Blended/Hybrid Integration of Health Physics And Homeland Security Graduate Education

1) INTRODUCTION

For nearly 45 years SDSU has provided a well-educated and dedicated workforce of radiation protection professionals. Many of our graduates have become Certified Health Physicists. In the early days we received funding from the Atomic Energy Commission to raise our program to a level where we could make major contributions to the radiological workforce. Our output of health physicists is well beyond ten-fold of any other educational institution within the State of California. Since 1965 we have graduated over 250 health- and medical-physics professionals including many within power reactor health physics. Many of our students taught by superbly trained adjunct faculty from San Onofre Nuclear Generating Station (SONGS) ensured that our students were on the cutting edge of the technology and also had access to the site for hands-on, real-world experiences and summer internships. Now, as the United States is committed to moving it's nuclear energy initiatives forward--SDSU is poised and ready to respond. With support as directed in part of the Energy Policy Act of 2005, SDSU can take on a significant role within the NRC Nuclear Education Grant Program. Our contribution will enhance the educational infrastructure necessary to allow our Nation to safely move forward with nuclear energy.

With September 11, 2001 in mind—"To safely move forward with nuclear energy," has a whole new meaning. **Health physics education must be broadened to include training in homeland security, specifically nuclear safety.** At San Diego State we are uniquely prepared to take on this educational initiative. We are the only institution in the United States that has established graduate academic programs in both health physics and homeland security. San Diego State is conveniently located near San Onofre Nuclear Generating Station (SONGS) and the busiest border crossings into the U.S., as well as seaport, and major smuggling routes from South America and Asia.

Our experience in homeland security dates back to April 2002 with our co-founding of the Regional Network for Homeland Security (RNHS). Since that event, and through the SDSU Visualization Center we have grown to be a leader in critical homeland security support efforts, regionally and nationally. These accomplishments include innovative applied research in the homeland security environment. Our program is extremely rich in academic, corporate, and government partners. Our interdisciplinary Homeland Security Master's degree, the first in the nation in the .edu domain (Naval Postgraduate School was the first .mil –they are now .edu), was launched in 2004. It now has about 130 graduate students, most working in Homeland Security in diverse agencies such as CBP, ICE, DEA, FAM, Coast Guard, military, IC, Law Enforcement, and corporations.

Under an expert-trainee model (university model), students are forced to submit to a top-down transfer of information and are discouraged from critical bottom-up analysis. Students listen to the lecture, write it down and memorize it only to be assessed later on what is told to them. Instructors assess their students based on this transfer of information---not on knowledge constructed by the student. Assessment is the key to instruction. Students have pre-existing self-constructed knowledge before they get to the classroom. Students and people in general construct their own knowledge. Teaching new concepts to this pre-existing knowledge base can be successful if we allow students to form their own knowledge based upon accepted research-proven instructional methodology.

Our Assessment strategy will lead our Instruction methodology. Students will experience new concepts and construct their own knowledge in authentic real-world experiences. **Our goal is to move away from traditional lecture model toward a hands-on authentic real-world experience model utilizing web technologies and scientific visualization. Having a real border, port, and power reactor for labs helps facilitate this experience.**

This project will address critical issues related to the nuclear education needs of our country employing many modern techniques. **Our development efforts will incorporate proven web-based instructional technologies and emerging technologies and infrastructure (wireless and optical fiber) into our existing curriculum. We will integrate our radiological health physics and homeland security programs to present an academic focus in nuclear safety and security.** SDSU will develop programs as a “studio source” that can be interactively delivered nationally, much as collaborative command-and-control or fusion systems, so that training can also pave the way for tactical response systems with the same tools, expertise, and capabilities. Learning will prepare responders and leverage collaboration tools, decision support systems, and distributed and mobile access to help teach critical people in a compelling way at the sites like the border and ports where deep challenges and yet opportunities for making a contribution to the safety of the nation exist.

2) Project Objectives

Our five objectives are listed and explained below:

a. Our main objective is to fully transform our traditional lecture model of instruction into a hands-on authentic real-world experiential model of instruction. We will research, design, develop, implement, assess and revise web-based instructional support and supplemental curriculum materials for seven courses that make up the core of our radiological health physics program. These courses are:

1. Radiological Physics and External Dosimetry
2. Nuclear Instrumentation Laboratory
3. Nuclear Physics
4. Radiation Transport and Shielding
5. Radiological Assessment, Internal Dosimetry, and Protection
6. Reactor Health Physics
7. Radiation Biology

b. Our second objective is to increase the blended learning aspect of our curriculum. Blended or Hybrid Learning is the use of more than one delivery method in a single course or program (<u>Staying the Course</u>, The Sloan Consortium, 2008, and References 1, 2, and 3). The instructor of an online course may want to have students meet once a week via an audio conference to discuss the last assignment together; or a videoconference (Wimba) can be combined with multiple media: text and graphics can be transmitted with a document camera; computer graphics, web sites, and videotapes can be transmitted and viewed by all students. Blending different technologies together in one course provides a more dynamic learning environment and allows for different options and expressions of educational materials. To be successful, a hybrid or blended course requires careful pedagogical design. Hybrid teaching is not just a matter of transferring a unit of your traditional course to the Web. It involves developing challenging and engaging online learning activities that supplement your in-class curriculum (References 1, 2, 3).

In our first year of the project, we plan to blend 15% of our current course curriculum into effective and engaging online learning objects. In the second year of the project, we plan to have 25% of our course curriculum online. In the last year of the project, we plan to have blended at least 35% of our curriculum to an online, distance education curriculum. Also at the end of the project we will have two or three fully online course offerings (80% or more). Our greatest challenges are within our laboratory courses (Reference 4).

c. Our third objective is to integrate the principles of homeland security into our courses in Instrumentation, Radiation Transport and Shielding, Radiological Assessment, and Reactor Health Physics. We will also integrate faculty, staff, and students from both health physics and homeland security programs. We will also develop a nuclear detection technology and radiological health physics division to our Center for Homeland Security Program.

d. Our fourth objective is to train students in the development of state-of-the-art Monte Carlo simulations utilizing MCNPX. Our models will range from simulated laboratory configurations to real-world field experiences. Field experiences will be user defined in such that we will design our simulations to model current technologies. Our end result will be to focus our data acquisition and data analysis into a Scientific Visualization form that is easily read and analyzed by everyone in the decision chain. Scientific Visualization (Reference 5) is the use of computer graphics to create visual images which aid in understanding of complex, often massive numerical representation of scientific concepts or results.

e. The fifth objective is to develop a web site along with various other electronic- and print-type media to advertise this unique program. Our student recruitment efforts will include targeting what has been historically underrepresented groups seeking education and employment in health physics. Also our department has identified that the next faculty hire will be in the discipline of radiological health physics. Therefore we will also use these media to help recruit a diverse pool of faculty applicants. We will advertise in many locations making it clear that the Nuclear Regulatory Commission, as allowable, has supported our program.

3) Shared Instructional Components for each course

a. In all of our curriculum, we will utilize a proven and reliable web-based Learning Content Management System (LCMS) such as; BlackBoard Academic Suite (provided and fully-supported by SDSU), Angel Learning Management Software, Moodle, LON-CAPA or Design2Learn Innovative Learning Technology as a distance education platform to deliver the major instructional components of our curriculum to our students in the classroom and over the internet for distance education purposes.

b. We will incorporate case studies, best practices, policies and programs related to the Homeland Security Act of 2002 and to the Department of Homeland Security into our existing health physics curriculum.

c. We will develop web-based instructional methodologies for the classroom as well as distance education purposes that will include methods to detect, respond, and report unauthorized attempts to import, possess, store, develop, or transport nuclear or radiological material for use against the United States. **We see this capability as a crucial component of an education health physics/radiation safety program.**

d. For each course we will design, develop, implement and assess

1. Specific content standards
2. Student benchmarks
3. Formative, summative and authentic real-world assessment tools
4. Quantifiable criteria to evaluate instruction effectiveness

e. From authentic real-world experiences (data acquisition) we will utilize Scientific Visualization techniques (data analysis, data fusion, and then visualization) throughout our instruction and assessment. Our students will

1. Acquire relevant authentic real-word data sets to add to our existing 70 terabytes of data that we currently serve to the web.
2. Create visual representations of data sets to show decision-makers.
3. Analyze these representations for possible alternative solutions made by decision-makers
4. Assess these visual representations for its value is solving problems.

f. To create an authentic real-world experience for our students, we will continue to grow and establish new collaborative partnerships with San Onofre Nuclear Generation Station.

g. We will develop and implement a professional Instructional website leveraging proven Instructional Design software such as; Adobe Captivate/Presenter, Articulate Studio or Authorware 7. For each class that will include these learning objects and modules:

1. Video archives of selected lectures on theory or in the field training demonstrations.
2. Stand-alone, content-specific short concept movies, Flash and JavaScript concept animation, Adobe Flex and Air, wikis, YouTube FAQs, and networking tools via appropriate use of commodity tools such as Facebook and Google groups, with major use of Google Earth, Apps, gears, widgets, Sites, and other Google tools and developing capabilities.
3. Keynote concept presentations-learning modules to replace the necessity of in-class lecture instruction.
4. Relevant real-world case studies to practice problem-solving and decision-making procedures
5. MCNP simulations for comparison to real laboratory and fieldwork.

6. Synchronous Wimba Interactive Classroom (conferencing for distance education) as well as products such as VSEE (http://www.vseelabs.com), which was used by Washington, DC police for linking together during the inauguration for President Obama, as well as widely used in the military and Humanitarian Assistance Disaster Relief (HADR) world, linking Congress to each other, and doing videostreaming over cell phones for Law Enforcement and the IC as a ultra-secure and deeply functional system.
7. Online student-Instructor-Industry chat forums, wikis, and social networking tools such as Facebook, Flickr, Twitter, Google Groups, and IRC channels.
8. Asynchronous Discussion forums for students and Industry personnel.
9. Online training modules including formative and summative assessments with delivery tools including Web, YouTube, Second Life, and similar tools.
10. Student Homepages and group pages, collaborative wikis and similar tools to build and share knowledge (Peer learning groups)
11. A student repository (Digital Drop Box and Homepages) of all their work, ways of electronically sharing, as well as pathways to publication (e.g., Murray Jennex as editor of the major Knowledge Management journal).

4) Authentic Real-world Curriculum Development Examples

The following examples illustrate the "real-life" applications that will be incorporated into our curriculum. Each of these examples will pull in information from authentic real-world experiences (data acquisition) we will utilize Scientific Visualization techniques (data analysis, visual analytics, simulation) throughout our instruction and assessment.

Our students will:

1) Work with relevant authentic real-word data sets.
2) Create visual representations of data sets.
3) Analyze these representations for possible alternative solutions.
4) Assess these visual representations for their value in solving problems and conveying results in a compelling fashion to decision makers and public.

a) Nuclear Instrumentation Laboratory

Health physics instruction will include a complete series of well-designed laboratory exercises offering students an opportunity to explore and experiment the basics of radiation measurement. This grant will supply the lab with an array of Industry standard radiation detection equipment. Our students will develop nuclear and radiation theory through the experimental use of nuclear instrumentation. Initially, we will develop experiments that will be done face-to-face with our sights set on limited on-campus contact time. We will investigate and develop alternative hands-on experiences (assignments, assessments) that students receive at their local site. To deliver Instruction to students offsite, we will develop hybrid teaching and learning modules to both supplement and replace in-class instruction. Our goal is to migrate or instruction towards a distance education in-the-field laboratory experience for all our students. Examples of these experiences would include;

- Specific laboratory procedures will be developed as well as background theory in reactor health physics. These experiments will address specific issues in nuclear safety and/or the detection of diverted radioactive materials (nuclear security).

- Instrument calibrations of area and particulate air monitors, portal monitor (standard instruments installed at the facility) and personnel dosimeter responses during background conditions and interpreting responses to operating or emergency conditions. Instrument calibrations and measurements for environmental tests (wipe counts) by liquid scintillation – beta spectrometry.

- Measurements with HPGe detectors for identification of isotopes in environmental samples. In addition production and decay of common short-lived isotopes will be observed using gamma-ray spectrometry. This work will include common isotopes (^{28}Al, ^{56}Mn, ^{24}Na, ^{49}Ca, ^{51}Cr, ^{65}Ni, ^{66}Cu, etc as well as fission products that might escape from irradiated fuel (extremely small samples of uranium will be irradiated to create samples for analysis).

Additional experiments to be developed with new equipment funded by this project.

1. **Rem-ball detector for detection of fast/thermal reactor neutrons**. Students will learn principles of operation for a widely used reactor-monitoring instrument.
2. **Plastic scintillator detectors for fast neutrons, for thermal neutrons**. Students will learn principles of neutron-based scintillator detectors.
3. **Phoswich scintillator detector for mixed neutrons and gamma rays**. Students will learn principles of operation of Phoswich detectors, which can be used to discriminate between neutrons and gamma rays in mixed fields.
4. **Probe for alpha/beta detection**. Students will learn to principles of operation for alpha/beta particle detectors used for surface contamination analysis.
5. **Scintillation fiber optics for remote neutron/gamma detection**. Students will learn principles of scintillator fiber area detectors and the use of WLS (wavelength shifting materials) for neutrons and gamma rays.
6. **Whole Body Counter measurement and simulation**. Students will measure internal emission with a given detector and geometry using the whole body counter. Results will be compared with MCNPX Monte Carlo simulations. Alternative geometries and/or detectors will be simulated. Students will learn principles of importance of detector type and placement for internal dosimetry. Students will learn how to run a Monte Carlo radiation transport simulation.
7. **Model gas-filled and scintillating detectors** for various radiation fields, including mixed neutron/gamma fields. Students will model various semiconductor detectors under a variety of environmental conditions. Students will provide data on ionization chambers, pulse-mode detectors, and integrating radiation detection systems.
8. We will develop various other simulations will lead to laboratory testing, and optimization of novel heterogeneous semiconductor structures based on CdTe, CdZnTe, GaAs, and HgI_2 to be used as detectors of gamma and neutron radiation. These materials have been shown to have the potential energy resolution to distinguish gamma-activated elements of the uranium family: uranium-238, uranium-235, and uranium-239. Simulations can help optimize the detection standoff, speed of response, shielding concerns, and covert settings.

9. **Modeling of novel 1-D scanning detectors, area detectors, and Compton gamma cameras**, and hand-held probes based on pending SDSU patents held by Dr. Nelson. The patents are directed toward the design of high-sensitivity imaging detectors for emission and transmission medical imaging that are directly applicable to reactor health physics materials detection needs. Other useful modeling areas include: nonlinear multi-photon laser spectroscopy, backscatter, and CT imaging.

b) Internal Dosimetry

All internal radiation doses should be assigned using proper dosimetry techniques, but the formal internal dosimetry process often takes time that may delay treatment, thus reducing the efficacy of some medical countermeasures. Magnitudes of inhalation or ingestion intakes, or intakes associated with contaminated wounds, can be estimated by applying simple rules of thumb to sample results or direct measurements and comparing your answers to known limits for a projection of dose magnitude.

Although a regulatory unit, the annual limit on intake (ALI) is based on committed dose, and can therefore be used as a comparison point. For example, internal dose magnitudes associated with contaminated wounds can be estimated by comparing a direct wound measurement taken soon after the injury to the product of the ingestion ALI and the associated f1 value (the fractional uptake from the small intestine to the blood). International Commission on Radiation Protection (ICRP) Publication 96, as well as other resources, recommends treatment based on ALI determination. Often, treatment decisions have to be made without having all of the information one would like to have.

c) Radiological Assessment

The course in Radiological Assessment covers the principles and practices of radiological assessment including environmental transport and pathway analysis, concepts, models, and methodology for calculating internal doses, as well as risk estimates and risk communication. The course is divided into two major sections – in the first half we review environmental pathway analysis and in the second half we review internal exposure calculation methodology. We begin with the methods for assessing the dispersion of radioactive materials in the environment and calculation of the dose consequences to human receptors. This includes airborne dispersion based on meteorological models, methods that account for dose due to direct exposure to a plume, due to deposition on ground surfaces, and by inhalation. We then review liquid releases to surface waters and to groundwater including analytical methods for point surface discharges, discharges to small lakes and reservoirs, and discharges to rivers. Radionuclide migration in groundwater is also covered. We apply these concepts to the movement of radionuclides through the environment that results in human exposure. The focus is on internal exposure through food pathways although the exposure due to deposition and subsequent direct radiation exposure is also covered. Both terrestrial and marine exposure paths are considered.

d) Power Reactor Health Physics

Focuses on the specific radiation protection concepts associated with commercial power reactors. First a review of power reactor design and operation is covered. This includes nucleonics, basic PWR and BWR design, the fuel cycle, engineered safeguards and major plant systems including radioactive waste management as well as liquid and gaseous effluents. The majority of the course then covers the major program elements of a reactor radiation protection program. We cover external exposure controls including personnel monitoring and a brief review of plant radiation shielding. Internal exposure controls are then reviewed including engineered controls, air sampling and monitoring, respiratory protection programs, bioassay, and dose assessment. Next we look at ALARA programs that evaluate both design and operational reviews, collective and individual exposure controls, source control including plant chemistry considerations, and the application of standard ALARA dose reduction techniques (time, distance, and shielding). We review concepts and methods used for contamination control including assessment techniques, limits, and protective clothing. Effluent programs are covered including a brief review of control methods, dose assessment, and environmental monitoring programs. Lastly, the course reviews emergency preparedness: accident identification, source terms, release pathways, and protective actions.

Assignments are drawn from real-world problems encountered by reactor HPs. At least one field trip will be arranged to visit either the San Onofre Nuclear Generating Station or associated training facilities.

Emergency preparedness in the areas surrounding nuclear power plants represents some of the most robust emergency planning in the nation (References 6, 7, 8, 9, 10). An important component of these plans are the implementation of protective actions to ensure the safety of the public in the event of a general emergency condition at the plant. Exposures received by first responders will be important for a number of reasons, including planning for the appropriate use of key personnel in an extended emergency situation.

e) Exposed Population Assessment

Population monitoring is a process that begins soon after a radiation incident is reported and continues until all potentially affected people have been monitored and evaluated for: 1) needed medical treatment, 2) the presence of radioactive contamination on the body or clothing, 3) the intake of radioactive materials into the body, 4) the removal of external or internal contamination (decontamination), 5) the radiation dose received and the resulting health risk from the exposure, and 6) long-term health effects. Many critical components of population monitoring should be put in place in the first few hours after the incident, before the arrival of federal assets that might be used to assist in the monitoring efforts. However, the challenges of population monitoring especially in the first few hours and days after a radiation incident tend to be overlooked in emergency response planning. This module will discuss the practical considerations for operating a community reception center and the role that the reactor health physicists will take on. The HP will be involved in planning at the state and local public health departments throughout the country. The HP will analyze the risks of radiation contamination spread and determine mitigation strategies.

f) Emergency Preparedness and Response Issues

The National Guard Bureau's Weapons of Mass Destruction (WMD) Civil Support Teams (CSTs) comprised of full-time Army National Guard and Air National Guard members. These teams were established to rapidly deploy and assist and support local and state authorities at domestic WMD/Nuclear, Biological, or Chemical (NBC) incident sites. Their primary role is determining the nature and extent of an attack or incident; providing technical advice on WMD response operations; and event identification and support the arrival of follow-on state and federal military response assets. While CSTs are highly skilled and highly trained in chemical and biological responses some weaknesses in managing potential radiological events had been identified.
This is where our training will have an impact.

Improved practical training and radiological exercises will be part of our program. A program similar to the Volpentest Hazardous Material Management and Emergency Response (HAMMER) training facility located in Richland, WA will be employed.

http://www.hanford.gov/rl/uploadfiles/empr/fy06/sept/section-i.pdf

Our training capstone is to simulate a WMD scenario using not only sealed radiological sources, but also short-lived, dispersible radioactive material for maximum training realism and hands-on experience.

g) Licensing and Emergency Planning

The Nuclear Regulatory Commission is currently accepting and reviewing applications from companies considering building new nuclear power plants in the United States. The current fleet of operating nuclear power plants were licensed under a two-step process described in 10 CFR Part 50 requiring both a construction permit and an operating license. In 1989, the NRC established an alternative licensing process in 10 CFR Part 52. The Part 52 process includes provisions for design certifications, early site permits (ESP), and combined license (COL) application. A COL includes a construction permit and an operating license with conditions. For an application submitted under 10 CFR Part 52, the level of emergency planning review will depend on whether the application is for an ESP, design certification, or COL. An ESP review includes, at a minimum, physical characteristics unique to the proposed site that could significantly impede the development of emergency plans, and the description of contacts and arrangements made with offsite response organizations. At this time, the applicant can also submit additional information to address either major features of emergency plans or provide complete and integrated emergency plans for review. Design certification only addresses those design features, facilities, functions, and equipment that are technically relevant to the design and are not site-specific, and affect some aspect of emergency planning or the capability of a licensee to cope with plant emergencies. A COL application review includes an evaluation of all applicable emergency preparedness requirements. It may incorporate emergency plans that are approved in connection with the issuance of an

ESP and/or design features contained in a certified design. The review of the previously approved referenced information is to confirm it is appropriately incorporated into the emergency plans contained in the COL application.

h) Power Reactor Personnel Evacuation

In recent years, technologies supporting the development of Evacuation Time Estimates (ETEs) have substantially changed and additional evacuation considerations have emerged. ETEs are part of the planning basis for each nuclear power plant, and as such, ETE studies are required to be performed by licensees to estimate the time needed to evacuate the public in the unlikely event of a serious accident. ETEs are crucial when orchestrating any evacuation. As advancements in new technologies that support evacuations and evacuation planning continue, and as new information on evacuations becomes available, it is important that these technologies and information be considered in developing an ETE. The NRC staff revised existing ETE guidance in 2004 and is currently developing proposed rulemaking that will update the requirements for ETEs. Presently, the regulations do not specify when to review and update the ETEs after the plant has been initially licensed. The proposed rulemaking would require licensees to review and update their ETEs periodically when the population changes or significant changes are made to the emergency planning zone infrastructure. To reflect the rulemaking changes in the guidance, the NRC has commissioned Sandia National Laboratories to develop ETE analysis input parameters that will represent the current state of knowledge in emergency planning. Consistent methods, assumptions, and input parameter values will allow for a more meaningful comparison of ETE values among nuclear power plant sites. The ETE guidance will also include a personal computer-based capability for analyzing how roadway network changes, evacuation plan modifications, and other factors would influence evacuation times.

i) Post accident evaluation

This topic involves the progression and current findings of the NRC's State-of-the-Art Reactor Consequence Analyses (SOARCA) project, part of the ongoing refinement in severe accident and off-site consequence analysis. The SOARCA project is being performed by the NRC, with assistance from Sandia National Laboratories, to: (1) evaluate and update, as appropriate, analytical methods and models for realistic evaluation of severe accident progression and offsite consequences; (2) develop state-of-the-art reactor consequence assessments of severe accidents; and (3) identify mitigative measures that have the potential to significantly reduce risk of offsite consequences. To conduct the analyses, staff will use an improved understanding of source terms and severe accident phenomenology, and credit the use of severe accident mitigation strategies and procedures that were not in place when previous studies were performed. In addition to better understanding of accident phenomenology, the analyses will include design, operation, and emergency preparedness improvements to more accurately reflect plant performance and emergency response activities.

5) Creation of the "Center for the Assessment of Radiological and Homeland Security Technologies"

To effectively bring together faculty, staff, and students from both health physics and homeland security we will develop a nuclear detection technology and radiological health physics division to our Center for Homeland Security (http://homelandsecurity.sdsu.edu/). **The focus of this newly developed division of the center will be to develop and test nuclear detection instrumentation and methods specifically for applications in reactor health physics and for countering the serious threat of a nuclear terrorist attack. Striving to help produce an end product for deployment, and management of global nuclear detection architecture.** This center will improve the educational infrastructure, teaching competencies, subject matter expertise, and skills in serving students. Our health physics students will be integral component of the center.

This new division will come together within our existing center with its demonstrated commitment, abilities, partnerships, and accomplishments in homeland security. Including:

- Strong Angel III (http://www.strongangel3.net/)
- Center for Commercialization of Advanced Technology (CCAT)
- The Security Network (http://www.thesecuritynetwork.org)
- Calit2 Program (http://www.calit2.net) to utilize sensors, telecommunication, and visualization to in areas such as Homeland Security.
- International: Mexico for shared Homeland Security and natural disaster response through the use of telecommunications and shared computational and visualization capabilities.
- Research - With National Programs such as joint DHS and DTRA BioNet pilot project (civ-mil_bioterrorism_project), our NASA REASoN project, major civ-mil interactions such as Operation Golden Phoenix (summer 2008), AfterShock! (associated with Golden Guardian, fall 2008), and other cross-border imaging, sensor networks, alerting, and border collaboration efforts with dozens of agencies concerned with border and coastal (port) smuggling.
- Database and imagery integration along with visualization and web services delivery of terabytes of data controlled by tiny programs with Adobe Flex to produce production decision-support, policy, and tactical tools for groups like White House Office of National Drug Control Policy, HIDTA (High Intensity Drug Trafficking Areas), and Federal Law Enforcement.
- Large-scale imagery processing and presentation support for Desert Storm, Tsunami relief for Sumatra, National Hurricane relief support for Katrina and Rita, earthquake and volcano relief efforts for Java, and numerous efforts assisting in difficult areas such as Afghanistan, Darfur, other difficult sites. Effort is done collaboratively with the Navy in projects such as Navy NONCLASS Enclave that we host and work with many other groups such as NGA to develop national capabilities across the spectrum of government needs.

SDSU is currently involved with DHS efforts directed at international border between US and Mexico and also in trying to image containers entering the US from foreign ports, as about 44% of them enter at Long Beach/Los Angeles ($9.6 billion in import fees to US

Government in 2006). Specialized cargo (mostly non-container) enters at San Diego. We are also working with the senior Public Safety leaders in both states of Baja California, Mexico where largest port in North America (Punta Colonet) is being built (will be larger than LA-Long Beach), mostly to ship materials from China, Korea, and Japan to central US (WalMart, Target, Home Depot). President Calderon initiated the construction in 2008, with first shipments likely in about 3 or 4 years. Additionally, SDSU is a partner with the DHS funded Center of Excellence for Border Security Issues specializing in risk assessment and management.

Therefore, our center will focus on nuclear detection technologies as applied to the health physics, reactor health physics, and homeland security. Health physicists and emergency first responders will study and evaluate to deploy and test instruments for alerting decision makers with appropriately compelling data visualizations in our VIZ lab. We have been part of the Oak Ridge National Labs SensorNet project, where we have deployed radiological and chemical sensors with them to a number of events such as Mardi Gras (60,000 people in San Diego), sporting events, emergency response events, and similar integration of police and other first responders wanting to do radiological monitoring. SDSU is the only California school in the Oak Ridge Association of Universities (ORAU, http://www.orau.org) and is the closest ORAU school to the US-Mexico border. We are linked to other schools along the border via the Southwest Border Security Consortium (SBSC) and the DHS Center of Excellence on border Security and Immigration where SDSU focuses on the Risk Assessment (Murray Jennex lead, with Eric Frost and others.) and Geospatial Mapping and Visualization (Doug Stow lead, with Eric Frost and others). As we have worked with Homeland Security and law enforcement officers and officials on numerous efforts, we have deep operational contacts to have access, ability to image real places and discoveries, and can assist in the context or real borders, port, and multi-modal transportation and smuggling. We would like to provide this research interface to the nation and assist nuclear scientists, students, and others in designing radiologic-based technologies.

6) Use of the SDSU Visualization Center

The major facilities available to the SDSU Visualization Center (Viz Center) include computing, communications, visualization, data fusion, sensor networks, and data storage. We have several high-end computational machines including an SGI Prism with 24 GB of RAM, 8 processors, and 6 TB of local disk. We also have a high-end SGI Onyx devoted to processing daily MODIS imagery for law enforcement and fire. Our major servers are Sun Blades (17 blades or servers) that can support about 10 million web-service hits a day. Our servers are directly connected to the Internet backbone at the San Diego Supercomputer Center (SDSC) and are accessed by dedicated fiber from SDSU to SDSC. The Viz Center has a variable amount of bandwidth depending on which switches are running; up to a maximum of about 6 to 7 Gbps dedicated bandwidth. We will be increasing this to 10 Gbps, which is the research connection that we are traditionally trying to fill with our applications as we help design the Future Internet (http://www.optiputer.net) and also work with fiber groups connecting 1 GigE connections to the public safety offices at many universities in California, but also GigE connections to private homes, which is becoming commodity as IP TV, VOIP, Internet, film, and entertainment services are packaged (http://us-cca.org) as triple play, or quadruple play, or other telecommunications packages that are profoundly changing the world, especially in other countries. We have the facilities and social connections to build to this system, including fiber delivery along the entire board with wireless outreach from the end of the glass or plastic optical fiber (POF). We work within several such practical networks, including hosting the Navy NONCLASS Enclave, which is a Navy capability to respond to global disasters by being able to share data and especially imagery and associated real-time information with NGOs, law enforcement, and government groups worldwide—so sent around the world on research fiber and other networks in ways that have never been done before in linking technology, policy, and collaborative visualization, data fusion, and decision-support systems.

Besides the computing and fiber communications capabilities, we have major equipment for cameras, sensors (including components from the Oak Ridge National Labs SensorNet program, which we were the deployment site for, including radiological monitoring), and hybrid wireless devices to provide both local monitoring and backbone pathways to the Internet. These systems are regularly deployed as research and development efforts for the San Diego Police Department's Critical Incident Management Unit (CIMU), who then choose and deploy some of the devices. This is largely done by bringing dozens of companies together who are each contributing their own gear and engineering, often doing rapid prototyping and joins with other companies to produce new products. We also working closely with CBP and related border organizations on a daily (7 days a week) basis including co-sponsoring major real-play training efforts like Operation Golden Phoenix in 2008, which included about 160 agencies and over 800 people for several days of real-play training around the border, including smuggling and vessels tracked from Indonesia into LA-Long Beach (included shutting down of one of piers at LA-Long Beach for the first time ever for such a training event) and then the Otay and San Ysidro Ports of Entry from Mexico. This included several radiation and mapping and alerting concerns linking cameras, sensors, and communication devices and fed into CBP and other agencies, including the Border Intelligence Center (BIC) with whom we work on many research projects.

We have major software capabilities in terms of Open Source and geospatial capabilities for the Open Source community but also groups like NASA, USGS, NOAA, and the UN Food and Agriculture Organization (FAO). We use the OSSIM open source software funded by NGA and NRO for very large data sets, which are massively changing the image-processing world. We host tens of terabytes for different disaster data including Katrina, Banda Ache, Java earthquake and Merapi volcano, Hawaiian earthquake, and many other sites where we have done world-class imaging and comparison of data sets in an onion-skin style so anyone with Windows and now Mac and Linux can use a web browser to fly through terabytes of data over small networks. We deliver this to the world for free, especially now linking imagery to RSS, GeoRSS (Geospatial RSS), SSE (Simple Sharing Extension, basically bi-directional RSS), and web services and web feature services to link real-time icons such as of seismic events on top of the imagery. Providing data fusion tools for humanitarian assistance and disaster response (HADR) for areas like Afghanistan, Africa, Indonesia, and other difficult areas is the lifeblood of what we do as volunteers. These assets and world leading and NGO leading data fusion, visualization, sensor network, and communication research to produce highly scaleable and effective means of gathering, processing, detecting, visualizing, displaying, and communicating critical information. Nuclear detection sensing, data fusion, visualization, and decision support within the context of real first responders, real disasters where we automatically self deploy alongside first responders with whom we work daily (7 days a week) is a major asset for this project.

7) Literature Citations:

1) Allen, I., Seaman, J., Staying the Course, Online Education in the United States, 2005. The Sloan Consortium, 2008.

2) Allen, I., Seaman, J., Making the Grade, Online Education in the United States, 2005. The Sloan Consortium, 2006.

3) Allen, I., Seaman, J., Growing By Degrees, Online Education in the United States, 2005. The Sloan Consortium, 2005.

4) The Challenges Associated with Laboratory-Based Distance Education, Elliot and Kukula, Educase Quarterly, Nov 1 2007.

5) Barstow, D., Frost, E., Do we really understand what we see? Cognitive issues in remote-sensing from the perspective of a scientist and an educator, May 1996, Geoscience and Remote Sensing Symposium, 1996. IGARSS '96. 'Remote Sensing for a Sustainable Future.', International

6) NUREG/CR-6953 Vol 1. “Review of NUREG-0654, Supplement 3, “Criteria for Protective Action Recommendations for Severe Accidents.”

7) NUREG-0654/FEMA-REP1, Supplement 3. “A Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants.

8) Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism. National Council on Radiation Protection and Measurements (NCRP), Commentary 19: 2005.

9) Management of Terrorist Events Involving Radioactive Material. National Council on Radiation Protection and Measurements (NCRP) Report No. 138 (2001)

10) Report 65: Management of Persons Accidentally Contaminated With Radionuclides. National Council on Radiation Protection and Measurements (NCRP) Report No. 65 (1980)