. The electron energy can be varied from ~4 to 44 MeV with an energy resolution of 0.5% to 4%, which can be controlled by a set of retractable slits. This accelerator excels when short bremsstrahlung pulses are required for photonuclear experiments where timing is critical such as neutron time of flight spectrometry. More importantly for this project, this accelerator has been upgraded to 5 kW average beam power, which makes it ideal for support research in medical isotope production.

The 25 MeV LINAC in Accelerator Laboratory #1, is an S-band standing wave radio frequency accelerator operating at ~2.8 GHz. It is capable of delivering electron pulses with operator selectable widths between 0.5 μs to 4 μs at a repetition rate up to 600 Hz. The maximum charge per pulse ranges from 40 nC for 0.5 μs pulses to 350 nC for 4 μs pulses. The electron energy can be varied from ~5 to 25 MeV with an energy resolution of 5%, which can be

reduced using collimators or slits. This accelerator has a broad parameter space, is easy to operate and when short pulses are not required this is often the accelerator of choice.

Main IAC "Campus"-Accelerator Laboratory #2

Accelerator Laboratory #2 is shown in Figure 1 and is approximately 1000 sq. ft. accelerator hall, which is primarily used for initial construction and testing of accelerator systems and components. This accelerator hall is built into the hill and is approximately 10 feet underground for radiation shielding. It just underwent a major upgrade for high-power accelerator operations in support of isotope production. The IAC installed and commissioned a 10 kW, 50 MeV electron accelerator in this hall to specifically support isotope research and production.

Main IAC "Campus"-ISIS Laboratory

The ISIS Laboratory is shown in Figure 1 and is a 7,659 sq. ft. high-bay accelerator laboratory, which houses the Idaho State Induction Accelerator System (ISIS). The ISIS accelerator system, is a pulsed-power accelerator that provides an extraordinary high power accelerator capability at the IAC. It consists of a ~3 MeV injection accelerator that generates an electron beam for a ten cell induction accelerator. Due to the spiral lines, the electrons make two passes through each induction cell. At full power ISIS can deliver a 35 ns, 9.5 MeV electron pulse with 10 kA of current for ~0.1 TW of peak power. Due to the capacitor charging times, ISIS can fire about once every two minutes. This accelerator has been used for radiation effects research in electronic and biological systems. At a beam energy of 9.5 MeV, ISIS can be used for initial research into fissionable material detection using a single bremsstrahlung pulse.

Physical Building-HRRL Laboratory

The HRRL Laboratory is located in the basement of the physical sciences building and is a 400 sq. ft. accelerator hall with an adjoining 700 sq. ft. well shielded experimental cell. This laboratory houses the High-Repetition Rate LINAC (HRRL). The HRRL is a 20 MeV S-band standing wave radio frequency accelerator operating at ~2.8 GHz. It is capable of delivering electron pulses with a width 70 ns at a repetition rate up to 1,200 Hz. The maximum charge per pulse is 8.4 nC. The electron energy can be varied from ~12 to 20 MeV with an energy resolution of 8%. Due to its high-repetition rate this accelerator will be utilized for prompt γ-ray signatures from fissionable materials.

IAC lab at the Pocatello Airport

The IAC is located near the Pocatello Regional Airport and has a 20,000 sq. ft. high-bay space for large scale systems testing and 15 acres of open area for field testing. Currently at the IAC, is a 25 MeV accelerator similar to the ones located at the IAC Main "Campus", which is being used for investigating the detection of fissionable materials at large distances. In addition, there is a 10 MeV LINAC, which is part of the cargo container scanning test bed. This 10 MeV LINAC is an S-band standing wave radio frequency accelerator operating at ~2.8 GHz. It is capable of delivering electron pulses with operator selectable widths between 1 μs to 4 μs at a repetition rate up to120 Hz. The maximum charge per pulse ranges from 100 nC for 1 μs pulses to 400 nC for 4 μs pulses. The electron energy can be varied from ~8 to 10 MeV with an energy resolution of 10%. A full size 40 ft. cargo container can be pulled past the 10 MeV accelerator in as little as 20 sec. This system includes ample room for placing detectors and associated hardware for realistic scanning tests. This system is also an excellent test bed for investigating radiation safety issues associated with cargo scanning systems. Furthermore, a variety of

shielding pallets are available for investigating the effects of various fissionable material shielding scenarios.

Detectors and Data Acquisition

Detector and data acquisition equipment to support research is abundant. The IAC currently possesses over five HPGe detectors that can be utilize for prompt and delayed γ-ray signature research. There are a large number of various photomultiplier tubes with a large array of different scintillators ranging from fast plastics to NaI. For neutron detection, the IAC has over 12 ^{3}He detectors currently configured for fast neutron detection by using neutron absorbers and moderators. These detectors work exceptionally well for delayed neutron detection. Furthermore there are BF_3 and fission chambers for neutron detection. The data from these detectors can be acquired, by three different multiparameter data acquisition systems that can handle up to 16 channels of data each. There is also two VME systems that are very flexible and modules for these systems, include a 16 channel multihit time to digital converter, 16 charge to digital converters, a 16 channel pulse height analog to digital converter and 16 channel scalars. Finally, the IAC has over 100 nuclear instrument modules that can be employed for various pulse shaping functions and logic control.

New detector and data acquisition development such as the GEMS and LPMWPC will take place in the Detector Science Laboratory, which is a 1,100 sq. ft. lab specifically for the construction and testing of new detectors. This lab includes a dark room for photomultiplier work, chemical hoods for potential hazardous vent gasses and optical tables for precision wire placement. One of the two VME data acquisition system in normally located in the DSL for development work.

Radiation Transport Simulation Capabilities

The Department of Physics and the IAC maintain a Beowulf cluster in the Physical Sciences Building, which is the most powerful computation engine on the Idaho State University. The cluster consists of a 12-node dual-core processor AMD Opteron 246 with 1MB Cache and 9-node double dual-core processor AMD Opteron 246 with 1MB Cache for a total of 60 processors. Each unit has 2 GB DDR 400 MHz ECC/Registered Memory. In addition 1.75 TByte of RAID5 storage, a PCI Workstation, a Pioneer DVR-S606 External Firewire and a 24-port 10/100/1000 switch are also available. The cluster has the standard compilers (C, C++, Fortran etc…) and has Monte Carlo programs MCNPX and GEANT installed. Extensive and complex data analysis can be performed using the data analysis program ROOT.

Engineering and Technical Support at the IAC

As stated in the introduction, the IAC has 10 personnel on its engineering and technical staff. This includes 3 accelerator engineers, 3 pulsed-power engineers and an electronics engineer. These engineers are responsible for construction of the various accelerator systems, accelerator operations and care of the overall facilities. In addition, the IAC has an instrumentation physicist and a radiation engineer. The former's responsibilities include care and setup of the various detectors and data acquisition systems. The latter's responsibility is all aspects of safety with an emphasis on radiation safety. Support facilities heavily used by the technical staff include, the IAC machine shop, the IAC electronics shop and the IAC radiation dosimetry laboratory.

Summary - IAC has many accelerators among 3 Labs:

Electrons:

- A 1.2 MeV DC Accelerator
- A 4 MeV LINAC
- A ~ 10 MeV Pulsed-power Induction Accelerator (~10 kA)
- A 18 MeV High-Repetition (1kHz) LINAC
- (4) 25 MeV LINAC
- 44 MeV Short-Pulse (10 ps) 5 kW LINAC

Gammas from bremsstrahlung plus X-Rays from above electron Linacs plus:

- X-Ray Tubes: ~450 keV
- Monoenergetic LCS: Energy ~ 5-100 keV
- 137Cs Sheppard Source: 13 Ci

Positive Ions:

- 2 MeV Van de Graff

Neutrons:

- LINAC (gamma, n) sources, variety of radioactive sources

General Infrastructure includes three major laboratories, ~35,000 sq. feet of lab space, a well-equipped machine shop and an electronics shop. ISU also has chemistry labs ('hot' and 'cold') to support the radiochemical separations.

Appendix B: Biographical Sketches

Curriculum Vitae

Douglas P. Wells, Ph.D. wells@physics.isu.edu
Idaho Accelerator Center (208) 282-3986
Idaho State University (208) 282-5878 (fax)
Pocatello, ID, 83209-8236

Professional Preparation

Rutgers University	Physics,	B.S. 1982
University of Virginia	Mathematics,	M.S. 1984
University of Illinois	Physics,	M.S. 1985
University of Illinois	Physics,	Ph.D. 1990

Appointments

2006-present	Director, Idaho Accelerator Center at Idaho State University
2003-2006	Chair of the Department of Physics at Idaho State University
2003-present	Associate Professor of Physics at Idaho State University
1997-2003	Assistant Professor of Physics at Idaho State University
1996-1997	Associate Professor of Health Physics at Idaho State University
1993-1996	Radiation Health Physicist for Washington State Department of Health

Selected Recent Publications (over 100 peer-reviewed publications in all)

D.P. Wells and C.R. Segebade, *An Overview of Activation Analysis Techniques and Applications*, Proceedings of 21st International Conference on the Application of Accelerators in Research & Industry, AIP press, Vol. 1336, pg. 452, (2011).

Z.J. Sun, D.P. Wells, C. Segebade and J.R. Green, *Standardizing Activation Analysis: New Software for Photon Activation Analysis*, Proceedings of 21st International Conference on the Application of Accelerators in Research & Industry, AIP press, Vol. 1336, pg. 473, (2011).

J.R. Green, Z.J. Sun, D.P. Wells and H. Maschner, *Using Photon Activation Analysis to Determine Concentrations of Unknown Components in Reference Materials*, Proceedings of 21st International Conference on the Application of Accelerators in Research & Industry, AIP press, Vol. 1336, pg. 497, (2011).

V. Starovoitova, D. Foote, J. Harris, V. Makarashvili, C.R. Segebade, V. Sinha and D.P. Wells, *Cu-67 Photo-nuclear production*, Proceedings of 21st International Conference on the Application of Accelerators in Research & Industry, AIP press, Vol. 1336, pg. 502, (2011).

S. F. Naeem, D.P. Wells, T. White and T. Roney, *Activation Analysis for Transuranic (TRU) Waste Assay and Imaging*, Nuclear Instruments & Methods in Physics Research A (in press).

Mestari, M.A., D. P. Wells, L.C .DeVeaux, and S. F. Naeem, *Real-Time Dosimetry System for Radiobiology Experiments Using a 25 MeV LINAC*, Proceedings of 20th International Conference on the Application of Accelerators in Research & Industry, AIP press, Vol. 1099, pgs. 3-6, (2009).

J. Green, D. P. Wells, B. Benson, Z. J. Sun, and H. D. G. Maschner, *A Priori Method of Using Photon Activation Analysis to Determine Unknown Trace Element Concentrations in NIST standards,* Proceedings of 20th International Conference on the Application of Accelerators in Research & Industry, AIP press, Vol. 1099, pgs. 919-924 (2009).

G. Kharashvili, V. Makarashvili, M. Mitchell, W. Beezhold, R. Spaulding, D. P. Wells, T. F. Gesell, W. Wingert, *Development and Testing of Gallium Arsenide Photoconductive Detectors for Ultra Fast, High Dose Rate Pulsed Electron and Bremsstrahlung Radiation Measurements,* Proceedings of 20th International Conference on the Application of Accelerators in Research & Industry, AIP press, Vol. 1099, pgs. 55-58 (2009).

L. Tchelidze, D. P. Wells and S. A. Maloy, *Positron Annihilation Energy and Lifetime Spectroscopy Studies for Radiation Defects in Stainless Steel*, Proceedings of 20th International Conference on the Application of Accelerators in Research & Industry, AIP press, Vol. 1099, pgs. 985-988 (2009).

V. Makarashvili and D. P. Wells, *MCNPX simulations for positron production mechanisms to generate defect density images using positron annihilation energy spectroscopy*, Proceedings of the Eighth International Topical Meeting on Nuclear Applications and Utilization of Accelerators (American Nuclear Society), p. 973, 2008.

H. Maschner, B. Benson, J, Green and D.P. Wells, *Photon Activation for Archaeological Analysis at Idaho State University*, Proceedings of the Eighth International Topical Meeting on Nuclear Applications and Utilization of Accelerators (American Nuclear Society), p. 307, 2008.

Mestari, M.A., D. P. Wells, L.C .DeVeaux, and S. F. Naeem. 2008. Real-Time Dosimetry System for Radiobiology Experiments Using a 25 MeV LINAC, CAARI 2008: 20th International Conference on the Application of Accelerators in Research and Industry Conference Proceedings, 3-6.

S. Naeem, K. Chouffani and D.P. Wells: "X-ray Fluorescence (XRF) Analysis using Laser Compton Scattered (LCS) X-rays", Proceedings of 20th International Conference on the Application of Accelerators in Research & Industry AIP press, Vol. 1099, pg. 843-846, (2009).

V. Makarashvili, D.P. Wells, A.K. Roy, *Doppler broadening analysis of steel specimens using accelerator based in situ pair production*, Proceedings of 20th International Conference on the Application of Accelerators in Research & Industry, AIP press, Vol. 1099, pgs. 900-903 (2009).

Current and Pending Support:

Project/Proposal Title: Fuels Cycle Research and Development Activities in Support of INL
Source of Support: Battelle Energy Alliance LLC
Project Location: Idaho Accelerator Center, Pocatello, ID
Total award amount: $500,000
Start date (mm/dd/yy): 05/13/2011
End date (mm/dd/yy): 09/30/2011
Support type (**Current**/pending/submission planned in near future/transfer):
Person months per year committed to project (note **calendar**, academic or summer): 1.5

Project/Proposal Title: Fuels Cycle Research and Development Activities in Support of INL (extension)
Source of Support: Battelle Energy Alliance LLC
Project Location: Idaho Accelerator Center, Pocatello, ID
Total award amount: $400,000
Start date (mm/dd/yy): 05/13/2011
End date (mm/dd/yy): 09/30/2012
Support type (Current/**pending**/submission planned in near future/transfer): awarded, funds not here yet.
Person months per year committed to project (note **calendar**, academic or summer): 1.5

Project/Proposal Title: Non-Destructive Testing (NDT) Technology, Development, Testing & Commercialization
Source of Support: Dept. of Defense (DoD)
Project Location: Idaho Accelerator Center, Pocatello, ID
Total award amount: $1,116,923
Start date (mm/dd/yy): 8/1/2011
End date (mm/dd/yy): 12/31/2012
Support type (Current/**pending**/submission planned in near future/transfer): awarded, funds not here yet.
Person months per year committed to project (note **calendar**, academic or summer): 2

Project/Proposal Title: DRCT High Energy
Source of Support: Battelle Energy Alliance LLC
Project Location: Idaho Accelerator Center, Pocatello, ID
Total award amount: $ 26,117
Start date (mm/dd/yy): 7/15/11
End date (mm/dd/yy): 9/30/2011
Support type (**Current**/pending/submission planned in near future/transfer):
Person months per year committed to project (note **calendar**, academic or summer): 0.1

Project/Proposal Title: Work Order 1 -Valley Forge Composite Techmologies
Source of Support: Dept. of Energy (DOE)
Project Location: Idaho Accelerator Center, Pocatello, ID
Total award amount: $25,000
Start date (mm/dd/yy): 7/1/11

End date (mm/dd/yy): 9/30/11
Support type (**Current**/pending/submission planned in near future/transfer):
Person months per year committed to project (note **calendar**, academic or summer): 0.5

Project/Proposal Title: DRCT MMAS Research and Development
Source of Support: Battelle Energy Alliance LLC
Project Location: Idaho Accelerator Center, Pocatello, ID
Total award amount: $ 45,648
Start date (mm/dd/yy): 5/30/11
End date (mm/dd/yy): 9/30/11
Support type (**Current**/pending/submission planned in near future/transfer):
Person months per year committed to project (note **calendar**, academic or summer): 0.1

Project/Proposal Title: Commercialization of Electron Linear Accelerator Manufactured Isotopes
Source of Support: HERC
Project Location: Idaho Accelerator Center, Pocatello, ID
Total award amount: $50,000
Start date (mm/dd/yy):7/1/11
End date (mm/dd/yy): 9/30/12
Support type (**Current**/**pending**/submission planned in near future/transfer):
Person months per year committed to project (note **calendar**, academic or summer): 0.2

Project/Proposal Title: Development of production of 67Cu and investigations of methods of production of 149Pm, 177Lu, 90Y, 111In and 131Ba/131Cs isotopes using Photo-Nuclear Reactions
Source of Support: Dept. of Energy (DOE)
Project Location: Idaho Accelerator Center, Pocatello, ID
Total award amount: $3,897,902
Start date (mm/dd/yy): 9/1/11
End date (mm/dd/yy): 8/31/14
Support type (Current/**pending**/submission planned in near future/transfer):
Person months per year committed to project (note **calendar**, academic or summer): 4

Project/Proposal Title: Investigations of methods of 18F, 64Cu, 67Cu, 99Mo/99Tc, 111In and 131Ba/131Cs Isotope Production with Photo-Nuclear Reactions
Source of Support: Dept. of Energy
Project Location: Idaho Accelerator Center, Pocatello, ID
Total award amount: $1,458,000
Start date (mm/dd/yy): 3/1/2011
End date (mm/dd/yy): 2/28/2012
Support type (**Current**/pending/submission planned in near future/transfer):
Person months per year committed to project (note **calendar**, academic or summer): 3

Project/Proposal Title: DRCT X-ray Detectors
Source of Support: Battelle Energy Alliance LLC

Project Location: Idaho Accelerator Center, Pocatello, ID
Total award amount: $ 23,000
Start date (mm/dd/yy): 12/20/10
End date (mm/dd/yy): 9/30/2011
Support type (**Current**/pending/submission planned in near future/transfer):
Person months per year committed to project (note **calendar**, academic or summer): 0.1

Project/Proposal Title: NDA Capabilities for Assay of Transuranic-Bearing Wastes…
Source of Support: CH2M-WG Idaho, LLC (CWI)
Project Location: Idaho Falls, ID
Total award amount: $20,000
Start date (mm/dd/yy): 4/13/09
End date (mm/dd/yy): 3/31/12
Support type (**Current**/pending/submission planned in near future/transfer):
Person months per year committed to project (note **calendar**, academic or summer): 0.1

Project/Proposal Title: Technical Evaluation of Radiological Properties of the HFEF Waste Stream
Source of Support: CH2M-WG Idaho, LLC (CWI)
Project Location: Idaho Falls, ID
Total award amount: $125,000
Start date (mm/dd/yy): 4/13/09
End date (mm/dd/yy): 3/31/12
Support type (**Current**/pending/submission planned in near future/transfer):
Person months per year committed to project (note **calendar**, academic or summer): 0.1

Alan Wolfe Hunt
Curriculum Vitae

Date of Birth:	October 14, 1971
Mailing Address	Idaho Accelerator Center
	Idaho State University
	Pocatello, ID, 83209-8263
e-mail:	huntalan@physics.isu.edu
Phone:	(208) 282-5966
Fax:	(208) 282-5878

EDUCATION

Harvard University	Ph.D. in Physics, 2000
University of Michigan	B.S. with Highest Distinction in Physics, 1994

PROFESSIONAL EXPERIENCE

2006-present	**Idaho State University** Deputy Director of the Idaho Accelerator Center
2007-present	**Idaho State University** Associate Research Professor of Physics (tenured)
2002-2007	**Idaho State University** Assistant Research Professor of Physics (tenure track)
2001-2002	**Washington State University** Assistant Research Professor and Instructor (Fall Semester 2001)
2000-2001	**Washington State University** Research Associate
1998-1999	**Lawrence Livermore National Laboratory** Student Term Employee

HONORS AND ACTIVITIES

2006-2009	Chairman of ISU Radiation Safety Committee
2004-2006	Chairman of ISU Accelerator Safety Committee
2004	Outstanding Mentor Award in Siemens Westinghouse Competition
2003	Received Ralph E. Powe Junior Faculty Award
1997	Harold T. White Prize for Excellence in the Teaching of Introductory Physics
1994	William L. Williams Award for best senior thesis

PUBLICATIONS

Detecting fissionable materials in a variety of shielding matrices via delayed gamma and neutron photofission signatures – Part 2: Experimental results A. Procotor, T. A. Gabriel, A. W. Hunt, J. Manges and T. Handler *Nuclear Instruments & Methods in Physics Research A* **662**, 71 (2011)

Relative Defect Density Measurements of Laser Shock Peened 316L Stainless Steel Using Positron Annihilation Spectroscopy, M. A. Gagliardi, B. H. Sencer, A. W. Hunt, S. A. Maloy and G. T. Gray

Journal of Nondestructive Evaluation, 10.1007/s10921-011-0110-z (2011)

Testing the High-Energy Prompt Neutron Signature at Low Beam Energies S. J. Thompson, M. T. Kinlaw and A. W. Hunt *AIP Conference Proceedings* **1336**, 483 (2011)

Detector for intense, pulse active detection S. L. Jackson, R. J. Allen, J. P. Apruzese, R. J. Commisso, D. D. Hinshelwood, D. Mosher, D. P. Murphy, P. F. Ottinger, J. W. Schumer, S. B. Swanekamp, F. C. Young, G. Cooperstein, A. W. Hunt, H. A. Seipel and M. A. Gagliardi *Nuclear Science Symposium Conference Record (NSS/MIC)* **2010 IEEE**, 516 (2010)

Defect Density Mapping of Shot Peened Materials Using Positron Annihilation Spectroscopy M. A. Gagliardi and A. W. Hunt *AIP Conference Proceedings* **1099**, 857 (2009)

Identifying Nuclear Material via Prompt Photo-Neutron Multiplicity Measurements P. A. Hausladen, J. T. Mihalczo, B. W. Blackburn, S. M. Watson, J. L. Jones, A. W. Hunt and S. Thompson *AIP Conference Proceedings* **1099**, 670 (2009)

Temperature Dependence of Radiation Induced Conductivity in Insulators J. R. Dennison, J. Gilespie, J. Hodges, R. C. Hoffmann, J. Abbott, S. Hart and A. W. Hunt *AIP Conference Proceedings* **1099**, 203 (2009)

The detection of delayed -rays between intense bremsstrahlung pulses for discriminating fissionable from non-fissionable materials E. T. E. Reedy, S. J. Thompson and A. W. Hunt *Nuclear Instruments & Methods in Physics Research A* **606**, 811 (2009)

First Positron Flux Measurments at the Argonne Positron Source (AposS) S. Chemerisov, C. D.. Jonah, Y. C. Jean, H. Chen, D. Schrader, A. W. Hunt *Physica Status Solidi C* **4**, 3957 (2007)

Applicability of the MCNPX particle transport code for determination of the source correction effect in positron lifetime measurements on thin polymer films J. M. Urban-Klaehn, R. Spaulding, A. W. Hunt and E. S. Peterson *Physica Status Solidi C* **4**, 3731 (2007)

Application of the surface and volumetric positron techniques for the assessment of material damage in operational conditions J. M. Urban-Klaehn, S. Ritchie and A. W. Hunt and E. S. Peterson *Physica Status Solidi C* **4**, 3595 (2007)

Status of the Prototype Pulsed Photonuclear Assessment (PPA) Inspection System J. L. Jones, B. W. Blackburn, D. R. Norman, S. M. Watson, K. J. Haskell, J. T. Johnson, A. W. Hunt, F. Harmon and C. Moss

Current and Pending Support:

Project Title	Collaborators	Duration of Project	Funding Agency	Funding Amount
Delayed Gamma-Ray Spectroscopy for Non-Destructive Assay of Nuclear Materials	B. Ludewigt, LBL; V. Mozin LLNL; S. Tobin, LANL; L. Campbell, PNNL;	1/2012 to 9/2014	DOE	$400,000
Accelerator Based Active Measurements Utilizing PITAS	R. Mayo, JHU-APL	10/2011 to 9/2013	DoD	$683,255
Basic Research in High Sensitivity SNM Forensics via Correlated Photo Induced Emission Signatures for Topic B: Advanced Radiological Detection and Forensics	B. Failor L-3 Comm.; M. Kinlaw, INL; B. Blackburn Raytheon	11/2007 to 4/2013	DoD	$1,811,997
The Detection of Fissionable Materials in a Single Pulse	R. Commisso, J. Schumer, NRL	5/2010 to 4/2013	DoD	$275,453
09-093: Near real-time nondestructive active inspection technologies utilizing delayed -rays for advanced safeguards	S. Tobin, LANL	10/2009 to 12/2011	DOE	$466,233
Small Accelerator and Detection Systems		4/2010 to 11/2011	DoD	$1,715,400
Investigation of Active Inspection Techniques for Treaty Verification and at Higher Bremsstrahlung Energies	M. Kinlaw, INL	1/2011 to 9/2011	INL	$103,369
High Repetition Rate, Linac based Nuclear Resonance Fluorescence (NRF) for FY09 NA-22 Life Cycle Plan	J. Jones, M. Kinlaw, INL; G. Warren PNNL	2/2008 to 5/2011	DOE	$995,900
Active Interrogation Research for Raytheon Integrated Defense Systems	B. Blackburn Raytheon; D. Chichester INL	2/2010 to 12/2010	Raytheon	$50,305
Support of Large Standoff Fissionable Material	M. Kinlaw INL	4/2007 to 12/2009	DoD	$742,493

Detection for the DTRA MPTDS Project				
Microstructural evolution during spark plasma sintering of high-temperature fuels and coatings	W. Windes, INL	10/2008 to 9/2009	DOE	$69,699
Prompt and delayed scoping assessment for long standoff detection	J. Jones, INL	7/2009 to 9/2009	DOE	$44,851
Actively-Induced, Prompt Radiation Emission Characterization	J. Jones, INL; P. Hausladen ORNL; C. Moss LANL	8/2006 to 2/2009	DHS	$515,717

Appendix C: Other Support – Private Sector Partners

April 16, 2012

Idaho Higher Education Research Council
650 West State St
Boise, ID 83702

To Whom It May Concern;

Subject: Support of Idaho Accelerator Center

On Semiconductor has a long history of working with Idaho State University for mutually beneficial Research and Development programs. It is also important to us that ISU develops expertise and trains students in areas important to the future growth of our company.

Over the last year we have contracted with the Idaho Accelerator Center on proprietary projects irradiating materials and devices for our business. Recently, we have used facilities in other states for our development work because the IAC did not have the equipment in place to support further research. It is a competitive advantage for us to do R&D with our local University and the IAC so we strongly support the funding requested by the IAC to put in place equipment and fund research for development of novel materials using accelerators.

If our research with ISU and the IAC is successful, it may lead to business growth and future employment in Idaho.

Sincerely,

John Spicer
ON Semiconductor
Site Manager
Pocatello, Idaho

April 16, 2012

On Semiconductor supports the Idaho Accelerator Center and is in favor of its request and proposal to the Higher Education Research Council for funding equipment and research for accelerator irradiation of materials.

As a premier supplier of high performance silicon solutions for energy efficient electronics, ON Semiconductor has a broad portfolio of power and signal management, logic, discrete and custom devices serving customers in the automotive, communications, computing, consumer, industrial, LED lighting, medical, military/aerospace, and power markets. ON Semiconductor is headquarter in Phoenix, Arizona with a global network of manufacturing facilities, sales, offices and design centers that make it the 8th largest American semiconductor company. The company's Pocatello, Idaho and Gresham, Oregon manufacturing facilities have just been accredited as a " 1A Trusted Foundries" by the U.S. Defense Microelectronics Activity (DMEA) which will further their status as important on-shore locations for both commercial and military semiconductor production. The Defense Department established the trusted foundry program to ensure that only trusted microcircuits -- and not microcircuits that may have been tampered with or counterfeit -- are used in national security applications.

Some Aerospace and Military products must be tested and certified to prescribed levels of radiation tolerance. ON Semiconductor has consulted with the scientists at the Idaho Accelerator Center regarding methods of testing and physical effects. The center's proposed facility will provide additional capability for research and testing of radiation on semiconductors and as such will be valuable not only to our company, but also the wider defense industrial base.

Vincent C. Hopkin

Vincent C. Hopkin
Vice President and GM
Digital, Mil/Aero, Image Sensor

ON Semiconductor® :: 5005 E. McDowell Road :: Phoenix AZ 85008 :: 602-244-6600 :: fax 602-244-5544

International Isotopes Inc.

April 2, 2012

Higher Education Research Council
Idaho State Board of Education
P.O. Box 83720
Boise, ID 83720-0037

To: Higher Education Research Council

International Isotopes Inc. supports the request by the Idaho Accelerator Center (IAC) for additional research funding for improved methods of copper-67 isotope production and for research into additional commercially viable isotopes.

International Isotopes Inc. has signed a Development Agreement with the IAC for copper-67 production and we anticipate maintaining this partnership through full commercialization of the isotope.

Sincerely,

Steve T. Laflin
President and CEO

4137 Commerce Circle, Idaho Falls Idaho 83401
Phone: 208-524-5300, 800-699-3108 Fax: 208-524-1411
Website: www.intisoid.com

IOTRON
Industries Canada Inc.

April 3, 2012

Idaho Higher Education Research Council

Attention: Mr. Jon Stoner

Iotron Industries Canada Inc. has been discussing a collaborative arrangement with Idaho State University and their ability to provide a 20 MeV Linac Accelerator, capable of commercial production opportunities, when presented.
Our discussions have been that Iotron would work with IAC in developing the business potential.
On this basis Iotron support IAC's request for funding to put this capability in place.

Yours truly,

IOTRON INDUSTRIES CANADA INC.

Lloyd Scott
Chairman

Mailing Address: 1425 Kebet Way, Port Coquitlam, B.C. Canada V3C 6L3 Telephone: (604) 945-8838 Facsimile: (604) 945-8827