

Kansas State University

Homeland Defense Food Safety, Security and Emergency Preparedness Program

22 March 1999

RATIONALE & MISSION

THREATS & CAPABILITIES

DUAL-USE RESEARCH

DUAL-USE FACILITY

ADVANCED EDUCATION

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KANSAS STATE UNIVERSITY

FOOD SAFETY AND SECURITY PROGRAM

National security experts are concerned that terrorists or rogue governments could use weapons of mass destruction – nuclear, chemical, or biological – in U.S. population centers or that America’s electronic commerce could be disrupted. The possibility of biological agents being targeted to the domestic food supply is not arousing similar concern even though such agents could decimate America’s agricultural resources, evoking international trade sanctions, economic instability, food shortages, and dire public health outcomes.

Kansas State University has launched a food safety and security program intended to help protect our food crops, food animals, and domestic food supply. Areas of K-State expertise relevant to endemic and emerging biological threats include pre- and post-harvest food safety, animal disease (including diagnostics and detection), crop plant resistance to disease and pests, and countermeasures against biological and chemical agents, to name but a few. K-State’s diverse, long-standing capabilities in dealing with endemic risks to our agricultural resources provide a “dual use” mechanism for protecting the nation against emerging threats whether accidentally or terrorist-introduced, i.e., by applying existing civilian capabilities to the problem, a national defense need is addressed.

FOOD SECURITY & PREPAREDNESS NEEDS:

- **Advanced professional expertise**
 - **Animal diseases/toxicology**
 - **Crop plant diseases/pathobiology**
 - **Decontamination/detoxification**
 - **Food safety for food animals & crops**
 - **Microbiology/immunology**
- **Biological & chemical agent surveillance**
 - **Early detection & identification**
 - **Forensic tools and reagents**
 - **Remote detection**
- **Broad bandwidth data transmission**
- **Civil-military response training**
- **Crisis communication management**
- **Economic outcome assessment**
- **Public health planning & programs**

KSU & AFFILIATED RESOURCES/EXPERTISE:

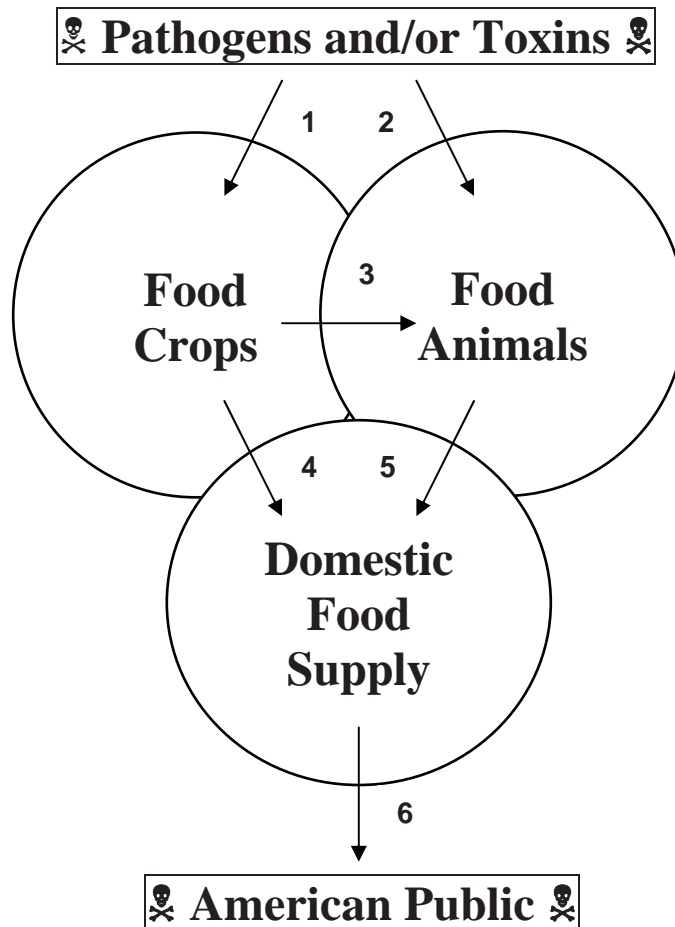
- **Research/graduate/certificate programs**
 - **Veterinary medicine/animal science**
 - **Plant biotechnology/grain science**
 - **Chem-bio countermeasures + Nantek**
 - **Pre- & post-harvest food safety/HACCP**
 - **Distributed expertise and programs**
- **Interdisciplinary expertise + FoodLabs**
 - **Extension service & diagnostic labs**
 - **Biological & molecular diagnostics**
 - **Electronics design laboratory & GIS**
- **Internet II charter member & the ECC**
- **Food safety exigency planning & response**
- **Extension & continuing education resources**
- **Agricultural economic modeling & analysis**
- **Agromedicine consortium with KUMC**

National Guard and Reserve military components, working in concert with civilian emergency services personnel, will function as “first responders” in dealing with direct human health threats from nuclear, chemical, or biological agents. They will likely be involved with any broad-based threat to the domestic food supply as well. Kansas State is well equipped to provide the responders with specialized advanced education and expertise in this area. In fact, K-State has a full spectrum of local, regional, and national capabilities in research, education, and outreach, including well-established relationships with Fort Riley and Fort Leavenworth. These capabilities and relationships will allow K-State to facilitate civil-military response policy development and implementation, as well as civil-military relations. In addition, K-State has research alliances with numerous public and private sector research entities that can provide additional expertise in addressing biological threats to our food supply, our economic well being, and our people.

KANSAS STATE UNIVERSITY

FOOD SAFETY AND SECURITY PROGRAM

MISSION: **TO PROTECT THE DOMESTIC FOOD SUPPLY AND AMERICAN PUBLIC FROM ENDEMIC AND EMERGING BIOLOGICAL THREATS**



THREATS [NUMBERS 1 THROUGH 6 ABOVE]:

1. a) Plant pathogens or toxins transmitted to food crops.
b) Animal pathogens or toxins transmitted pre- or post-harvest to food crops.
c) Human pathogens or toxins transmitted pre- or post-harvest to food crops.
 2. a) Animal pathogens or toxins transmitted to food animals.
b) Human pathogens or toxins transmitted pre- or post-harvest to food animals.
 3. a) Plant pathogen or toxin-induced losses of crops to feed animals.
b) Animal pathogens or toxins transmitted via crops to food animals.
 4. a) Plant pathogen or toxin-induced losses of crops for the domestic food supply.
b) Human pathogens or toxins from crops processed into the food supply.
 5. a) Animal pathogen or toxin-induced losses of food animals for the food supply.
b) Human pathogens or toxins from animals processed into the food supply.
 6. Human pathogens or toxins transmitted to the American public.
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EXAMPLES ILLUSTRATING THE THREATS:

Biological agents of concern as endemic and emerging threats include, but are not limited to, viruses, bacteria, protozoa, and fungi as well as toxins produced by these microbes. Such agents threaten our food crops and animals as well as our food supply and people.

Plant pathogens/toxins: An astounding forty-five percent (45%) of the world's calories come from wheat and rice. Furthermore, the feed for beef, swine and poultry is primarily cereal crops. A terrorist strike against the cereal crops would threaten the foundation of our food supply. A widespread disease outbreak affecting these crops could cause worldwide famine; a localized strike could cause an embargo of US exports, threatening our balance of payments and causing regional economic collapse.

- *Karnal Bunt* of wheat is caused by the pathogen *Tilletia indica*. This disease was first identified in India almost 70 years ago, and it has been documented in Mexico for the past 20 to 30 years. In 1996, it was discovered in the US Southwest. *Karnal Bunt* has been the cause of wheat quarantines and trade embargoes affecting many countries, and there is great concern that it could spread to the major wheat producing areas in the US. The economic outcome could be devastating.
- *Wheat Stem Rust*, a highly deleterious disease in wheat, was the first plant pathogen weaponized by the US in 1955. The Soviet Union also had a plant pathogen weapons program. Although the Soviets signed the biological weapons treaty in the early 1970s, they continued to produce such weapons in massive amounts for 2 decades. It's likely that wheat stem rust is among the biological agents in the old Soviet arsenal, an arsenal that remains largely undestroyed and a potential terrorist threat. KSU has a wheat genetic engineering and breeding program to counter such threats.
- *Rice Blast Disease* and *Brown Spot of Rice Fungus* were weaponized and field-tested at several sites in the US and Okinawa. Rice disease threats are a particular concern of our Philippine, Japanese, and Korean colleagues, and understanding rice diseases has been a research priority at Kansas State.
- *Late Blight Fungus*, a potato pathogen, illustrates an issue of major concern. In the 1990s, a novel, exotic strain of the fungus that had the capacity to generate almost infinite genetic variation spawned a myriad of new races in North America and Europe. In only a few years, decades of painstaking research in the development of new resistant plant varieties and new fungicides was destroyed as distinct pathogenic and fungicide-resistant races of the pathogen spread rapidly across the continents. A similar phenomenon could occur with wheat and/or rice pathogens.
- Plant pathogen diseases, as a terrorist threat, are especially pernicious due to the ease of dispersal:
 - *African Ergot*, a disease of sorghum, was introduced inadvertently into southern Brazil in 1996. By 1997, it had spread throughout Latin America and had arrived in the northern most sorghum producing areas of Nebraska.
 - US particulate dispersal tests in South Dakota and Minnesota documented an airborne spread of the particulates to New York City, into Canada, and as far south as the Gulf of Mexico.

Animal pathogens/toxins: Animal pathogens and toxins are responsible for enormous economic losses annually. This is unquestionably true of the beef feedlot industry in the central plains states, where huge financial losses are caused by a variety of infectious diseases and antibiotic-resistant foodborne pathogens such as *Salmonella typhimurium* DT-104. Furthermore, livestock in the US are no longer vaccinated against many of the infectious agents that were eradicated here decades ago, creating at-risk populations for many deadly and highly infectious diseases. Moreover, one need not look to third-world countries to witness the near-collapse of industries and economies when food safety concerns trigger an embargo.

- *Bovine Spongiform Encephalopathy* (BSE), also known as *Mad Cow Disease*, was first observed in the UK in April 1985. From that date to 15 October 1998, 172,499 confirmed cases of BSE in cattle were identified in Great Britain (plus another 1,777 in Northern Ireland). The EEC imposed a ban on the import of UK beef in 1996. Although less than 200,000 British cattle were infected, about 4,000,000 were slaughtered as a precautionary measure. This episode, coupled with BSE-imposed controls, has cost the British taxpayers about 4.6 billion pounds (\$7.5 billion). For comparison, the specter of the National Guard having to sacrifice hundreds of thousands of cattle in US feedlots due to a bioterrorist attack is a disquieting thought.
- *Bovine Respiratory Disease* is estimated to cost the US beef industry \$800 million annually. Severe losses are predominately due to infection by bacteria, such as *Pasteurella haemolytica*, *P. multocida*, and *Haemophilus somnus*. Nearly indistinguishable from pneumonia caused by these agents is contagious bovine pleuropneumonia, a highly fatal condition caused by *Mycoplasma mycoides*. Although this agent has been eradicated from the US, its inadvertent or intentional reintroduction could ravage the US beef cattle industry. Kansas State University is well positioned to meet potential challenges due to its international leadership in clinical management, diagnosis, and research on bovine respiratory disease.
- *Johne's Disease*, caused by *Mycobacterium paratuberculosis*, is a highly contagious, slowly developing disease of cattle and sheep. Most infected cattle only show signs of the disease after five years of age, sheep after two or more years. Animals suffering from the disease lose the ability to absorb nutrients from food, and although they appear hungry and alert, they lose weight, waste away, and eventually die. The insidious nature of this type of disease would make *M. paratuberculosis* and related organisms especially problematic as a bioterrorist threat.
- *Hog Cholera Virus and Newcastle Virus* (a poultry pathogen) were the first anti-animal warfare agents' field tested by the United States. This research was initiated in 1942. Based on the results of these tests, scientists were convinced that devastating epidemics in domestic animal populations could be inflicted much more predictably than could human epidemics using human pathogens.
- *Foot and Mouth Disease* is a serious animal health problem in many countries of the world, including Cuba and other Caribbean nations. Although currently eradicated from the US, introduction into this country could devastate the cattle, swine, and sheep industries. In addition to losses due to debilitation and death, immediate sanctions would be imposed blocking exports of these animals and food products.

Zoonotic diseases are diseases of animals that can be transmitted to humans. The domestic and foreign animal pathogens capable of causing these diseases are numerous and include viruses, bacteria, rickettsia, and parasites. The spectrum of zoonotic diseases ranges from the highly infectious and highly fatal hemorrhagic fevers (such as Ebola and Hanta viruses) to the less spectacular, but equally problematic, foodborne diseases such as colibacillosis, salmonellosis, and campylobacteriosis. Zoonotic agents are a source of human illness and death, decreased human productivity and economic hardship.

- *Japanese Encephalitis* is a viral zoonotic disease of swine transmitted to humans by mosquitoes. During an outbreak of encephalitis in Malaysia in 1998-99, numerous people died, and pork consumption dropped 30 to 40 percent even though the disease is not spread via meat products; it requires the mosquito vector. An outbreak in the US is not out of the realm of possibility.
- *Tuberculosis* has awakened from its temporary quiescent period during the mid- to late-1900s to once again become a major killer. In 1990, 3 million deaths and 8.5 million new cases were reported. These numbers have increased since then due to the emergence of drug-resistant strains and an increasingly susceptible human population. *Mycobacterium bovis*, the cause of bovine tuberculosis, is highly infectious for humans and currently accounts for up to 5% of all human cases.
- *Brucellosis*, a zoonotic infection of domesticated as well as wild animals, is passed to humans by the ingestion of adulterated products, by direct contact with infected animals, or by inhalation of contaminated aerosols. The causative agent, *Brucella*, was weaponized by the US during WWII, formulated to maintain long-term viability, incorporated into bombs, and field-tested using animal targets.

Human food pathogens/toxins: Many human pathogens/toxins can be transmitted via food crops and food animals. *Trichothecene mycotoxins* occur naturally at hazardous concentrations in moldy grains, cereals, and agricultural products. The insidious nature of these toxins rests in the fact that they are effective at extremely low dosages, they can accumulate significantly in feed grains in the absence of yield reduction in the field, and they can be genetically engineered to increase toxin production and potency.

- *Mycotoxins* are produced by food- and feed-contaminating fungi and cereal pathogens (e.g., *Aspergillus* and *Fusarium*). They can cause a number of adverse health outcomes, including liver failure, cancer, and death. A close relative of the wheat scab pathogen produces the extremely potent *T2 toxin*.
- *Alimentary Toxic Aleukia* killed more than 10% of the population of Orenburg (near Siberia) from 1942-1947. The cause was a toxin (probably *T2*) produced by the fungus *Fusarium* that tainted the supply of barley, wheat, and millet. KSU has scientific expertise in the genetics of *Fusarium* mycotoxin production, which is essential to understanding how these emerging threats might be countered.
- *Ergot Fungi* pathogenic on a range of cereals produce a class of mycotoxins that are cumulative in humans and cause severe neurological disorders and eventual death. The burning symptoms and associated dementia were known in mediaeval times as “Saint Elmo’s Fire.”

Foodborne pathogens are an even greater concern, and those causing significant health problems in the US in recent years include *Escherichia coli O157:H7*, *Salmonella*, *Listeria*, *Campylobacter*, *Cryptosporidium*, *Cyclospora*, and Hepatitis A. Contamination of the domestic food supply with these and other endemic agents is already a tremendous societal burden. Unintentional contamination of food supplies is devastating, and the terrorist threat in the food arena is almost incalculable.

- *E. coli O157:H7* has caused numerous foodborne disease outbreaks in the US in the 1990s. Hundreds of people have become sick and many have died. Hudson Foods is a recent example of the economic impact of *E. coli O157:H7*. That recall of millions of pounds of ground beef caused this viable company to be sold at a fraction of its pre-recall value.
- *Listeria monocytogenes* is human pathogen that causes significant health problems, including miscarriages, meningitis, encephalitis, and death. *Listeria* can contaminate many different food products, but three major outbreaks since mid-1998 have affected deli meats and hot dogs. Millions of pounds of meat products were recalled in the US. At least 20 people died and 5 women had miscarriages during the first of these outbreaks. In the most recent example, a Michigan firm filed for protection under Chapter 11, allowing corporate reorganization after a *Listeria* recall. This company has undertaken an extensive program *under the direction of K-State researchers* to assure that the company has the most comprehensive food safety program in the US.
- *Cyclospora* is a food-borne protozoan pathogen that has recently resulted in outbreaks tied to fresh produce imported into the US. This organism can cause enteric infection, loss of appetite, diarrhea, and death in immuno-compromised individuals. This has resulted in the allocation of significant US resources for evaluation of foreign producers, to help ensure the safety of imported products.

RESPONDING TO THE THREATS:

Prevention is always the preferred option for dealing with endemic or exotic threats to our food crops, food animals, or domestic food supply. However, when prevention isn't possible, rapid response to contain the threat is the next best course of action. The food safety and security program provides preventive measures and rapid response alternatives for endemic and emerging biological threats.

THREAT	PREVENTIVE MEASURE	RAPID RESPONSE
Food crop pathogens & toxins	Breeding and engineering food crop multi-agent resistance	Identify causal agent; isolate and destroy affected crops
Food animal pathogens & toxins	Surveillance and vaccination against projected threats	Quarantine, diagnose and treat, or destroy affected animals
Human pathogens & toxins	Surveillance & decontamination of tainted food products	Identify contamination source; recall products; contain threat

AGRICULTURAL BIOTECHNOLOGY AT KANSAS STATE UNIVERSITY:

Kansas State University, because of its location and research mission, is poised to have a significant impact on agricultural bioterrorist threats. K-State is located in the heart of the central United States, in a region having an economic dependence on food and fiber production. Because of K-State's locale, it is an ideal place for research infrastructure development. The facilities will be easily accessible and available for both federal and neighboring-state collaborators.

K-State has a comprehensive *research mission in food production and in food safety biotechnology* (see Attachment 1). *One hundred and twenty faculty scientists* are involved in this agricultural biotechnology enterprise (for a listing, see Attachment 2). A large part of this effort is focused on understanding the basic principles of cellular and molecular biology, building the foundation for the practical application of these principles in fostering food production and safety. For example, there is a strong emphasis in understanding the role of genetics in development using model systems ranging from plant (wheat, rice, sorghum, soybean, and *Arabidopsis*) to animal (insect pests of grain, nematodes, and cattle) to human.

Plant Biotechnology: A strong collaborative team of researchers seeks to apply basic biological principles to enhance plant-related agricultural production. For example, the Wheat Genetics Resource Center is a repository of important germplasm for the development of new wheat varieties. Kansas State University has been active in the release of wheat varieties which resist environmental stresses, in the development of wheat varieties with improved grain characteristics, and in the development of wheat varieties genetically engineered to resist plant pathogens.

Especially important in a focus on bioterrorist threats is an understanding of how plant pathogens devastate cereal crops, and how plants may mount a defensive response. Kansas State University researchers have developed expertise in understanding bacterial, fungal, and viral plant pathogens, and in deploying defense response genes in the genome of the cereal crop. However, research to combat agricultural terrorism cannot be conducted by KSU alone. It will be essential to link basic research and monitoring activities with other strong institutions in the region and with international alliances.

- KSU has already initiated strong formal links with neighboring central plains' institutions (University of Nebraska, Oklahoma State University, and the Noble Foundation) via the Great Plains Cereals Biotechnology Consortium. This Consortium focuses on collaborative research in understanding, improving and manipulating durable and broad-spectrum disease resistance in cereal crops.
- KSU also has strong formal links to the two largest and most relevant international agricultural crop research centers: the International Rice Research Institute (IRRI, the Philippines) and the International Corn and Wheat Center (CIMMYT, Mexico). From these relationships, KSU's expertise can be applied to address distant threats to global food safety and security, and they provide distant locations for evaluating crops in which resistance genes have been introduced.

Animal Biotechnology: Animal research, as well as plant research, seeks to apply the lessons of biotechnology to the food safety enterprise. One important Kansas State University research focus is the control of infectious diseases. For example, the incidence of *rabies* within the wildlife population is an overwhelming concern, and a significant K-State program seeks both to understand the disease and to develop vaccine countermeasures. This is an interesting viral disease, since it illustrates the special threat of the epizootic interrelationship between wildlife, domesticated animals, and human populations as mutual reservoirs of pathogenic organisms. Furthermore, human intervention in the trafficking of wildlife has played a major role in its nation-wide spread. In the US, raccoons with rabies used to be confined to the southeastern United States, but hunters transferred about 500 wild-caught raccoons to the northeast and now the disease is found up and down the eastern seaboard, advancing as far west as Ohio. K-State research has directly contributed to the FDA approval of human anti-rabies vaccines. Research here has also examined the incidence/etiology of rabies in domesticated wildlife species, such as ferrets.

Examining the onset of diseases in domesticated animals can lead to important discoveries. For example, K-State research seeks to understand the cell biology of *Cryptosporidium parvum* and *Giardia* as animal intestinal pathogens, and to understand how water quality intervention can limit the spread of these in both domestic and wildlife populations. Examining the cell biology of viral infections can lead to similar discoveries, and K-State has historic research strength in examining virus/cell interactions of a number of important viral species.

Animal infectious disease research can also be used as a model for human infections. In certain instances, the identification of animal models has been recalcitrant, limiting the opportunities to devise countermeasures or vaccines. For example, food contamination with *E. coli* O157:H7 has caused considerable concern, yet few animal model systems are available to study how disease occurrence can be countered. One K-State research program is in place that may provide an animal model for understanding the efficacy of this microbe in humans.

Clearly, our best defense against bioterrorist threats is to understand the pathogenic organisms and the mechanisms by which they infect their hosts. With this information and through research, we can develop diagnostic tests, preventative regimes, and treatment countermeasures. K-State brings a strong collaborative team of researchers to this enterprise (see Attachment 2). However, a national thrust will be needed in this arena, and K-State has taken a leadership role in national and regional partnerships for the safety of food animal production.

- KSU is a member of the *Food Animal Production Medicine Consortium*, with the University of California at Davis, University of Illinois, Michigan State University, University of Nebraska, and University of Florida. This Consortium has provided much of the leadership in the area of pre-harvest (on-farm) food safety (theory and research). KSU has been a leading partner in the Consortium research.

Food Biotechnology: Research into the post-harvest processing of plant- and animal-based foodstuffs has also focused on food safety, with K-State emerging as a national leader in this area (see *Food Safety News*, Attachment 3). For example, a collaborative group of investigators have contributed significantly to the general area of meat animal processing, focusing their efforts on two broadly defined problems.

First, they have been active in developing methodologies for the detection and identification of foodborne pathogens. They are internationally recognized for advances in rapid methods for detection and enumeration of microbial and chemical contamination, and these methodologies are refined and brought to the user communities by annual workshops.

Second, they have been active in the development of pathogen intervention technologies, and have provided the meat processing industry with alternative methods for assuring that foodborne pathogens are eradicated on the product before shipment from the plant. Highly effective intervention steps have been widely adopted by the meat and poultry processing industry.

One part of intervention, when considered within the context of an agricultural bioterrorist threat, is that of access. It has been estimated that 30 grams of the toxin *ricin*, easily concealed in a pocket, could lethally poison 150 pounds of meat, enough to produce 1,500 hot dogs. K-State has expertise in security procedures that could limit the access of bioterrorists to animal processing facilities. These are important areas of focus, since the CDC has estimated between 6 and 33 million illnesses annually are caused by foodborne pathogens in the US, with perhaps as many as 9,000 deaths.

Clearly, K-State has research capabilities that can be directed against agricultural bioterrorist threats, however a national effort is needed. K-State has taken a leadership role in developing consortia that should be an asset in this research arena:

- *Food Safety Consortium.* KSU (beef), University of Arkansas (poultry), and Iowa State University (pork) have collaborated for over a decade in research, education, and technology transfer.
- *National Alliance for Food Safety.* Twenty universities, three USDA agencies, and industry and consumer groups have joined forces to better plan and coordinate national food safety initiatives.
- *North American Agromedicine Consortium.* This K-State/University of Kansas Medical Center partnership permits Kansas to enter an 18-state alliance on health safety issues covering the entire agricultural sector.
- *Farmland Industries Research Alliance.* The goal of this K-State/Farmland alliance is to enhance research in animal nutrition, feed manufacturing, and safety and to reduce costly duplication of university/industry research activities.

Support Capabilities: K-State has invested in specialized research facilities and programs that benefit the researcher focusing on food safety. Likewise, these could aid in research to counter bioterrorist threats.

- ***Electronics Design Laboratory (EDL).*** The EDL staff are expert at developing electro-optic and remote sensing systems, instrumentation systems involving data acquisition and signal processing, and novel sensors (see Attachment 4). Detecting and tracking pathogens in food crops and food animals are national priorities, and the EDL can be a partner in developing novel applications of advanced technology. The ideal biological detection and disease management system would minimize human contact with infected materials, permit rapid surveying of large plant or animal populations, and differentiate pathogenic and non-pathogenic agents from natural backgrounds and interference. The EDL staff has a track record of achievement in the development of novel sensors. Their existing partnerships with K-State researchers, as well as a growing alliance with federal research laboratories, make the EDL uniquely positioned to provide system-level solutions to rapid disease detection and monitoring needs.
- ***Geographic information systems (GIS), remote sensing, and image analysis.*** A collaborative team of K-State investigators has acquired the baseline data and the expertise needed to provide epidemiological assistance in countering bioterrorist threat activities. The geographic analysis technologies of remote sensing and GIS provide important ways for K-State researchers to assess environmental change. Capabilities can be summarized as measurement, mapping, monitoring of change, and modeling of the environmental system. Two decades of satellite imaging data, produced in part by NASA's Mission to Planet Earth initiative, provide baseline information for understanding environmental change.

The current K-State focus is on two parameters in the environmental change process. First, researchers are examining the impact of human land use practices on environmental change. Land, taken out of cultivation and/or farmland use, is subjected to different pressures and this results in a different landscape ecology. For example, prairie taken out of cattle grazing has caused the expansion of eastern red cedar trees into the Flint Hills rangeland areas. Ongoing work is documenting the importance of land cover change associated with dryland crop rotation relative to the longer-term trend toward an increased amount of acreage in irrigation. Second, researchers examine the impact of weather, such as rainfall, on environmental change. With these techniques and baseline data, this interdisciplinary team can: (1) use remote sensing techniques to diagnose the difference between healthy and stressed vegetation; (2) assess the magnitude of the stresses; (3) map patterns to document change (such as the spread of an invading disease in a cropland); and (4) devise models to characterize how invasions occur and to characterize the impact of countermeasures.

- ***Biotech Core Laboratory (BCL).*** The BCL has both synthetic and analytical capabilities that could help to detect and ameliorate peptide/protein biohazards. Four peptide synthesizers can produce peptides up to 50 residues in length, and BCL expertise has used this strategy for preparing domain-specific immunological probes in rabbits. Such probes may be of value in rapid detection strategies. Two peptide sequencers and a time-of-flight MALDI mass spectrometer are analytical tools that may provide a means to identify unknown peptides or toxins. The BCL has active collaborations across the K-State campus, and growing partnerships with industry.

- ***Economic Modeling:*** Natural or man-made disasters can have significant short-term and long-term economic impacts on the agricultural economy. Of course, factors such as the size of the geographic region affected, the importance of the region to the world's supply of various commodities, and the long-term effect on the production capability of the land would determine the magnitude of the economic impacts. Agricultural policy simulation models will be used to estimate the economic impacts of various natural or man-made disaster scenarios on agricultural commodity supply and prices. Estimates of reductions in crop yield and livestock production provided by agronomists and livestock production specialists will be entered into the policy simulation model and ten-year policy simulations will be completed. These simulations will provide estimates of the impact of the disaster event on total production; use of fertilizers, agrichemicals, seeds, and other inputs; commodity prices; and agricultural income in production regions across the United States. Impacts on worldwide food balances, including trade flows and world price, can also be estimated for the ten-year period.

At the state level, a 69-sector, survey-based input-output model of the Kansas economy has been developed. This model is a quantitative framework of analysis for measuring the complicated interdependence of industries in the Kansas economy. The model measures the sales of each Kansas industry to the other Kansas industries and to industries outside Kansas. It also measures the purchases of inputs of each Kansas industry from other Kansas industries and from industries outside Kansas. The model has output multipliers for each of the 69 sectors. For example, the multiplier for heavy construction is 2.765. Thus, if a disaster reduced output in the Kansas heavy construction industry by \$50 million, the negative effect on the Kansas economy would be \$138.25 million. This modeling capability will allow Kansas State to predict and analyze the economic outcomes of agricultural bioterrorist acts.

- ***Communication and Outreach System:*** K-State has developed an extensive communication and outreach system that enables researchers, educators, and clinicians to engage in consultation and provide services throughout Kansas and the nation. The Regents Educational Communication Center (ECC) on the K-State campus and the National Agricultural Satellite Service, A*DEC (formerly, AgSat), at the University of Nebraska, in combination with K-State's charter membership in Internet II, places K-State at the hub of a communication system that would play a central role in any crisis. In addition, the Cooperative Extension Service at K-State has extensive experience in dealing with crisis communication. This system was tested fully during the 1993 floods and the aftermath provision of family and community support services.

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FOOD SAFETY & SECURITY DUAL-USE RESEARCH:

Conceptual Basis: The integrity of our nation's food supply has been an historical, significant, and comprehensive issue in public health and safety. It is an issue that rightly consumes considerable resources. For example, local, county, and/or statewide level programs are in place to regulate the sanitation conditions in areas of public food preparation. Restaurants are regulated and inspected. School cafeterias are scrutinized for microbiological safety and for the integrity of food preparation procedures. The application of food-safety microbiology is enforced at significant cost to the taxpayer.

On the regional front, food safety issues have motivated interstate collaboration on a variety of issues. Most of these focus on matters that strike at the economic core of regional interests. For example, a long-standing interstate collaboration funded by the USDA focuses on understanding the epidemiology of *wheat leaf rust* in the annual spread of the disease from the Gulf of Mexico to North Dakota, following the seasonal progression of wheat production in the central US region.

Nationally, resources are in place to protect our citizens from unsafe foods, both from *within our borders* and from *our imports* of foodstuffs. A nationwide system of production inspection protects our animal food-processing program. Considerable investments in local, statewide, regional, and national programs are in place to assure our citizens' trust in the foods that they consume. This infrastructure can be applied, in a dual-use manner, to food safety issues that might be impacted by agricultural bioterrorism.

The previous section, *Threats and Capabilities*, outlined three special areas of concern in the continuum of "field to fork" processes. That section cited known concerns about the introduction of exotic pathogens, whether inadvertent or intentional, into three levels of our national food crop/food animal/food production safety continuum:

- ***Crop plant production could be compromised by plant pathogens:*** Clearly, plant diseases have the potential to destroy large acreages of crops covering very large areas and to spread across continents in only a few seasons. The threat they continue to pose to global human food security is unquestioned. However, even plant pathogens and their relatives that might cause little direct losses can produce powerful toxins that, among other effects, can lethally contaminate food supplies. KSU expertise is focused on the resistance of cereal crop plants against their pathogens. We have expertise in the basic cell biology of resistance, both systemic and acquired, and we seek to understand how to deploy resistance genes to affect long-term, durable resistance against a host range that includes many dangerous exotic agents.
- ***Food animal herds could be compromised by tainted feed or by a pathogen threat:*** If a pathogen strikes the food animal species exclusively, the result may be limited to a collapse of the food production industry. However, many diseases of farm animals transcend that specificity. Many pathogens can exist in wildlife reservoirs and, therefore, are epizootic. Others can also infect human populations and, therefore, are zoonotic. One example of a disease that has both characteristics is *Rabies*, an area of

considerable expertise at K-State. We also have an emerging strength in the understanding of the genetics of pathogenic microbes, and are developing systems whereby this knowledge can be used in a diagnostic context. Development of rapid, specific diagnostic tools against a variety of animal pathogens and toxins would provide an advantage in combating disease scenarios in crowded feedlot situations.

- ***Foodborne pathogens or toxins could compromise food production systems:*** International examples of foodborne outbreaks that compromise production systems include Mad Cow Disease, a disease mandating the slaughter of 4 million cattle in the United Kingdom, and an embargo by the EEC that devastated the beef producing industry. US national problems include *E. coli* O157:H7, drug-resistant *Salmonella* and *Campylobacter*, *Cryptosporidium*, *Cyclospora*, and *Hepatitis*. KSU expertise is focused on the clinical detection of these pathogens, and on developing decontamination countermeasures that may be employed to ensure a safe food supply. This expertise applies to the food animal production industry, regarding both the prevention of and decontamination of deadly inoculations during meat processing.

A nationwide investment in food safety must be focused on pre-harvest (plant and animal) and post-harvest (plant and animal) aspects of agricultural biotechnology research. To derive the greatest returns, this investment should also be available to enhance research addressing agricultural bioterrorism.

Two requirements appear certain. First, there is an urgent need for *food safety research infrastructure*, especially a flexible, dual-use biocontainment facility in the food and fiber production region of the central United States. Second, *food safety research programs*, like those in place at Kansas State University, must be enhanced to meet and neutralize emerging agricultural bioterrorist threats.

Production of crops for human and domestic livestock consumption: Introductions of exotic plant diseases have caused catastrophic crop losses, famine, and untold suffering throughout the course of human history. Ancient records from China, India, the Middle East, and Europe repeatedly refer to famines following blights or rust epidemics. With global movement of plant material commonplace, mobile plant pathogens hitchhike with disastrous consequences. The Irish potato famine, caused by *Phytophthora infestans*, inflicted massive loss of life and an exodus of an ethnic people from their homeland. *Fungal wilts* of banana and *African ergot* of sorghum have also caused economic and human health hardship.

The scope for agricultural terrorism is broad indeed. The economic impact, for example, of wheat exports on the central US region is astounding. On average, Kansas produces 495 million bushels of hard red winter wheat, representing about 40% of the US total. These wheat varieties account for nearly one-third of the total US wheat export, and could be subject to immediate embargo should diseases like *Karnal bunt* be introduced.

To address the most likely catastrophic eventualities we must focus our research and germplasm development on the principal human food cereals and feed grains and their pathogens. Kansas State University has state-of-the-art research facilities and world class scientists in most of the areas that must be addressed to prevent and combat

agricultural terrorism. Research strategies to minimize the terrorist threat to our food supplies, as a part of this agricultural homeland defense initiative, include the following:

➤ ***Development of broad-spectrum resistance to diseases:*** This dual-use thrust involves the development of resistance mechanisms that will be effective against pathogens previously considered to be of little consequence, or even unknown. This is in contrast to the current approach of breeding for resistance to specific diseases, i.e., the current approach focuses efforts on specific resistance to common high priority pathogens, and will not be as effective in protecting our crops from intentionally introduced exotics. This proposal presents a change in our approach to breeding for resistance properties.

- Kansas State University has an aggressive and internationally known research program on understanding and manipulating broad-spectrum resistance to bacterial and fungal pathogens of wheat and rice. This program must be expanded to include additional microbes that are exotic to the Kansas landscape and that are important pathogens to our Southeast Asian allies.
- Because of the importance of wheat on the Kansas economy, strong partnerships between Kansas State University and commodity production groups like the **Kansas Wheat Commission** have focused on wheat improvement. One outcome has established the **Wheat Genetics Recourse Center** at KSU (URL: <http://www.ksu.edu/wgrc/>). This group has released over forty germplasm wheat lines in the past 14 years (see: <http://www.ksu.edu/wgrc/Germplasm/grmplsm.html>) and maintains over 2,000 wheat germ lines. The latest releases have focused on genes conferring resistance to *Spetoria nodorum*, wheat curl mite, tan spot fungus, powdery mildew, Russian wheat aphid, and wheat leaf rust. Therefore, they have developed wheat cultivars with genetic backgrounds having specific disease resistance properties, and these are available for the introduction of broad-spectrum resistance.
- KSU is ideally situated to study dangerous pathogens to rice. First, there is a major concentration of expertise on rice disease resistance and pathogens at KSU. This includes an understanding of the plant resistance mechanisms and of the genetic properties of the pathogens that elicit resistance responses. Second, there is little risk to surrounding croplands, because rice is not a major Kansas crop. Third, much of the information generated from research on rice can be almost directly applied to wheat, corn, and sorghum, and these crops are a part of the KSU neighboring landscape.

➤ ***Development of means for identifying and evaluating threats:*** It will only be possible to respond to emerging threats effectively if the responsible agent can be identified. And, this must include the potential for the threat to be a genetically modified pathogen.

- The location of Kansas State University places it squarely in the center of any likely agricultural terrorist attack. Thus, it is ideally suited and situated to assume the role of lead research and identification center. Moreover, the biotechnological

expertise in a range of cereal crop pathogens makes it an ideal center for developing rapid diagnostic tools.

- ***Understand the nature and evolution of pathogenesis and virulence:*** In order to predict how pathogens might be utilized by terrorists, it is essential to understand how pathogens cause disease in plants, and what regulates disease severity. This requires fundamental knowledge of the cell biology of pathogen infection, on the genetics of developmental events in crop plants, and ecology of disease pathogen spread.
 - Kansas State has a wealth of expertise in understanding and manipulating the molecular and genetic basis for pathogenesis in plants in a range of viral, bacterial, and fungal pathogens. This includes an understanding of the cellular biology of the host species, the developmental mechanisms that regulate form and function, and the microbial ecology of complex cropping systems.
- ***Development of exotic resistance:*** Manipulation of plant disease resistance to pathogen attack may not be sufficient to nullify disease from genetically modified pathogens. Thus, research must concentrate on the introduction of completely novel resistance mechanisms. There is evidence that basic disease resistance mechanisms from other plants, and even animals, can be transferred to plants and remain effective. These should be superbly effective against a range of target pathogens.
 - KSU and its collaborators from the University of Nebraska and Oklahoma State University are actively exploring the possibility of introducing genes from other plant species, as well as from poultry and mammals into plants, to confer broad-spectrum resistance.
- ***Understand the nature and evolution of toxin synthesis by plant pathogens:*** In order to detect and neutralize mycotoxins, we must be able to identify them in all their variants, and determine which pathways are most easily transferred among different microorganisms.
 - KSU has scientific expertise in the genetics of mycotoxin production in the key fungus pathogen *Fusarium*. Such rare expertise is an essential foundation to understanding the potential for mycotoxin production in field strains of pathogens.

The research efforts to combat agricultural terrorism outlined above cannot be conducted by KSU alone. It will be essential to link basic research and monitoring activities with other strong institutions in the region and internationally. KSU investigators have linkages to regional partners and to international collaborators in the arena of plant molecular biology and food crop safety.

Safety of food animal health: As has been the case with food crop plants, an introduction (either inadvertent or intentional) of pathogens to food animal production systems has the potential to be economically devastating. A crushing blow to the British livestock industry occurred by the discovery of *Mad Cow Disease* (BSE), causing the

destruction of about 4 million animals, with less than ten percent actually having the disease. Foot and Mouth Disease was found in California in the 1920s, and a large number of animals were destroyed. Foot and Mouth Disease is currently found in Cuba, and this Caribbean nation is almost certain to reenter the US trading sphere within the next decade. Perhaps the most pernicious type of pathogen is one that is extremely deadly, yet with an onset time long enough to permit animal shipment (and subsequent infection of other herds) before the disease is noted. *Johne's disease* is one such pernicious disease, caused by *Mycobacterium paratuberculosis*. It is highly contagious and develops slowly in cattle and sheep. Most infected cattle only show signs of the disease after five years of age, and although they appear hungry and alert, they lose weight, waste away, and eventually die.

The health of the nation's food animal production requires: (1) a rapid detection of infected animals; (2) cessation of shipment when there is a danger of animals spreading a disease; (3) quarantine of infected herds; and (4) application of effective countermeasures to eradicate the disease while minimizing animal pain and suffering. A long-term strategy should be devised for the tracking of disease-free animals, for their certification as "disease-free" by reliable diagnostics, and for the capacity of logging a national database for these activities. Such a strategy should be thought-out in advance of a tragic event similar to the BSE outbreak in Britain, and should be a partnership between the federal government, state agencies, and commodity producing groups.

Three areas of research activities are needed to meet the US national food animal safety needs:

- ***Rapid, reliable, and sensitive diagnostic tools:*** In order to detect infected animals and infected animal food products, reliable diagnostic tests are required. Current clinical methods in the detection of agricultural pathogens, although reliable, are slow, costly, relatively insensitive, and greatly limit the numbers of tests that can be performed. For example, consider the standard tests for *E. coli*. The US production of ground beef exceeds 7 billion pounds per year. Less than one ounce in every 1.2 million pounds is tested for *E. coli* content. Current practices are not in step with emerging potential. Rather, the goal should be to detect the pathogen in the animal *before* clinical manifestations are apparent. Our research goal is to develop such sensitive and rapid techniques, and K-State researchers have an expertise in these critical activities.
- KSU has developed a number of *Enzyme-Linked Immunosorbent Assays* (ELISAs) for use in clinical settings. These include the use of ELISAs in the determination of ferritin levels in the serum of dogs and cats, and for the rapid detection of *Bovine Herpesvirus-1* in cattle. Similarly, ELISAs are under development for pneumonic diseases of cattle, and that can detect surface antigens and secreted antigens of *Pasteurella haemolytica* and *P. multocida*. Certain products, such as novel monoclonal antibodies against *Bovine Coronavirus Type III*, are already licensed to a major pharmaceutical company and are nearing commercialization.
- PCR-based technology holds the brightest future for diagnostics that can

specifically distinguish pathogenic strains (from non-pathogenic variants or related species), can have a high through-put of diagnostic tests, and can deliver reliable results at modest costs. The use of this method to aid in *Rabies* diagnosis is proposed, with a short-term goal to develop a PCR-based test that can distinguish virus strains circulating in the midwestern region. The long-term goals are both to increase the database on the occurrence of the virus in this region, and to develop technology that can identify the virus before clinical manifestations and at a time when vaccination countermeasures would still be effective. Developing PCR technology for detection strategies of *Rabies* would complement a K-State leadership role in the understanding of this epizootic/zoonotic disease and in the development of vaccine-based countermeasures.

- K-State expertise in developing nucleic acid-based pathogen detection systems has grown during the past decade. These include PCR-based procedures for a number of infectious agents, such as *Eperthrozoon suis*, *Bovine Respiratory Syncytial Virus*, *Cryptosporidium parvum*, *Salmonella*, and *E. coli O157:H7*. Our next step, and a critical feature of our activities here, is to develop these as automated systems for veterinary medicine diagnostics, food safety monitoring, and food animal disease-free certification purposes. Toward this end, partnerships with industry have been developed, and these industries will be critical players in helping us protect the nation against agricultural bioterrorist threats.
- ***Assessing the efficacy of the rapid procedures in the food-processing continuum:*** Many foodborne pathogens are inadvertently introduced into the food production chain at the production (on-farm) level. Cross contamination and spread of contamination occurs readily in the highly concentrated food-processing sector where there is a mixture of raw food products from a large number of different on-farm sources. While control measures at the processing level must be part of the strategy to assure food safety, the incidences of diseases caused by *E. coli O157:H7* have increased despite the fact that many new control measures have been imposed in meat processing plants during the past 5 years. As a result, there is a strong research need to examine the extent to which food safety risks continue, as infected animals (from sub-clinical to acute infection levels) are processed. There is also a research need for a facility that permits the study of infection of food animals, coupled with the processing of those animals, in the assessment of safety risks and the application of countermeasures. This capability does not currently exist anywhere in the United States. The proposed physical infrastructure enhancement (described in the next section) will provide such a facility.
- A partnership between Kansas State veterinary clinicians, animal health physiologists, and animal science/industry practitioners is poised to examine the impact of sub-clinical infection of food animals on the safety issues impacting food animal processing. This interaction, coupled with the proposed BL-3(Ag) facility, would bring K-State's leadership role in this arena to world-class prominence. The facility would provide an enhanced venue for regional, national, and international collaborations.

- ***Designing a model food animal tracking system:*** Should our food-safety needs require an animal-specific disease-free credential in the future, the US must be poised to act. A tracking system could be mandated, should the US food animal safety industry be faced with an exotic disease. The British response to the Mad Cow Disease, as extended to the EEC community, provides a model response to a devastating economic scenario. As of 1998, Britain had issued over 5 million cattle “passports” that track the pedigree and disease-free status of individual animals, applying it to imports and domestic production and to beef and milk production. It took years and the destruction of millions of cattle to solve the embargo-related economic disaster in Great Britain. This type of system, should it be necessary in the US, would require an adequate disease diagnostic system coupled with computer-based tracking, and it should be a priority in any emerging threat program.

Integrity of food processing systems: Foodborne diseases, as they occur in the food animal processing industry, are vivid examples of how illness and death can undermine national security. From a research perspective, they represent a cycle of research/regulation mismanagement. For example, USDA regulations and industrial practices mandate that processing facilities be largely free of foodborne microbes. USDA regulations forbid their introduction into industrial settings. Thus, research/teaching meat processing facilities that are set up according to USDA guidelines cannot use intentional inoculation by foodborne disease organisms as an experimental approach toward determining the efficacy of antimicrobial countermeasures.

There is an acute need for a *pre- and post-harvest food safety biocontainment research facility* in the agricultural region of the central United States. This will allow an integrated approach for inoculating animals for observation and manipulation, with the processing of the inoculated animals to assess the resulting food products. Food safety advances will be realized only through integrated risk reduction practices combining pre-harvest and post-harvest phases of food production.

The current meat processing facility at Kansas State University is USDA-inspected and certified and, as such, is valuable for training students in meat science and food processing under current industry conditions. However, because the facility is federally inspected and the product can be sold for human consumption, it is forbidden for pathogens to be intentionally introduced. Tests of intervention practices and/or control methodologies are limited to contaminants (microbes and toxins) that are native to the carcasses and that are largely present in relatively low amounts.

Research intervention strategies during meat processing procedures are a main focus at KSU. The construction of a BL-3(Ag) facility will address a major deficiency that limits the expansion of K-State expertise into biosafety concerns of agricultural bioterrorism.

- K-State researchers have been active in the development of pathogen intervention technologies, and have provided the meat processing industry with alternative methods for assuring that foodborne pathogens are eradicated on the product before shipment from the plant. Highly effective intervention steps have been widely adopted by the meat and poultry processing industry. These include, for example,

steam treatment of product for surface sterilization. Continued process development activities will focus on exotic foodborne pathogens that would likely constitute a bioterrorist threat.

- Partnerships with industry are in place for the use of novel strategies in process development activities, some based on technologies developed at K-State. One such licensing partnership is with **Nantek, Inc.** (Attachment 5), a company developing novel, reactive nanoparticle products with great potential for destroying both biological and chemical hazards (e.g., anthrax spores and nerve gas). Another, **Water Technology Corporation (WTC)** markets a penta-iodide resin, invented at K-State, that has broad-spectrum water sanitation properties. These partnerships will be expanded in the research efforts focused toward agricultural bioterrorist threats.

The goal of developing processing procedures that ensure product safety is closely coupled to a need for detection systems that rapidly, reliably, and sensitively identify foodborne pathogens. K-State researchers have an emerging expertise in the use of modern molecular and nucleic acid based technologies for such industrial-based diagnostic operations. These industrial-based diagnostic tools are complementary to the clinical methods that are proposed above.

- K-State investigators in the clinical science disciplines have been using PCR technology to develop probes that are specific to virulent subspecies of *Rabies*, *Eperthrozoon suis*, *Bovine Respiratory Syncytial Virus*, *Cryptosporidium parvum*, *Salmonella*, and *E. coli O157:H7*. Critical to their utility in an industrial setting is their sensitivity. There is a need to sample small amounts of product, using sampling techniques that cover large volumes of product throughput, and reliably detect pathogen concentrations far below human health threat levels.
- Partnerships are in place to enhance these efforts. **FoodLabs, Inc.** (Attachment 6), a local food safety laboratory, has broad-based expertise for detecting biological and chemical hazards in food products. Furthermore, the company provides custom solutions to industry food safety problems, preferably before a problem occurs, but responding to emergencies when need be. Additionally, the K-State **Electronics Design Laboratory (EDL)**, Attachment 4) has the design capabilities to help automate PCR-based detection technologies. The EDL also has considerable experience in the design and fabrication of remote biosensors that may be useful in this context as well.

Expected Outcomes: Three independent but interrelated research themes – crop plant disease prevention, food animal health, and pre- and post-harvest food safety – will greatly improve America’s homeland defense against emerging biological threats while protecting our food supply and people from ever increasing endemic threats. ***K-State’s dual-use approach will be solving today’s food crop, food animal, and food safety problems, while preparing to meet and defeat emerging threats of tomorrow.*** The research strategies pursued will protect and enhance the viability of an important sector of our nation’s economy by providing new resistant cereal crop varieties, new sensitive diagnostic tools for the recognition of important pathogens and toxins, and new processing procedures to ensure the pathogen-free, toxin-free status of our food products.

The strategies will impact the food safety and security of our nation, by focusing on agricultural pathogens that are likely candidates for deployment by bioterrorists.

The expected outcomes of these research activities include:

- Wheat, rice, sorghum, and corn engineered with broad-spectrum durable resistance. This resistance may extend to bio-threat species, thereby preventing outbreaks in case of a terrorist event.
- Genetic reference libraries for pathogenicity genes of major and minor cereal crop pathogens, and for pathogens of important food animal species.
- Genetic probes for rapid detection of pathogens, both plant and animal, constructed using genetic reference libraries.
- Detection kits for mycotoxins in field stands of crops, in feed, and in consumable animal products.
- Reserve resistance genes ready for incorporation into cereal genomes.
- Rapid, automated monitoring systems that are useful in cereal crop fields, in a clinical detection of animal health threats, and in a food production setting (pre- and post-harvest) for the elucidation of foodborne disease organisms.
- Elucidation of broadly applicable means to protect food products from biological agents and to eradicate pathogens and toxins contaminating these products.

Conclusion: The ever increasing efforts directed toward protecting American citizens in densely populated areas from biological and chemical terrorism will prove to be truly beneficial only if and when the threat becomes reality ... and, then, only if the actual agent used was anticipated. The research program proposed above would yield solutions to everyday problems affecting our agricultural resources and domestic food supply, and, beyond that, it would help the nation prepare for emerging threats whether accidentally or intentionally introduced. Ensuring our food safety and security by this means is a clear dual-use solution.

RATIONALE & MISSION

THREATS & CAPABILITIES

DUAL-USE RESEARCH

DUAL-USE FACILITY

ADVANCED EDUCATION

PUBLIC OUTREACH

BUDGET & JUSTIFICATION

UNIQUE ATTRIBUTES

DEFENSE RELATEDNESS

ATTACHMENTS

FOOD SAFETY AND SECURITY DUAL-USE FACILITY:

An ambitious program in food safety research and education has been proposed at Kansas State University. A part of this program is already in place, as an existing component of the overall mission of the institution. Research programs in crop productivity, in the cellular biology of pathogenic infection, and in the biotechnology of food processing are in place. Education and outreach activities are ongoing, with lines of communication open between researchers and students, concerned industry officers, and the general public. This proposal seeks to *enhance the existing program elements*, and thus provide additional momentum for the positive steps that K-State activities have on the economics of food safety issues. Furthermore, this proposal seeks to direct K-State activities in a manner that they would be useful in the event of an agricultural bioterrorist threat. The complementary nature of these program elements – serving the food safety needs of the regional agricultural community and offering safeguards that impact the security of the nation’s food supply – demonstrates that this program will have a positive impact even in the absence of a food-related bioterrorist act.

A facility is proposed that will allow the K-State research program to develop in ways that are currently not possible. Furthermore, it will provide national and regional collaborators, both from neighboring academic institutions and from national laboratories, a facility that is uniquely focused on the agricultural aspects of biosafety. The facility would be available for routine collaborative research. As a dual-use facility, it would be available for first-response needs that might arise due to food crop, food animal, or food safety bioterrorist activity.

We propose the construction of a BL-3(Ag) biocontainment research laboratory building of approximately 127,000 net available square feet. The facility, with an abbreviated rationale, is outlined in the pages that follow. It is a necessity to allow K-State research efforts to be directed in three major ways:

- ***The biotechnology of multi-component resistance of crop plants against pathogenic threats.*** Understanding the molecular genetic mechanisms of defining and transferring disease-resistance genes in crop plants is a current research enterprise. A BL-3(Ag) facility will be critical in assessing the success of moving these genes into plants, by challenging the plants with the pathogens.
- ***The clinical and diagnostic challenges of keeping the food animal supply safe.*** Many of the pathogens and toxins affecting our food animals are hazardous to humans as well. A biocontainment facility is required to work safely with these biological agents.
- ***The biotechnology of biosafety in food production activities.*** Current facilities, for example, do not permit the introduction of foodborne pathogens to the product in food-production trials, in order to assess the efficacy of detection and countermeasure technologies.

AGENCY: Kansas State University
 DATE: April 1, 1999

PROJECT REQUEST EXPLANATION
 FISCAL YEAR: 2001

DA-418B

1. Project Title: Food Safety & Security
 Research Facility

2. PROJECT PRIORITY:
 KSU) ___ Regents ___

3. **Project Description and Justification:** Kansas State University (KSU) is positioned to play a leadership role in food crop, food animal and food safety through research, education and outreach. Faculty members from many KSU Colleges have expertise in areas that are relevant to emerging biological and chemical threats for pre- and post-harvest food safety, animal disease (including diagnostics, detection and treatment), crop plant resistance to disease and pests, and countermeasures for biological and chemical agents. These diverse capabilities in dealing with endemic risks provide a mechanism for protection against emerging threats whether natural, accidental or intentional by applying existing capabilities to the problems. The results may have a positive impact not only on the economy, but also on the over all health and welfare of animals and people. However, for this advanced level of research to occur, the proposed facility is a necessity.

The requested funding source for this project will be from Federal Funds. Review and approval of the Joint Committee on State Building Construction is required. Statutory authorization is required.

4. Estimated Project Cost:		5. Project Phasing:	
1. Construction, including fixed equipment & site work	\$61,211,454	1. Preliminary plan, including miscellaneous costs	\$2,000,000
2. Architect/Engineering fee commissioning.	10,302,918	2. Final plan, including miscellaneous costs	10,000,000
3. Movable equipment	2,850,000	3. Construction, including miscellaneous costs	74,243,174
4. Project contingency	6,060,540		
5. Miscellaneous costs	1,818,162		
Total:	\$82,243,074	Total:	\$82,243,074

6. Recommended Financing					
Fiscal Years	AMOUNT BY SOURCE OF FINANCING				
	1. SGF	2. KEBF	3. Federal	4. Other	5. Total
Prior Years					
FY 2001			\$2,243,074		\$2,243,074
FY 2002			20,000,000		20,000,000
FY 2003			30,000,000		30,000,000
FY 2004			20,000,000		20,000,000
FY 2005			10,000,000		10,000,000
Subsequent Years					
Total			\$82,243,074		\$82,243,074

FOOD SAFETY AND SECURITY RESEARCH FACILITY

Introduction

Through their mission of teaching, research and service, the Colleges of Veterinary Medicine and Agriculture, along with several other Kansas State University (KSU) colleges have a focus on assuring the health and well being of food crops and animals and food safety and security.

Although a great deal of progress has been made, crop and animal diseases represent a major limitation to agriculture's contribution to the Kansas economy. In addition, infectious diseases in all crops, domestic animals and wildlife are a major concern in the areas of public health, food safety, international security, commerce and animal welfare.

Infectious diseases of food animals represent a major loss in the form of wastage, increased production costs and risk of spread of disease to other animals and in some instances to human beings. These diseases substantially reduce profitability of food and fiber production by causing death and morbidity, increasing cost of production by reducing feed-efficiency and growth rates and other direct costs associated with disease prevention, treatment and control. Infectious diseases are the primary cause of restriction to interstate and international movement of plants and animals and retard trade nationally and worldwide. Bacterial and viral contamination from farm animals and farm environments are major causes of food-borne diseases in human beings.

Zoonotic diseases are a major worldwide cause of human suffering, economic loss, death and are at the core of potential biological terrorist activities. The use of antibiotics to limit the impact of animal disease and to improve productivity may limit the utility of these same drugs in treating human infections by inducing antibiotic resistance in pathogens.

Approximately 75% of all human caloric intake and half its protein comes from cereals. Furthermore, the food stuffs for domesticated beef, swine and poultry is primarily cereals as well. Plant diseases have the potential to destroy very large acreages of crops by spreading across continents in only one or a few seasons. Certain plant pathogens and their relatives cause little direct loss of total crop production. Yet those microbes can produce powerful toxins that, among other effects, can lethally contaminate food supplies and raise the possibility of an economically disastrous embargo of Kansas food products.

Complicating the efforts to control infectious disease is the emergence of new pathogens and the increased movement of plant, animal and biological products worldwide as a part of world trade and travel. In a production and trade environment beset by new or changing infectious disease threats, the control of plant, animal and human diseases are interdependent, and their prevention or treatment is dependent upon a constant flow of new scientific discoveries from research facilities specifically constructed for infectious disease and food safety and security research.

Current Conditions/Justification

Kansas State University (KSU) expertise relevant to emerging biological and chemical threats includes, but is not limited to, pre- and post-harvest food safety, animal disease (including diagnostics, detection and treatment), crop plant resistance to disease and pests, and countermeasures for biological and chemical agents. These diverse capabilities in dealing with endemic risks provide a mechanism for protecting the nation against emerging threats whether natural, accidental or intentional by applying existing capabilities to the problem.

Plant Biotechnology

A major focus of plant-related biotechnology research at KSU is on the cereal crops that provide a large portion of the human caloric intake. This is a focus that is extremely important especially from a state-wide perspective, due to the leadership of Kansas in the national production of wheat. In approaching emerging biological threat issues, plant scientists have taken a strategy of 'prevention'. Seeking to understand the biological basis of plant/pathogen interaction and by genetic means enhance crop plant abilities for defense provides a "dual use" strategy. It enhances our existing crops, while preparing for an introduction of an exotic or infectious pathogen. Some areas of expertise include: the understanding and manipulation of resistance genes to bacterial or fungal pathogens of wheat and rice; the molecular and genetic bases for pathogenesis in plants in a range of bacterial and fungal pathogens; identifying resistance genes from other plant or animal species and, by application of transformation technology, mobilizing those genes into cereal crops; conferring durable, broad spectrum resistance; and cellular and genetic basis of developmental mechanisms, that impact upon resistance processes. In these areas, Department of Plant Pathology investigators have active collaborations in place with several mid-western universities and strategic international research organizations.

Animal Health Biotechnology

Kansas State University researchers in Veterinary Medicine have a long and distinguished history in the area of food animal infectious disease research. The faculty have discovered the causative organisms (pathogens) of a number of extremely important livestock diseases and have made both fundamental and applied discoveries that led to the prevention or control of many livestock diseases. In addition, significant contributions have been made for the prevention of human diseases, including food-borne diseases caused by infectious agents transmitted into the food production system by infected food animals. While the work accomplished is laudable, it has been repeatedly compromised because of lack of adequate infectious disease research facilities with even minimal standards.

Several potent and devastating domestic animal diseases are currently not found in Kansas. These include hoof and mouth disease (HMD) and mad cow disease (MCD). Epizootic diseases are

pernicious since they can have reservoir pathogen populations in wildlife species. Zoonotic diseases are of concern since they are also infectious to humans. Some are pathogenetic organisms which are emerging threats. Some because of trade or travel considerations, could be exotic introductions. KSU expertise is necessary for the development of diagnostic and treatment protocols to deal with inadvertent or intentional introduction of exotic domestic animal pathogens. From their inception, the animal health biotechnology disciplines at KSU have recognized their limitations in meeting the needs of the Kansas livestock industry. They do not have the infrastructure for meeting the infectious disease research needs of their constituents.

Food Processing Biotechnology

Faculty research activities have established KSU as a leader in post-harvest food safety research, particularly in the areas of food-borne pathogen detection and in the development of pathogen intervention technologies for meat processing. Researchers are also well recognized for advances in rapid methods for detection and enumeration of microbial and chemical contamination and for highly effective intervention steps that have been widely adopted by the meat and poultry processing industry. However, the government in approving these processing technologies and the industry in implementing them is now requiring in-depth and full-scale inoculated studies to be conducted under actual pilot plant conditions. These “validation” studies mimic commercial production and provide concrete evidence on the technologies antimicrobial effectiveness when used in the production environment. Additionally, such a controlled validation facility would allow researchers to evaluate the effectiveness of integrated intervention steps, including the live animal phase. Presently, bio-contained research facilities to allow this type of research do not exist in the United States.

The current meat processing facility is a USDA inspected facility, and as such, is valuable for training students in meat science and processing under current industry conditions. However, because the facility is a federally inspected facility, and product can be sold for human consumption, it is forbidden for pathogens to be intentionally introduced into the facility. Department of Animal Science and Industry researchers are able to test intervention and control methods only against microbes and contaminants that are native to the carcasses presented for processing and are unable to “challenge” the methods with high levels of food-borne pathogens. The incorporation of a pathogen challenge meat processing facility with a plant and animal health bio-technology research facility would create a unique research complex that would bridge the gap between pre-harvest and post-harvest interests, creating a seamless “conception to consumption” research program.

Research with infectious agents and biotechnology require special facilities. The requirements for safety and bio-security are stringent, but necessary to ensure public safety. The proposed animal disease and food safety and security research complex, with its comprehensive range of study, would provide the needed facilities for KSU to serve not only their immediate clients and the State of Kansas but our country and countries around the world.

Description of Proposed Construction

The major design concept is the need for bio-security which will enable investigation of infectious diseases and provide for safe handling of biotechnology products. At the same time, the facility must be adaptable to changing research focuses within the areas of infectious diseases and biotechnology. The building should be designed to accommodate the latest computer and communications technology and must provide an environment that encourages creativity, interdisciplinary synergy, and scholarship by those who work there.

Infrastructure (security, ventilation, plumbing, electrical, access and traffic patterns, waste management, space arrangements, building materials, and animal movement patterns) must be designed to support Bio-security Level 3 (BL-3) research activity throughout the building. Because the operation cost of BL-3 is much greater than BL-2, the design should be such that all areas need not operate at BL-3, and some areas could be retrofitted to operate at BL-2 or less for periods of time. The security system should identify all movement of individuals, animals and potentially dangerous materials throughout the building. The design should accommodate research in a manner that minimizes entry and exit of personnel and should be self-contained.

Attention should be given to function and esthetics of both internal and external design and to convenient access to shared working and meeting space.

Research Facility

Ten theme related work centers (TRWC) will be the core of the basic biotechnology (plant and animal) research space. Each work center will focus on a particular research theme within the overall areas of infectious disease, food safety, and biotechnology. Example of potential areas are bacterial, food-borne, viral zoonotic and special diseases; biotechnology; diagnostics research and special projects. Each work center will have four laboratories adjacent to support laboratories and faculty and graduate student offices. Each TRWC should function as an independent unit to accommodate both large and small research programs.

Other areas required are an animal isolation/exposure facility, vivarium, receiving and storage, administrative and faculty offices. In addition, bio-security space for waste disposal, necropsy, autoclaves, animal services, emergency equipment, bathroom/locker rooms and related features must be included..

Animal-related food safety issues present a special challenge, since few meat processing facilities are designed to be experimental. The facility will include animal holding and weighing areas, cooler and freezer, microbiology laboratory, meat processing equipment/supply storage, office areas and other support services. The slaughter floor will be designed primarily for on-the-rail slaughter and dressing for red meat species. Although some equipment will be fixed, as much flexibility as possible should be incorporated into the design, including movable hydraulic

platforms and other portable equipment to accommodate rattite slaughter as well as smaller species such as poultry. This flexibility will also allow for the incorporation of new pathogen reduction intervention strategies equipment.

Renovations/Reassignments

The completion of this facility will allow needed growth for existing research programs in the Colleges of Agriculture and Veterinary Medicine and other participating disciplines. Vacated space will also provide opportunities for consolidating departments that are now assigned space in multiple buildings and for the renovation of space that is out dated or in marginal condition.

Description of Space

The following is a summary of the types and amount of space for the proposed project. The development of a detailed program with added information may require the modification of some of these estimates.

	<u>NASF*</u>	<u>GSF (NASFX1.5)*</u>
Theme Related Work Centers (10) (Bacterial, food-borne, viral, zoonotic, special infectious diseases; biotechnology; advanced diagnostics; plant molecular and diagnostics; special projects)	74,875	112,312
Specialty Laboratories (4) Advanced, viral and rabies diagnostics; meat processing and slaughter.	12,210	18,315
Animal Isolation/Exposure Areas Large and small animals; poultry; wildlife; rodents.	14,500	21,750
Vivarium	14,000	21,000
Receiving and Storage	3,000	4,500
Administrative Office/Support	<u>7,600</u>	<u>11,400</u>
Total	126,185	189,277

*NASF = net assignable square feet

*GSF = gross square feet

Budget

The following preliminary budget is based on general estimates and the amount and type of space described in this proposal. The development of a detailed program with additional information may require the modification of this cost estimate.

A. Construction

1.	Building		
	189,277 gsf @\$200	\$37,855,400	
2.	Special Utilities, Security Systems, Site development, etc.	15,000,000	
3.	Fixed Equipment	7,750,000	
	Total Construction		\$60,605,400

B. Other

1.	Fees - 15% (Architectural/Engg.-10.5%; Int. Design.-1.5%;Commissioning -3%)	9,090,810	
2.	DOAS/Facilities Planning -2%	1,212,108	
3.	Contingency - 10%	6,060,540	
4.	Landscape - 1%	606,054	
5.	Movable Equipment/Furnishings	2,850,000	
6.	Miscellaneous - 3%	1,818,162	
	Total Other		\$21,637,674
	Total Estimated Project Construction Cost -		\$82,243,074

New Building Operating Support Estimate

Operating funds will be requested beginning in FY 2005 or when the building is substantially completed. The estimated annual costs, based on the proposed building and time schedule are:

FTE - 8,600sf/FTE	
@189,277gsf=22@\$25,533	-\$ 561,954
OOE - 189,277gsf @ \$.58	- 109,781
Utilities -189,277gsf @ \$2.50	- 473,193
Total	-\$1,144,928

Funding

The proposed funding source for the total project construction cost and building servicing is Federal funds.

Time Schedule

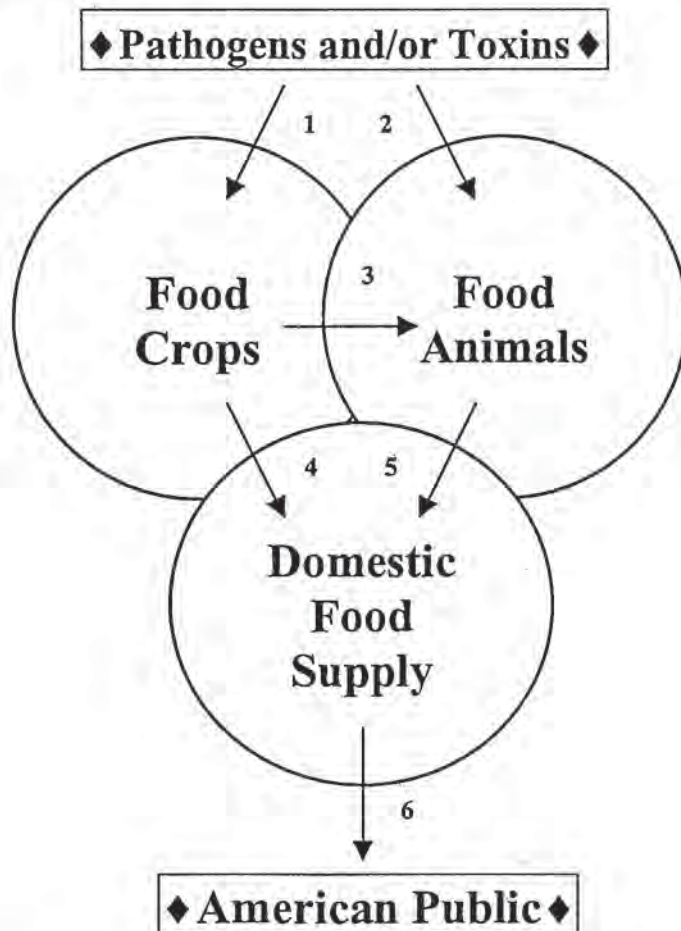
The current proposed schedule for this project is:

FY 2000	-	Proposed Project Approval
FY 2001	-	Allocation of funds Develop program and preliminary plans
FY 2002	-	Complete plans and construction documents
FY 2003	-	Begin Construction
FY 2004	-	Construction
FY 2005	-	Complete Project, Occupy Facility

Kansas State University

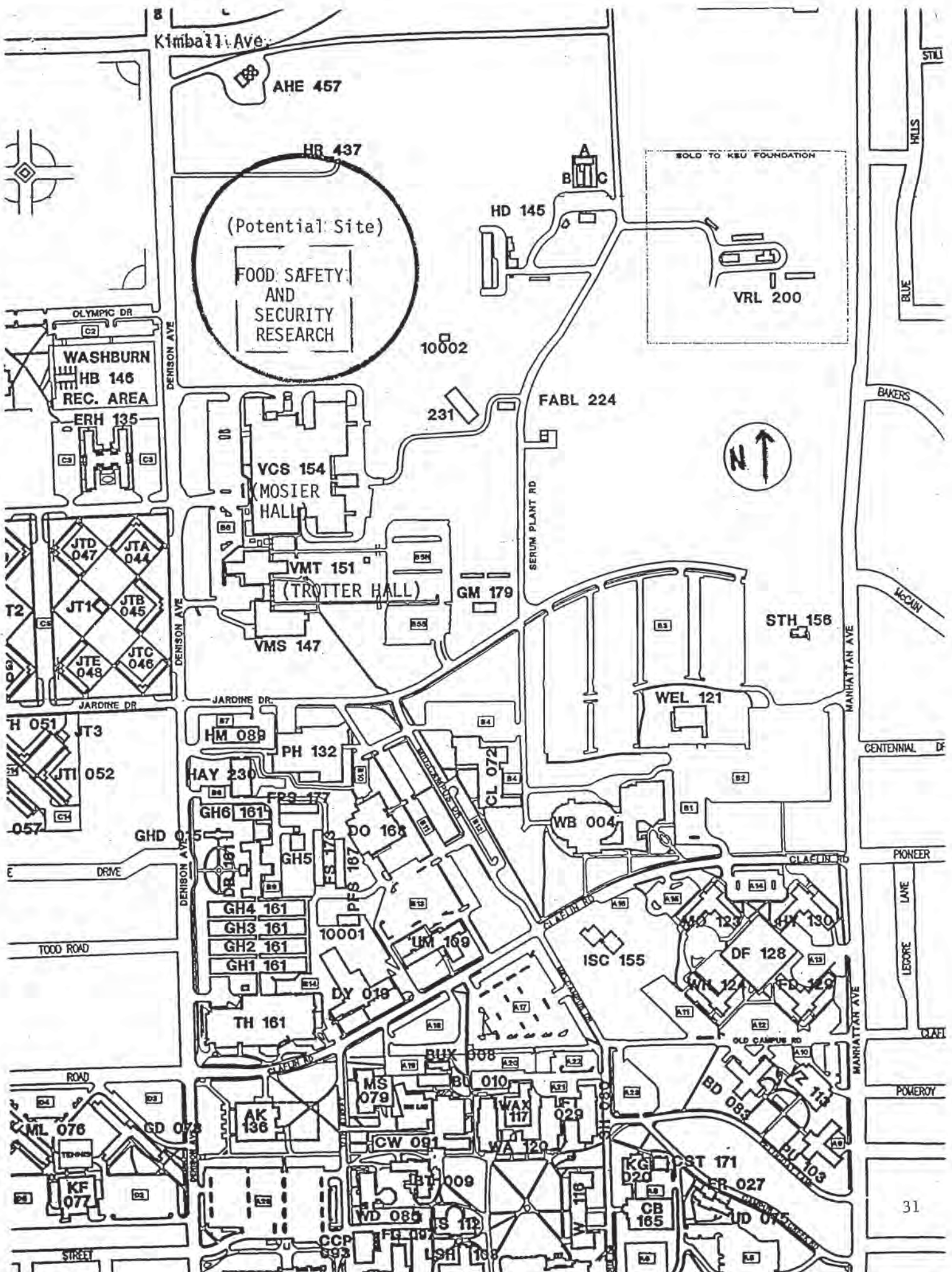
Food Safety and Security Program

MISSION: **TO PROTECT THE DOMESTIC FOOD SUPPLY AND AMERICAN PUBLIC FROM ENDEMIC AND EMERGING THREATS.**



THREATS {NUMBERS 1–6 ABOVE}:

1. a) Plant pathogens or toxins transmitted to food crops.
b) Animal pathogens or toxins transmitted initially to food crops.
c) Human pathogens or toxins transmitted initially to food crops.
2. a) Animal pathogens or toxins transmitted to food animals.
b) Human pathogens or toxins transmitted initially to food animals.
3. a) Plant pathogen/toxin-induced losses of crops to feed animals.
b) Animal pathogens or toxins transmitted via crops to food animals.
4. a) Plant pathogen/toxin-induced losses of crops for the domestic food supply.
b) Human pathogens or toxins from crops processed into the food supply.
5. a) Animal pathogen/toxin-induced losses of food animals for the food supply.
b) Human pathogens or toxins from animals processed into the food supply.
6. Human pathogens or toxins transmitted to the American public.



Kimball Ave

AHE 457

HR 437

(Potential Site)
FOOD SAFETY
AND
SECURITY
RESEARCH

HD 145

SOLD TO KBU FOUNDATION

VRL 200

10002

FABL 224



OLYMPIC DR

WASHBURN
HB 146
REC. AREA

ERH 135

VCS 154
MOSIER HALL

VMT 151
(TROTTER HALL)

GM 179

VMS 147

STH 156

WEL 121

H 051

JT3

JTI 052

HM 089

PH 132

HAY 230

GH6 161

DO 168

WB 004

GHD 055

GH5

FS 175

PS 187

GH4 161

GH3 161

GH2 161

GH1 161

10001

UM 169

ISC 155

DF 128

GM 121

FD 129

TH 161

DY 019

BUY 008

MS 079

BU 010

WAX 117

WA 120

BD 083

Z 113

BU 103

ML 076

GD 073

AK 136

CW 091

WA 120

KG 020

PST 171

ER 027

KF 077

WD 085

CCP 093

IS 112

CB 165

JD 015

STREET

RATIONALE & MISSION

THREATS & CAPABILITIES

DUAL-USE RESEARCH

DUAL-USE FACILITY

ADVANCED EDUCATION

PUBLIC OUTREACH

BUDGET & JUSTIFICATION

UNIQUE ATTRIBUTES

DEFENSE RELATEDNESS

ATTACHMENTS

ADVANCED EDUCATION COMPONENTS:

A comprehensive program of information transfer to students and to the general public is an integral component of the food safety research enterprise at K-State. The elements of this comprehensive program that focus specifically on the general public and on the food production industry will be elaborated in a section on *public outreach Components*. In this section, we consider the formal graduate education mission of K-State, an explicit charge to the institution by the State of Kansas to provide graduate training to its citizens. Since an excellent graduate educational program has been developed in food safety biotechnology for the Kansas citizen, additional resources could be used to apply this program as well, in a *dual-use manner*, to the objectives of the homeland defense initiative as it relates to the agricultural bioterrorist threat.

The goal of this graduate educational process is one of training, to provide the student with the necessary skills to excel in tasks relating to food safety issues. As we will describe, education is not *place-bound*, and not confined within the borders of the KSU campus. Graduate education programs have been developed to bring knowledge into the workplace. With additional resources, for example, educational programs *could be delivered to first-responding National Guard members* to provide them with skills needed in coping with food safety concerns, or to the other Armed Forces personnel who will be active in homeland defense activities. Graduate programs could be developed that would benefit the technical support staff of federal installations, such as Fort Detrick, that are tasked with biosafety issues.

Graduate education provides skills to the post-baccalaureate student. On one hand, these skills could be directed toward the acquisition of new knowledge. These skills could be related to food safety biotechnology research, and doctoral as well as postdoctoral training programs prepare students for the rigors of the research laboratory. Furthermore, these skills could involve research in communication effectiveness during crisis episodes, and we will describe graduate research activities in understanding the leadership skills necessary in government/citizen crisis communication. On a more applied scale, these skills could be related to workforce needs, and we will highlight Masters degree programs and graduate certificate programs that have been designed to provide employees with graduate credentials to improve job performance. This training could provide skills in specialty areas, for example in toxicology, DVM specialties, or international relations. The Kansas State University Graduate School administers these programs.

A complete listing of the graduate degrees and credentials *currently in place* are given at the end of this section. This sterile listing belies the dynamic nature of the K-State graduate education enterprise, as evidenced by the following concepts:

- *The intimate relationship between graduate education and research in the food safety biotechnology fields.* The KSU Graduate Faculty members working in natural science disciplines strongly believe that research and graduate education are two sides of the same coin. Students are trained, not merely to provide them with facts, but to give them the research skills to discover the facts. This research-based education, although also present in many Masters degree programs, is expected at the

doctoral level. That the food safety biotechnology faculty members were awarded nearly \$9 million in extramural research funding last year attests to the strength and success of this research/graduate education approach. *A component of the program that we propose here will enhance this already-successful enterprise and will focus the research and training activities of this successful faculty group toward food safety/agricultural terrorist concerns.*

- *The value-added nature of cross training graduate education activities.* Often, knowledge in an area that is apart from one's specialty can have a value-added impact on one's performance within one's specialty. Skills in business administration, for example, may help the biologist prepare for a job in the industrial workplace. Graduate training in mass communication may help the National Guard first-responder, as might an understanding of the cell biology nature of a bioterrorist threat. Graduate-level training in leadership skills, or an understanding of international relations as they gave rise to the culture of terrorism, may be an asset for many Armed Forces personnel. *Funding is re uested here to amplify the cross-training graduate activities focused on food safety/agricultural bioterrorist concerns.* We see the recently developed **raduate Certificate rogram** as being an ideal vehicle for this process.
- *Special relationships e ist between K-State and its neighboring military installations of Fort Leavenworth and Fort Riley.* K-State and its Armed Forces neighbors have a history of educational collaboration at both the undergraduate and the graduate levels, and additional relationships of this type are being sought out. At the undergraduate level, K-State offers a curriculum on the Fort Riley military base that can lead to an associate degree. Credits can apply toward a bachelor's degree, if additional coursework is taken on the K-State campus. Graduate work is also possible on the military base. For example, an assessment documented the need for a Masters in Engineering Management to complement the curriculum of the U.S. Army Command and General Staff College and this has been a highly successful educational initiative within the K-State College of Engineering. In 1987 (and running until 1997), a special Army program directed by the Chief of Chaplain's office in the Pentagon created the Army Chaplain Advanced Life Training Program on the K-State campus. These examples document the history of K-State/military educational activities, and suggest that further opportunities may exist to reinforce the objectives of this agricultural bioterrorist threat initiative. *Funds are re uested to 1) identify areas of mutual concern,) develop educational programs that meets the need, and) e pand the coverage nationally beyond the central plains region.*
- *K-State's food safety research and graduate education is international in scope, having partnerships with allied nations in food safety concerns.* Since 1967 through AID contact, K-State has been providing technical assistance in food, feed and grain drying, storage, handling, transportation, processing, and marketing on a worldwide basis. We belong to three consortia that facilitate faculty participation in international activities: Mid-America International Agricultural Consortia, Mid-America State niversity Association, and the Southwest Alliance for Latin America. Since 1977, KSU has been involved in the *Integrated Agricultural Production and Marketing Pro ect* in the Philippines. This is complemented by the cereal grain

education/ research collaborations between the KSU *Plant Biotechnology Center* and the *International Rice Research Institute* in the Philippines, which has several documented collaborative training successes in the cereal grain food safety arena, and with the *International Corn and Wheat Center* in Mexico. *With additional funding, these partnerships can be strengthened in the agricultural bioterrorist threat arena.*

Biotechnology Research and Graduate Education: Doctoral level training implies both a deep understanding of the intellectual context of a discipline and an independent scholarship that adds to that intellectual context. At the end of this section, there is a listing of the 6 EdD and the 30 PhD programs offered at Kansas State University. The PhD programs in Economics, Engineering, and Human Ecology offer a total of 14 areas of special concentration. Three of the 30 PhD programs—Biochemistry, Foods and Nutrition, and Genetics—are interdisciplinary, with faculty members from several departments and colleges collaborating for the purposes of PhD level training.

Doctoral training in the areas of food safety is largely focused on biological science or on the applied application of biological science. The following programs will play a major role in the training activities described in this proposal:

- ***biochemistry, biology, genetics, and microbiology:*** These basic science programs provide the cell biology and molecular genetic training that underlies the extensive use of these concepts in agricultural bioterrorism concerns. Specific areas of interest include virology, bacteriology, the cell biology of toxin production and excretion, immunology, and the molecular events associated with pathogen association with host species. These programs need the continual infusion of equipment infrastructural support that makes the program faculty competitive in the extramural funding arena, and graduate assistantship packages that will attract highly qualified students.
- ***Agronomy, genetics, and plant pathology:*** Training is focused on understanding the genetics of crop plants, and using that information to increase the viability of plant production in stressful environments. A strength of these programs is an expertise in the mechanisms by which plants respond to pathogens, and a growing research/educational interest in strategies for deploying defense response genes. These programs need the continual infusion of equipment infrastructural support that makes the program faculty competitive in the extramural funding arena, and graduate assistantship packages that will attract highly qualified students.
- ***Animal Science, veterinary pathology, and veterinary physiology:*** Research and training delves the causes and countermeasures to food animal diseases, and the technology of food production safety as applied to food animal production. These programs need the continual infusion of equipment infrastructural support that makes the program faculty competitive in the extramural funding arena, and graduate assistantship packages that will attract highly qualified students.
- ***Food Science, Foods Nutrition, and Foodservice Hospitality Management:*** Research and training is focused on the food utilization side of food safety. Interestingly, these have been programs that have interested senior military career officers who have taken furloughs to pursue advanced degrees. Competitive stipend

packages are needed to attract highly qualified students, and formal interactions could be put in place to encourage senior officers to acquire their advanced degrees via these programs.

Graduate Programs that Meet Professional Needs: Graduate programs that are designed to meet professional are offered largely at the Masters and Graduate Certificate levels. These provide the student with an intellectual context of the discipline, and professional skills to meet workforce objectives. As shown in the accompanying list, Kansas State University offers 63 masters degrees, of which 9 are Masters of Arts and 43 are Masters of Science.

Several of these masters programs were initiated in response to workforce needs, and are offered to students in the workforce by distance-learning techniques. For example, the Masters in Engineering Management can be taken by off-campus students, and has a strong relationship with the U.S. Army Command and General Staff College in Fort Leavenworth. Similarly, the Masters in Computer Software program can be taken in a distance learning environment and one Computer and Information Science course is listed in the Kansas State University Graduate Catalog as offered at Fort Leavenworth only. A need was recognized in the electrical power industry for a graduate credential in electrical power distribution, and a Masters degree having this thrust was developed by the Department of Electrical and Computer Engineering. Three additional engineering degrees, in chemical engineering, civil engineering, and electrical engineering, are offered in a distance learning mode.

One distance-learning program, the Masters in Agribusiness, has its focus on the food product professional and therefore serves the same clientele as the food production safety initiatives. This has been developed by the Department of Agricultural Economics faculty, and is one of two such programs in the US.

The K-State School of Journalism and Mass Communications offers a Masters of Science degree in mass communications. One emphasis in this program is on public relations, and program faculty members, who have interests in crisis communication issues, have expressed interest in developing graduate-training programs in the agricultural bioterrorism arena.

Graduate Certificate Programs: K-State is developing a suite of graduate programs that meet specific needs. These provide the student with a Graduate Certificate, which is a non-degree credential documenting the mastery of a defined body of information and is less extensive than a Master's degree. These programs provide the advantages of:

- ***Flexibility and rapid response:*** Decisions on the feasibility and implementation of these programs as internal to K-State, and we can offer programs that have a market and which make sense within the perspective of food safety and agricultural bioterrorism threats.
- ***A documented credential:*** A certificate program completion will be documented on the K-State transcript.
- ***interdepartmental and inter-college cooperation:*** Some of the best graduate certificate programs are interdisciplinary in nature, and can combine the strengths of

several disciplines and colleges.

Three independent goals motivate us to provide these non-degree credentials to our students.

- First, such credentials provide value-added opportunities to our existing graduate students. For example, a student in political science can earn a credential in international service, and enhance his/her job prospects in the US State Department.
- Second, students in the workforce can earn credentials to enhance their professional advancement opportunities. This has been the case in the K-12 education workforce. As the agricultural bioterrorist threat initiative becomes increasingly complex, one can envision credentials being valuable in this arena as well.
- Third, students in the workforce often need encouragement to return to school for the purpose of obtaining an advanced degree. We seek a mechanism to encourage highly qualified students to reach their full potential, and we realize that this is a goal mutually shared with their employers.

At present, K-State offers Graduate Certificates in *Community Planning*, *International Service*, and *Women's Studies*. Programs that are approaching implementation or are in the advanced planning stages include *Air Quality*, *Business Administration*, *Complex Fluid Flows*, *Crisis Communications*, *Material Science*, *Occupational Health*, *Science Communications*, *Toxicology*, and *Water Quality*. A whole host of additional Graduate Certificate Programs can be envisioned to meet specific national security and professional advancement needs.

Military Graduate Student Recruitment Program: Kansas State University has already initiated a unique graduate student recruitment program targeting individuals in the military or individuals transitioning out of the military. Compared to the vast majority of college campuses in America, K-State is an exceedingly military-friendly, veteran-friendly institution. Manhattan, Kansas is a military-friendly, veteran-friendly community. In fact, K-State and Manhattan actively seek out opportunities to interact with our neighbor Fort Riley. Distance education will offer additional opportunities for us to reach out to military personnel across the nation and around the world.

Although the *Military Graduate Student Recruitment Program* is in the early stages of development, a concise implementation plan has been formulated. A brief program description and the implementation plan follow on the next few pages.

KANSAS STATE UNIVERSITY

MILITARY GRADUATE STUDENT RECRUITMENT PROGRAM

The military offers an underutilized resource for recruiting high quality, highly motivated individuals into graduate school at Kansas State University. A multifaceted approach is being developed to enhance K-State enrollments from this pool.

ROTC STUDENTS: ROTC students are not necessarily encouraged to consider graduate school as a future option, yet, many of these individuals are excellent candidates for advanced degrees. Furthermore, graduate study will be required of those individuals making a career of the military. This offers an opportunity for Kansas State to develop a program for recruiting these students to graduate school.

- **Graduate Record Exam:** Advanced ROTC students will be encouraged to take the GRE while they are still in school. Their performance on the exam is likely to be better than if they waited until they are ready to enter graduate school, and having taken the exam, they may be more inclined to keep graduate school in their future plans.
- **Preadmission/Deferred Entry:** Many K-State graduate programs are willing to accept ROTC students into their programs even though the individuals are not able to pursue full-time graduate study immediately. Nonetheless, once a program of study is defined, this will assist the person in identifying acceptable part-time courses (or KSU distance courses) while they are on active duty. Furthermore, they may be able to take some applicable graduate courses while they are still in ROTC.

ACTIVE DUTY PERSONNEL: Military personnel on active duty offer another underutilized resource for graduate students. Among the officers, most already have at least a bachelor's degree; some of the enlisted personnel do as well. Many of these individuals should be excellent candidates for graduate study at K-State.

- **Part-time Students:** With the proximity of K-State to Fort Riley, it should be possible to recruit more part-time graduate students into our programs. Some of the graduate certificate programs being developed may be particularly appealing, since it should be possible to complete the credential requirements in a relatively short period of time. This may help bring people back for full-time study later. Furthermore, as the number of graduate level, distance education courses increase at K-State, additional opportunities will become available nationally and worldwide.
- **Full-time Students:** After a few years on active duty, career military personnel can become eligible for limited duration, full-time education opportunities. It is especially common for career officers to exploit these opportunities to pursue advanced degrees. K-State should be an attractive option for these individuals to consider, since they could take advantage of military services at Fort Riley while pursuing graduate studies in Manhattan. A national recruitment initiative will be developed.

NATIONAL GUARD AND RESERVES: Individuals in the National Guard and Reserves have a variety of graduate education needs that could be served by K-State as well.

- **Career Officers:** Post-baccalaureate education is a requirement for those officers making a career of the National Guard or Reserves, just as it is for active duty personnel. K-State should be a good option for many of these individuals for the same reasons outlined above.
- **Homeland Defense:** National security experts are concerned that terrorists could introduce biological or chemical agents into the food chain or water supplies in this country, and National Guard and Reserve components will be among the "first responders." K-State is well positioned to provide advanced education in food safety, environmental remediation, and a host of related areas.

TRANSITIONING PERSONNEL: Each of the military service branches provides assistance to personnel transitioning from the military into civilian society. State employment services and the U.S. Department of Labor's Veterans Employment and Training Service provide transition assistance as well. However, graduate school is not one of the options these individuals are normally encouraged to consider. This provides an opportunity for K-State to establish a national pilot program in this area working with the appropriate federal and state agencies.

MILITARY GRADUATE STUDENT RECRUITMENT PROGRAM

IMPLEMENTATION PLAN

Successful implementation of this program will require the Graduate School to assume a central role in facilitating each of the complementary recruitment initiatives. This will be accomplished in multiple phases.

- ❖ **PHASE 1:** The focus in the first phase of this program will be at the local level. This will entail on-campus activities as well as establishing contacts at Fort Riley.
 - **K-State ROTC:** Meetings have already been initiated with ROTC faculty and students at KSU. Outcomes of these meetings will be used to structure a formalized ROTC recruitment program, initially focused on KSU ROTC students.
 - **K-State Programs:** K-State graduate programs will be informed of the potential long-term benefits of a preadmission/deferred entry option for ROTC students, and they will be surveyed to determine their interest in providing such an option.
 - **Fort Riley:** The Graduate School will participate in job fairs and other potential recruitment functions at Fort Riley. Formal linkages will also be established with education officials at the Fort as well as individuals involved in providing transition assistance to personnel being discharged from the Army.

- ❖ **PHASE 2:** The second phase of the recruitment program will focus on publicizing and expanding the activities throughout the state and on preparing for further expansion beyond Kansas.
 - **Publicity Materials:** Various recruitment materials and resources will be developed to help publicize the program locally and beyond the local region.
 - **K-State Website:** The Graduate School will create a website describing the comprehensive military graduate student recruitment program.
 - **Printed Materials:** Printed materials describing individual components of the program will be generated. Program attributes, contact information, application procedures, and the website URL will be highlighted.
 - **Press Releases:** When the printed materials and website have been completed (and assuming no unforeseen problems were encountered in Phase 1), press releases will be generated to publicize the program.
 - **Kansas Military Installations:** After establishing a set of “best practices” working with Fort Riley, the recruitment program will be expanded to other installations. The focus will be on attracting full-time students from active duty and transitioning personnel rosters, and there may be opportunities for delivering distance education courses.
 - **Fort Leavenworth:** K-State is already providing continuing education services to Fort Leavenworth, so implementing the program there should be attainable.
 - **McConnell AF Base:** The Air Force ROTC faculty at K-State have already offered to facilitate these interactions whenever and however appropriate.
 - **State Government Initiatives:** Agencies of Kansas state government that might be able to assist in identifying appropriate transitioning personnel will be contacted. State legislators will be informed about the program as well, especially if legislative enhancements might prove beneficial.
 - **Federal Legislative Contacts:** As a prelude to launching a nationwide effort to recruit graduate students from the military, members of the Kansas delegation and other appropriate legislators will be informed of the program to solicit their support.

MILITARY GRADUATE STUDENT RECRUITMENT PROGRAM

IMPLEMENTATION PLAN {CONTINUED}

- ❖ **PHASE 3:** Phase three of the recruitment program will concentrate on outreach activities at the regional and national levels.
 - **Federal Government Initiatives:** The federal agencies actually or potentially affected by the recruitment program will be contacted for guidance and assistance.
 - **Department of Defense:** The relevant administrative components of the Department of Defense and the various military branches will be informed of the uniqueness, value, and scope of the recruitment program at K-State. Their support in notifying the constituency groups within their organizations will be solicited.
 - **Department of Labor:** The Department of Labor's Veterans Employment and Training Service, which has a role nationally in supporting the transition assistance programs for military veterans, will be contacted to determine how K-State's graduate student recruitment initiative can best be accommodated within their activities. The initial contact will be with appropriate administrators at the Kansas City regional office, followed by the Washington national office.
 - **ROTC:** The ROTC recruiting materials developed during Phase 2 will be distributed to ROTC units around the country. Initially, colleges and universities in nearby states will be targeted, with expanded distribution thereafter as deemed reasonable and appropriate. The Graduate School will facilitate matching ROTC student inquiries and applications with K-State graduate programs offering the preadmission/deferred entry option for admission.
 - **Active Duty Personnel:** From the Department of Defense meetings and those with the individual service branches, approaches will be defined for attracting active duty personnel into full-time graduate studies at K-State. It's likely that the greatest early success will be with the Army, based on the proximity of Fort Riley and the greater involvement of Army personnel in part-time graduate studies during Phases 1 and 2. However, the program will be advertised and made available to all military branches.
 - **Transitioning Personnel:** The earlier interactions at Fort Riley and other military bases, as well as those with state and federal agencies, should expedite the expansion of this effort to neighboring states and beyond. If components of the Department of Defense make the military graduate student recruitment program at K-State part of their informational materials for personnel transitioning out of the military, the expansion may, in fact, occur without much additional effort. The same is true with regard to the Department of Labor's Veterans Employment and Training Service.

Graduate School degree programs

**The
Graduate
School**

**Kansas State
University**

Master's

Master of accountancy

Master of agribusiness

Master of architecture

Master of business administration

Master of engineering management

Master of fine arts

Master of landscape architecture

Master of music

Master of public administration

Master of regional and community planning

Master of software engineering

Master of arts

Economics

English

Environmental planning and management

Geography

History

Modern languages

Political science

Sociology

Speech

Master of science

Adult, occupational, and continuing education

Agricultural economics

Agronomy

Animal science

Apparel and textiles

Architectural engineering

Biochemistry

Biological and agricultural engineering

Biology

Chemical engineering

Chemistry

Civil engineering

Computer science

Educational administration

Electrical and computer engineering

Elementary education

Entomology

Family studies and human services

Food science

Food service and hospitality management

and dietetics administration

Foods and nutrition

Genetics

Geology

Grain science

Horticulture

Industrial engineering

Kinesiology

Mass communications

Mathematics

Mechanical engineering

Microbiology

Nuclear engineering

Operations research

Physics

Plant pathology

Psychology

Secondary education

Special education

Statistics

Student counseling and personnel services

Veterinary anatomy and physiology

Veterinary clinical sciences

Veterinary pathology

EdD / PhD

Doctor of education

Adult, occupational, and continuing education

Curriculum and instruction

Educational administration

Educational psychology

Special education

Student counseling and personnel services

Doctor of philosophy

Adult, occupational, and continuing education

Agronomy

Animal science

Biochemistry

Biology

Chemistry

Computer science

Curriculum and instruction

Economics

Agricultural economics

General economics

Engineering

Biological and agricultural engineering

Chemical engineering

Civil engineering

Electrical and computer engineering

Industrial engineering

Mechanical engineering

Nuclear engineering

Entomology

Food science

Foods and nutrition

Genetics

Geography

Geology (PhD cooperative with the University of Kansas)

Grain science

History

Horticulture

Human ecology

Apparel and Textiles

Family Life Education and Consultation

Foodservice and Hospitality Management

Life Span Human Development

Marriage and Family Therapy

Mathematics

Microbiology

Physics

Plant pathology

Psychology

Sociology

Statistics

Student counseling and personnel services

Veterinary pathology

Veterinary physiology

Other

Other classifications

Nondegree student

Graduate certificate programs

Community planning

International service

Women's studies

RATIONALE & MISSION

THREATS & CAPABILITIES

DUAL-USE RESEARCH

DUAL-USE FACILITY

ADVANCED EDUCATION

PUBLIC OUTREACH

BUDGET & JUSTIFICATION

UNIQUE ATTRIBUTES

DEFENSE RELATEDNESS

ATTACHMENTS

PUBLIC OUTREACH COMPONENTS:

Agromedicine Public Health Consortium: Kansas State University is actively involved in an agromedicine partnership with the University of Kansas Medical Center to promote the health and safety of farm families and environments, agriculture workers, consumers of agricultural products, and associated industries. Kansas is one of 18 states involved in a national agromedicine consortium which link the states' land-grant institutions with one or more of their medical schools.

There are many problem areas in agriculture that require health professional resources to identify the causes and ways to prevent them. When farmer and related industry worker morbidity rises, prompt medical diagnosis and effective treatment are essential. Further, all of these problem areas require educational outreach to explain, reassure, and train the public and the agriculture industry workers and their families about morbidity etiology and the prevention, as well as other relevant health and safety promotion.

The Office of Community Health in the Kansas Cooperative Extension Service has been facilitating discussions among faculty at KU Medical School, K-State Research and Extension, and KSU Veterinary Medicine. Initial areas for partnering involve teaching, research, and service on a range of topics, including the epidemiology, prevention, and treatment of problems associated with the following:

- Agricultural chemicals (toxicity, oncology, teratology, etc.),
- Trauma from farm machinery,
- Skin cancer,
- Stress associated with agricultural occupations,
- Insect- and animal-transmitted diseases and endocrinology problems arising from agricultural production and food processing.

Agromedicine in Kansas is a flexible interdisciplinary partnership that links resources at the State's land-grant university and medical center. Faculty of the land-grant university provide the agricultural and veterinary medicine expertise, while the cooperative extension service provides the educational outreach and community-based intervention programs. Faculty of the medical center provide expertise in environmental and occupational medicine, occupational nursing, industrial hygiene, medical epidemiology, risk assessment, toxicology, and a broad range of clinical services that include the diagnosis and treatment of cases in consultation with local practitioners. Effective collaborations may evolve in areas of shared expertise, such as environmental sciences, toxicology, and health and safety training.

The Kansas State University agromedicine partnership provides the basis for a strong outreach program and facilitates a rapid response to human or animal biological crisis issues. This close working relationship will enable coordinated outreach programs targeted to public health concerns, including agricultural bioterrorist threats. Pilot public health programs in Kansas dealing with emerging agricultural threats will be made available to the other members of the national agromedicine consortium, thereby minimizing the need for duplicative efforts. This network should also be ideal for addressing civil-military relations' issues that might arise in rural areas from National Guard or other military first-responder activities that relate to public health.

Crisis Communication Network: Kansas State University has a well-established network for dealing with crisis communication issues – both in dealing with the crisis, itself, and providing training and support for professionals involved in crisis communication. In addition, the Kansas Cooperative Extension Service is producing communication programs that are targeted to the diverse stages of a development crisis. During the early stages of a disaster, mass communication is important (e.g., media interviews, news releases, public service announcements, flyers).

As the community moves past the initial shock of the disaster/crisis and into recovery stages or long-term coping, the survivors, special populations, and emergency workers are targeted with public education forums, brochures, websites, and personal letters.

Sometime during the disaster, people will become more aware of their emotional needs and may feel distress because their natural coping skills are strained. Communication targeted to re-establishing or strengthening natural support and communication networks in the community can begin through regular newsletters, new columns, biweekly or monthly public meetings, and an identified community information/recovery center or focal point.

Finally, survivors who recover from tragedy have several characteristics. One is the ability to find meaning in the tragedy and increased confidence that they can adapt to new situations. As the months go by, as disaster anniversaries approach, people who are unable to adjust can benefit from communication strategies that provide them with some sense of meaning and affirmation of their resilience. Such strategies include call-in radio or TV shows; special tabloids; Internet chat groups; oral, video, and written histories; and informal contact with natural helpers (e.g., county extension agents).

K-State Research and Extension is suited to helping establish an inter-organizational strategy that:

- Establishes a disaster communication plan,
- Exercises and reviews that plan regularly,
- Implements the plan during disaster, and
- Evaluates outcomes in preparation for future disasters.

It would include, for example, emergency management agencies, faith communities, schools, health organizations, mental health providers, businesses, governance, etc.

Clearly, this crisis communication network would be ideal both in preparing for and responding to a bioterrorist threat to our food crops, food animals, or food supply. The expertise is already here; it does not need to be recreated to deal with emerging threats. And, this network is also poised to address unforeseen civil-military relations' issues.

Agricultural Distance Education Consortium: The Agricultural Distance Education Consortium (ADEC) includes most of the land-grant universities and cooperative extension resources in the United States; K-State is a member of this consortium. The ADEC communication network is designed to bring together people and technologies on an “as-needed” basis to address a problem. It could be mobilized quickly if a crisis arises due to agricultural bioterrorist activity.

The heart of ADEC is its comprehensive network of knowledgeable experts. The ADEC can almost instantaneously get the word out to every part of the nation, including sending warnings, collecting data and information, and distributing informational and educational material in text, voice and video, or in whatever mixture is needed. Its systems are redundant and hybrid in nature – they do not rely on only one medium for delivery, but rather, use both ground-based and wireless systems.

Again, there is no need to duplicate a network of this type to deal exclusively with bioterrorist threats. The consortium is in place and can be adapted easily to deal with emerging issues and concerns.

RATIONALE & MISSION

THREATS & CAPABILITIES

DUAL-USE RESEARCH

DUAL-USE FACILITY

ADVANCED EDUCATION

PUBLIC OUTREACH

BUDGET & JUSTIFICATION

UNIQUE ATTRIBUTES

DEFENSE RELATEDNESS

ATTACHMENTS

FOOD SAFETY & SECURITY PROGRAM BUDGET:

Part I. Food Safety & Security Dual-Use Facility

A. Construction of a BL-3(Ag) Containment Facility (Costs Phased in FY2000-2005)

A. Construction			
	1. Building	\$37,855,400	
	2. Special Utilities, Security, Site concerns	15,000,000	
	3. Fixed Equipment	7,750,000	
	Total construction		\$60,605,400
B. Other			
	1. Fees – 15%	9,090,810	
	2. DOAS/Facilities Planning – 2%	1,212,108	
	3. Contingency – 10%	6,060,540	
	4. Landscape – 1%	606,054	
	5. Movable Equipment/Furnishings	2,850,000	
	6. Miscellaneous – 3%	1,818,162	
	Total other		\$21,637,674
Total Facility Construction			\$82,243,074

B. Facility Operations (Annual Expenditures Beginning in FY2005)

A. General Building			
	1. Custodial, maintenance	\$ 386,625	
	2. Operating expenses	109,781	
	3. Utilities	626,507	
	Total A. (beginning FY2005)		\$ 1,122,913
B. BL-3(Ag) Specific			
	1. Salaries: compliance and occupational safety (3 positions)	375,000	
	2. Operating funds (special BL-3 maintenance, special animal care upkeep)	75,000	
	3. Salaries: Senior animal care technicians (3 positions)	225,000	
	4. Salaries: Animal care technical and student support staff (6 positions)	300,000	
	Total B. (beginning FY2005)		975,000
C. Building Core Administration			
	1. Salaries: (administrative core facility director, 2 support staff, student help)	225,000	
	2. Electronic library and computer support (2 person staff)	150,000	
	3. Office expenses and electronic supplies	20,000	
	Total part C.		395,000
Total Facility Operations			2,492,913

Part II. Food Safety & Security Dual-Use Research

A. Protection of Crops for Human and Livestock Consumption			
	Senior level staff scientist positions (3)	280,000	
	Molecular geneticist (Res. Assist. Prof.)		
	Mycotoxinologist (Res. Assist. Prof.)		
	Bioinformation specialist (Res. Prof.)		
	Postdoctoral support staff (10)	330,000	
	Technical support/research assistants (10)	300,000	
	Summer salary (9 month faculty)	50,000	
	Consumable research supplies & services	150,000	
	Total for A.		1,110,000
B. Safety of Food Animal Health.			
	Senior level staff scientist positions (3)	280,000	
	Microbiologist/infect. disease (Res. Asst. Prof.)		
	Molecular toxicologist (Res. Asst. Prof.)		
	Molecular diagnostics (Res. Prof.)		
	Postdoctoral support staff (10)	330,000	
	Technical support/research assistants (10)	300,000	
	Summer salary (9 month faculty)	50,000	
	Consumable research supplies & services	150,000	
	Total Part B.		1,110,000
C. Integrity of Food Processing Systems			
	Senior level staff scientist positions (3)	280,000	
	Meat process biotechnologist (Res. Asst. Prof.)		
	Food microbiologist (Res. Asst. Prof.)		
	Food processing diagnostics (Res. Prof.)		
	Postdoctoral support staff (10)	330,000	
	Technical support/research assistants (10)	300,000	
	Summer salary (9 month faculty)	50,000	
	Consumable research supplies & services	150,000	
	Total Part C.		1,110,000
D. Basic and Support Sciences			
	Senior level staff scientist positions (3)	280,000	
	Molecular Virology/Bacteriology (Res. Asst. Prof.)		
	Molec. Genetics/Monocots (Res. Asst. Prof.)		
	Developmental Geneticist (Res. Prof.)		
	Postdoctoral support staff (10)	330,000	
	Technical support/research assistants (10)	300,000	
	Summer salary (9 month faculty)	50,000	
	Consumable research supplies & services	150,000	
	Total Part D.		1,110,000
E. Fostering Partnerships with Collaborators			500,000
	Partnerships with neighboring states, industry, and federal laboratories		
F. Competitive Pilot Project Program			1,000,000
G. Research Equipment Infrastructure			1,750,000
Total Research Operations			7,690,000

Part III. Food Safety & Security Advanced Education

A. Biotechnology Research and Graduate Education			
	Graduate students (16)		400,000
	Stipend/Assistantship 18,000		
	Cost of education allowance 7,000		
	Graduate education enhancement activities		
	Exchange programs/internships with federal labs	100,000	
	International travel/ IRRI & CYMMET	50,000	
	Industry internships (Nantek, PE Biosystems)	50,000	
	Total Part A.		600,000
B. Graduate Programs that Meet Professional Needs			
	Faculty release time for curriculum and course development	120,000	
	Student support activities	80,000	
	Courseware development technical support	80,000	
	Program travel	30,000	
	Military student tuition assistance	35,000	
	Total Part B.		345,000
C. Graduate Certificate Programs			
	Faculty release time for curriculum and course development	120,000	
	Student support activities	80,000	
	Courseware development technical support	80,000	
	Program travel	30,000	
	Military student tuition assistance	35,000	
	Total Part C.		345,000
D. Military Graduate Student Recruitment Program			
	Advertising materials	25,000	
	Recruitment travel	35,000	
	Military student tuition assistance	100,000	
	Military student assistantship program	450,000	
	Total Part D.		610,000
Total Advanced Education			1,900,000

Part IV. Food Safety & Security Public Outreach

A. Outreach Program Coordination			
	Senior Coordinator and 2 staff members	140,000	
	Supplies and consumables	30,000	
	Total Part A.		170,000
B. Outreach Initiative Enhancement			
	Faculty/staff release time	100,000	
	Communication materials preparation and printing	50,000	
	Travel activities	30,000	
	Annual regional food safety and security meeting	250,000	
	Food safety and security lectureship program	250,000	
	Total Part B.		680,000
Total Public Outreach			850,000

FOOD SAFETY & SECURITY PROGRAM BUDGET JUSTIFICATION:

Food Safety & Security Dual-User Facility:

Funds are requested for the construction and operations of a BL-3(Ag) food safety and security research facility on the campus of Kansas State University. Construction funds will be phased during the five-year planning and construction time period, and the funds for the building operations will be in place at the time that the building is occupied. This building will impact the agricultural bioterrorist threat initiative in three important ways:

- A BL-3 laboratory suite will permit the assessment of plant genetic and animal vaccine countermeasures to exotic pathogens.
- By incorporating food animal processing technology, this facility will allow the intentional inoculation of food materials, to assess the efficacy of novel counter-measure procedures.
- In the event of actual agricultural bioterrorist activity somewhere in the US (most likely in the central food and fiber-producing region), this will provide our researchers and responding federal and state agencies with a secure, BL-3 working environment.

Operating funds are requested to maintain the building, provide custodial services, and utilities. Furthermore, we realize that a BL-3 research facility faces special challenges for facility maintenance, for concerns about the occupational health of the staff, and for animal care. Funds are requested for a safety administrative staff and technical support team to deal with these challenges.

Food Safety & Security Administrative Oversight:

This project will require strong administrative leadership to ensure that the programmatic funds are distributed in a manner that enhances program effectiveness and ensures that the goals and objectives of the program are accomplished in the Food Safety & Security BL-3 laboratory facility.

The building core administration will report directly to the Kansas State University Vice Provost for Research, who will coordinate lines of communication between the Colleges of Agriculture, Arts & Sciences, Human Ecology, Veterinary Medicine, and any others that get involved. The named colleges have faculty members who would likely be facility users. Likewise, the Vice Provost for Research would have budgetary authority over the programmatic funding that will be described below.

To ensure appropriate administrative oversight, the Vice Provost for Research will appoint a **Food Safety and Security Advisory Committee**. This Committee will meet as part of the annual **Food Safety & Security Symposium**, and will be comprised of members of the Armed Forces, relevant industries and commodity groups, expert researchers from federal laboratories and other universities, as well as K-State faculty researchers.

Food Safety & Security Dual-Use Research:

Funds are requested to perform research in important areas in food safety and security. First, the protection of our crops will be assured by work in genetic engineering,

incorporating into cereal crops the broad spectrum defense genes that may have an impact on resistance to exotic pathogen species. Second, food animal health will be assessed in a clinical setting, by the development of rapid diagnostic tools and techniques. Third, the processes employed in the meat production industry will be improved by the application of novel technologies. Additionally, programmatic, human resource, and research infrastructure additions will enhance the basic sciences that underpin the applied areas.

In each of these research areas, we are requesting funds for 3 staff scientists. We envision that 2 of these will be relatively junior, hired at the research assistant professor level. We also envision the need for leadership in these areas, and plan to hire 1 of the 3 at the more senior research professor level.

To support research in each of the thrust areas, both by the new faculty members hired as a part of this project and by existing K-State researchers, we envision deploying postdoctoral scholars to these research activities, and providing technical support by the hiring of research assistants. Some faculty members have only a 9-month appointment at K-State, and funds are requested to focus their efforts on this initiative during the summer months. Consumable supplies, such as restriction enzymes, radioisotopes, disposable plasticware, etc., are necessary in biotechnology research.

We have tried to stress throughout the project description that a comprehensive program in food safety and security, as an approach to agricultural bioterrorism, must have regional, national, and international linkages. Funds are requested to enhance these linkages by funding collaborative research between KSU and regional, national, and international scientists.

We seek ways to encourage creative approaches to food safety and security problems, and one mechanism that has been successful is to provide funds for pilot projects. Funds are requested to establish such a pilot project program here. This program would be competitive, in that investigators would present their approaches for evaluation. The **Food Safety and Security Advisory Committee** would play a direct role in defining which projects are to be funded to address key homeland defense needs.

Funds for research equipment infrastructure are requested, as a continuing capital improvement program for laboratory instrumentation. The equipment that is made available to new faculty hires profoundly influences the quality of the investigator that Kansas State can attract.

Food Safety & Security Advanced Education:

We have identified research areas that are critical to this initiative, including the basic biological sciences, the applied biological sciences, clinical/diagnostic sciences, and the human-health aspects of applied nutrition. Funds are requested to support 16 PhD students in these areas, and to provide educational enhancements including internships (industrial or international) and exchange programs with relevant federal laboratories.

Funds are requested to enhance our efforts to spread our educational umbrella over the professional workplace and to enhance our linkages with military or federal laboratory establishments. This will involve both masters degree programs that have an applied

focus and graduate certificate programs that impact issues of food safety & security. Faculty release time is requested, to allow the human resources needed to refine existing (or to prepare new) courses that can be offered by distance learning technologies. Funds are also requested to provide a professional quality to this courseware material, and to offer tuition assistance to military and/or first-responder program employees who would benefit from food safety and security graduate information.

Funds are requested to enhance our existing military graduate student recruitment program, in terms of advertising material preparation and travel related to recruitment strategies. A component of this would be providing financial assistance, in terms of stipends and tuition assistance, to members of the military who turn to higher education either following or as a temporary duty assignment in a military career.

Food Safety & Security Public Outreach:

As was evident from the description, there is a range of K-State programs that address food safety and security outreach needs. Some of these are new, and their successes are as yet untested. Others are fairly mature, and have been proven successful in disaster relief and in disaster communication efforts.

We propose two ways to strengthen our public outreach activities. First, we seek to provide coordination among the various outreach programs and critical civil-military response issues. Second, we wish to enhance these activities by providing faculty members the release time needed to develop, enhance, or participate in these programs; by providing funds to bring internationally-recognized speakers onto campus; and by holding (annually) a **Food Safety & Security Symposium**. The **Symposium** will provide a venue for an **Advisory Committee** meeting, and will bring our national and international collaborators onto campus.

RATIONALE & MISSION

THREATS & CAPABILITIES

DUAL-USE RESEARCH

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BUDGET & JUSTIFICATION

UNIQUE ATTRIBUTES

DEFENSE RELATEDNESS

ATTACHMENTS

UNIQUE ATTRIBUTES OF THE PROPOSED PROGRAM:

- **Focus on Agricultural Resources (Food Crops Food Animals and Food Safety):** This program provides a unique blend of research and graduate education expertise in areas not currently receiving adequate national security coverage. The primary focus is on the significant pathogen threat to food crops, food animals, and food safety, with the latter covering the full gambit of pre-harvest to post-harvest food security.
- **Regional Relevance:** Food crop and food animal production for the nation is centered in the Great Plains. Kansas is at the geographic center of the contiguous 48 states, with wheat and beef production and processing centered in and around Kansas. It's likely that emerging threats to the domestic food supply, if and when they occur, will arise in this part of the country. This geographic linkage to potentially vulnerable food supplies should provide significant benefits and aid rapid response.
- **Reverse Dual-Use Programmatic Approach:** The federal government has recognized the importance of "dual use" in DoD-funded activities in recent years, i.e., emphasized the desirability of civilian applications to military research endeavors whenever possible. Our program takes the reverse approach: Ongoing research and graduate education programs at K-State are already addressing endemic threats to our food crops and food animals, threats that are becoming recognized as serious concerns for our national and economic security. Furthermore, our food safety and environmental protection programs are attempting to minimize the impact of these endemic threats to the American public and our way of life. K-State is proposing to expand these activities into the homeland defense realm by applying existing expertise to exotic and potential terrorist-introduced threats as well. The benefit of this approach is to minimize the need for duplicative efforts.
- **BL-3 Facilities for Pre- and Post- arvest Food Safety (Crops Animals):** KSU is developing plans for a unique BL-3 containment facility which will be capable not only of meeting our research and education needs regarding infectious diseases of plants and animals, but pre- and post-harvest food safety as well. In the food safety arena, this will include the ability to infect animals with human pathogens and track them through the food processing cycle. By designing the facility for dual-use purposes, it will be possible to study not only endemic threats, but emerging exotic threats as well. Moreover, the inclusion of BL-3 capabilities for working with food crop pathogens and toxins will make the facility flexible in dealing with any and all potential threats to the domestic food supply requiring specialized containment. No such facility is currently available in the country to address fully these dual-use needs.
- **Relevant Advanced Education Opportunities for ilitary Personnel:** We are designing a focused program that will provide military personnel with the opportunity to pursue advanced education and training in areas relevant to the food safety and security. Our program is unique among academic institutions. Moreover, it interfaces with the ilitary raduate Student recruitment ro ram already under development at K-State. This program covers the full gambit of graduate education opportunities at KSU, including masters and doctoral programs as well as non-degree and degree-linked graduate certificate programs. Many of the graduate certificate programs can and will be targeted to specific food safety and security needs.

- **High Capacity Communication Systems:** K-State is one of the charter member sites for the operational rollout of Internet II. Therefore, K-State has advanced experience in the installation, maintenance, and operation of broadband, high-speed communication. Also, the availability of the Regents Educational Communication Center (ECC) on the K-State campus, with full satellite downlink capabilities, allows the integration of extensive voice, video, and data transmission throughout the country and the world.
- **Crisis Communication Management:** K-State has special resources to deal with crises that threaten human health or agricultural production on farms and ranches, both in Kansas and the Central and Western regions, through the Kansas Cooperative Extension Service (KCES). With agricultural and family and community extension agents in every county in Kansas, the KCES is able to provide coordinated disaster and crisis information to each locality using local staff who are known and respected by the local citizens. Indeed, this communication system has been “field-tested” during the flood disaster in 1993. In this instance, KCES agents provided timely factual information on crop and homestead reclamation as well as coordinating human crisis concerns and psychological support systems for victims and service providers. Furthermore, the Office of Community Health in KCES has well-established working relationships with public health and human services programs which could be a real plus for coordinating civil-military response matters.
- **Economic Modeling and Assessment:** The departments of Economics and Agricultural Economics at K-State have a long tradition of providing crop and industry forecasts and conducting input/output analyses that enable modeling of economic system responses to environmental changes. In particular, work in the Department of Agricultural Economics has explored the impact of plant pathologies such as **arna unt** and considered the likely impact of the outbreak of animal diseases on the production and marketing of agricultural products.
- **Diverse Public-Private Sector Partnerships:** KSU has an exceptional mix of qualified individuals to carry out the program (see Attachment 2). However, another equally important attribute K-State brings to this program is a documented track record in partnering with public and private sector entities in conducting research, education and training, and outreach. Many of our ongoing partners have already committed to join us in this endeavor. New partners will be added as needed to address programmatic objectives. Clearly, it is in the best interest of all concerned to have as many qualified partners as possible addressing this vital national interest of homeland defense.
- **Strong Civil-ilitary Community Relations:** Manhattan, Kansas has particularly strong relations with its military neighbor, Fort Riley. Active duty and retired military personnel are fully integrated into the community. The Chamber of Commerce has a Military Relations Committee that facilitates a variety of social interactions between the city and the post. Membership on the committee includes not only business leaders from the community and key cadre from the post, but constituents of the local National Guard, Reserve, and ROTC units as well. A Community Co-op Program that pairs local businesses with specific units at the fort is also active and growing.

- **Favorable DoD- SU Linkages (Fort Riley Fort Leavenworth National Guard):** Kansas State University has active, broadly supported Army and Air Force ROTC programs, and researchers at K-State have had numerous projects sponsored by the National Guard as well as the other DoD branches. In 1986, Kansas State faculty members in family studies were selected to teach an Army Chaplain's program on military family life. Moreover, K-State has offered an Associate of Arts degree program at Fort Riley and an industrial engineering program at Fort Leavenworth for many years. In addition, we are expanding upon these already favorable linkages to create the broad-based **Military Graduate Student Recruitment Program** described in this proposal.

- **Differences from Existing Federal Programs:** Enactment of the Defense Against Weapons of Mass Destruction Act of 1996 laid the foundation for implementing the "homeland defense" initiative. The Nunn-Lugar-Domenici Domestic Preparedness Program began training first responders in FY97, with 120 cities targeted for initial funding. The proposed FY00 budget from the White House includes \$10 billion overall for homeland defense, mainly to combat weapons of mass destruction terrorism, and a sprawling federal bureaucracy has been tasked with preparing for such threats (<http://www.ndpo.com>; <http://cns.miis.edu/research/cbw/domestic.htm>). Nonetheless, the focus to date has been almost exclusively on direct threats to population centers. Nowhere in the domestic preparedness scheme is protection of the domestic food supply addressed. The **Home and Defense Food Safety Security and Emergency Preparedness Program** developed by Kansas State University targets this critical national vulnerability by employing an innovative, integrated, dual-use approach. Moreover, implementation will address the lack of specialized facilities capable of dealing with threats to America's food crops, food animals, and the resultant food supply.
 - **DPO:** The National Domestic Preparedness Office (NDPO) has the mission: "to coordinate all Federal efforts, including those of the Department of Defense, Federal Emergency Management Agency, Department of Health and Human Services, Department of Energy, and the Environmental Protection Agency, to assist State and local first responders with planning, training, equipment, and exercise necessary to respond to a conventional or non-conventional weapon of mass destruction incident." The NDPO also clarifies that "the Department of Justice, through the FBI, will coordinate the domestic preparedness programs and activities of this nation..." but no information on the NDPO website (<http://www.ndpo.com>) or elsewhere addresses how the domestic food supply will be protected. This emerging threat has yet to be adequately addressed.
 - **CDC:** The Center for Disease Control, a subdivision of the Department of Health and Human Services, has as its mission "to promote health and quality of life by preventing and controlling disease, injury, and disability." While the CDC will, no doubt, have a role in addressing any bioterrorist act affecting human health in the US, it is not equipped or mandated to carry out a food safety and security program as described.

- **DoD Fort Detrick** : The US Army Medical Research Institute of Infectious Diseases (USAMRIID) conducts research programs for “medical defense against biological warfare threats and naturally occurring infectious diseases.” It has BL-3 and BL-4 containment labs for studying biological agents, but USAMRIID focuses its efforts on agents as direct human infectious disease threats. This DoD containment facility would not be appropriate for addressing emerging threats to the domestic food supply as described, although it could provide a valuable complement for work with highly hazardous zoonotic and human pathogens.
- **USDA Plum Island Fort Detrick** : The US Department of Agriculture has containment facilities and related programs that deal with foreign, exotic threats to America’s food crops, food animals, and food safety, but none that address homeland defense in the comprehensive manner outlined in this proposal.

The Plum Island Animal Disease Center deals with foreign diseases of animals and, in fact, it is the only location in the US where these diseases can be studied. The food safety and security program at K-State would conduct research on foreign diseases of animals in Kansas only as the need arises. In other words, we are not proposing to work with these agents in the proposed BL-3 facilities so long as the quarantine at the US borders is not breached. However, if a disease outbreak occurs anywhere in the US, the food safety and security program at K-State would be ready to respond immediately to the threat ... the dual-use facility would be available to address the threat as soon as it surfaces.

The Foreign Disease-Weed Science Research Program at Fort Detrick deals with exotic plant diseases that might attack our food crops in much the same way as Plum Island deals with exotic animal diseases. These activities focus on diagnostics, and the containment facility there is used largely to examine the impact of exotic pathogens and insects. The K-State program and facility would complement these activities by examining mechanisms of long-term durable resistance and determining how these mechanisms can be applied to combat inadvertent or intentional introduction of exotic species.

RATIONALE & MISSION

THREATS & CAPABILITIES

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DEFENSE, ANTITERRORIST RELATEDNESS OF THE PROGRAM:

- **Reverse Dual-Use Programmatic Approach:** The mission of the **Food Safety and Emergency Preparedness Program** at Kansas State University is “to protect the domestic food supply and American public from endemic and emerging threats.” Accomplishing this mission for endemic threats may not have a direct defense, antiterrorist relationship, since terrorists are likely to utilize naturally occurring foreign pathogens or toxins or genetically engineered versions of these exotic agents. Nonetheless, our research programs to protect (1) crops for human and livestock consumption, (2) the safety of food animal health, and (3) the integrity of food processing systems could well yield results applicable to emerging bioterrorist threats. Moreover, these programs will allow us to develop preventive measures and rapid response approaches for dealing with emerging threats, thereby establishing a direct defense, antiterrorist relatedness for the program.

As already stated: “**Our dual-use approach will be solving today's food crop food animal and food safety problems while preparing to meet and defeat emerging threats of tomorrow.**” In that regard, it provides an optimal approach for addressing homeland defense. Investing in this program will make the domestic food supply safer from endemic threats in the near-term, while designing appropriate security measures against agricultural bioterrorism for the long-term.

- **Dual-Use Facility Designed to Meet Defense Security Needs:** The domestic food supply and the American public must be protected from the ever-increasing endemic threats posed by innumerable pathogens and toxins. Designing a BL-3 containment facility specifically to meet these needs offers a unique opportunity to cope with emerging threats in a dual-use manner. If and when the domestic food supply is threatened by a terrorist act in the future, an appropriately designed laboratory will be available in the geographic center of the country to deal with the threat whether it is targeted to food crops, food animals or food safety. Government and non-government scientific experts from around the country and the world will be able to assemble here to resolve the crisis, whatever it may be. As already mentioned, a broad-based capability of this type is not available anywhere else in the country. It is an obvious necessity for our national security on into the 21st century.
- **Integral Emerging Threat Prevention and Countermeasures:** Researchers at Kansas State, along with public and private sector collaborators locally and around the world, have been actively involved for many years in projects designed to prevent or respond to biological and chemical threats to our food supply and our people. K-State faculty played a pivotal role in establishing steam pasteurization as a method of choice for significantly reducing the level of dangerous pathogens on carcasses during meat processing. Additional, improved methods are currently under development. A technology invented at Kansas State for adsorbing and inactivating hazardous chemical agents such as nerve gas has now been found to be effective against biological agents as well. **Coincidin** and **acidus** spores similar to anthrax are killed in short order. Research of this type could greatly reduce emerging threats to the domestic food supply and the American public. Prevention and rapid response are integral components of the program proposed which should greatly enhance America's emergency preparedness for acts of bioterrorism in the future.

RATIONALE & MISSION

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DUAL-USE FACILITY

ADVANCED EDUCATION

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BUDGET & JUSTIFICATION

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DEFENSE RELATEDNESS

ATTACHMENTS

ATTACHMENTS:

- 1. Agricultural Biotechnology: A National Critical Technology at KSU**
- 2. KSU Agricultural Biotechnology Faculty Roster**
- 3. K-State Research and Extension Food Safety e s, February 1999**
- 4. KSU's Electronics Design Laboratory**
- 5. Nantek, Inc.**
- 6. FoodLabs, Inc.**
- 7. Agromedicine: A K-State/KU Medical Center Public Health Collaboration**
- 8. EPA Hazardous Substance Research Center at KSU**

A NATIONAL CRITICAL TECHNOLOGY: AGRICULTURAL BIOTECHNOLOGY

THE ROLE OF BIOTECHNOLOGY IN KANSAS AGRICULTURE

Agriculture is a mainstay of the Kansas economy with its combined cash receipts from crops and livestock products exceeding \$7 billion a year.

In the future, biotechnology will be a key to protecting, sustaining and improving plants and animals. Broadly defined, biotechnology uses living organisms to make a product or run a process. Tightly defined, its tools and techniques operate at the level of the genetic code. At present, more than 100 K-State plant scientists and food animal scientists are using biotechnology to improve crops and animals and thwart diseases and pests in order to maintain a reliable food supply.

BIOTECHNOLOGY TO IMPROVE FOOD CROPS

Biotechnology has revolutionized plant improvements by expanding the potential gene pool of a crop species. No longer are advances limited to accessing the genes of close plant relatives. Rather, all genes from all living things are now potentially available. Genomes are so similar that researchers can translate information from a model system such as rice, for example, and use it to improve wheat or other cereal crops.

Plant biotechnology has the potential to reduce losses to insects, weeds and diseases, reduce fungicide and insecticide uses, improve plant resistance to cold, heat, drought and flood, and increase yield and the quality. Beyond maintaining and protecting plants as food sources, plants are being looked at as possible bio-factories, perhaps someday producing pharmaceuticals or new types of oils.

Wheat is planted on more acres in Kansas than any other crop, and worldwide, wheat and rice account for nearly half the total human caloric intake. Safeguarding wheat is a primary focus of K-State efforts. Two strong centers are devoted to this:

The Wheat Genetic Resource Center maintains a gene bank of 2,500 wheat species accessions and 2,200 cytogenetic stocks. From the collection, genes for host plant resistances to viral, bacterial, fungal, and insect pests and abiotic stresses are identified, transferred to agronomically useful breeding lines, and deployed. The Center complements USDA, American Institute of Baking and other wheat research programs.

The Plant Biotechnology Center at K-State is an interdisciplinary research group of scientists using biotechnology for crop improvement. The PBC's initial work has focused on questions of enhancing wheat yield and improving its quality for traditional uses.

Among the techniques being used: marker-assisted breeding; gene identification and characterization; genetic engineering; and molecular genetics and physiology of host-pest interactions.

Marker-assisted breeding techniques assist tracking useful genes. These techniques will complement traditional approaches such as plant breeding to improve Kansas crops.

Genetic engineering can introduce cloned genes into wheat, thereby conveying resistance to diseases caused by virus, bacteria, fungi and nematodes. The techniques can provide a longer shelf life, and bestow antibiotic and other valuable proteins to plants.

Host-pest interaction studies will make it possible to defend wheat against pests or disease by inserting plant resistance genes from related species, in particular, rice or maize. Genes that direct one crop to protect itself can be placed in other crops to set up similar defense mechanisms; plants could receive genes plants that will protect the animals that feed on those plants. In addition to its wheat programs, K-State has strong programs in molecular genetics of corn and host-pathogen interactions in rice.

The PBC-affiliated faculty are becoming an international resource for biotechnological applications to other plant, animal and microbial systems.

BIOTECHNOLOGY AND FOOD ANIMALS

A parallel biotechnology research effort focuses on food animal health and safety. Faculty include some of the leading researchers in the world. Researchers have been mapping the genetics of cattle and pigs, and research has identified important markers that have an impact on traits like stress susceptibility and meat tenderness.

K-State is uniquely positioned to use genetic information to improve beef cattle yields, improve meat quality, and, ultimately, to reduce production costs. For example, genetic tools can be used to overcome two limitations to improving cattle — the low reproductive rate and the long interval between generations.

One tool of animal biotechnology, egg genetics or velogenetics, could help reduce the generation interval for cattle. It includes selecting calf embryos using genetic markers. As more markers are known, trait selection is refined. Working with the genetics of eggs has appeal as a way to reduce by two to four years the time that's needed to run selection experiments.

Animal biotechnology will play a major role in tailoring new food products for specific markets. For example, protein composition of milk might be changed to make it better for cheese production. Or animal muscle quality would be enhanced to make better retail meat cuts.

BIOTECHNOLOGY AND FOOD SAFETY

Food safety issues frequently capture media headlines: the problem of the bacteria *E. coli* 0157:H7 in ground beef and other meat products persists; processed food products are recalled; and word about contaminated fruit or vegetables, even bean sprouts, panics consumers.

The frequency of reported human infections of *E. coli* 0157:H7 has increased dramatically during the last 10 years, and most outbreaks were associated with eating contaminated beef.

Cattle, and particularly young calves, seem to be a principal reservoir of the bacteria *E. coli* 0157:H7. Microbiological surveys have found that up to 5.3 percent of sampled healthy cattle shed this bacteria in feces. K-State research shows that some sub-populations may have an even higher incidence of the bacteria; They have learned that stress causes cattle to shed bacteria. So, if meat becomes contaminated with feces at the slaughterhouse, either by direct exposure or exposure to contaminated surfaces, there's a possibility of an unsafe product and potential for human illness.

K-State animal scientists are working diligently to track such pathogens, in search of critical control points between producers and consumers. Animal biotechnology, applied at such points, has potential to control food safety hazards at the earliest possible point in the chain, in the live animal. K-State faculty played a key role in verifying that new technologies, including steam pasteurization of whole carcasses and of ground meat products, can significantly reduce the risk of E. coli 0157:H7. Steam pasteurization is being widely adopted by the industry.

IN SUMMARY

Agricultural biotechnology is a critical tool for ensuring the quality and safety of the nation's food supply. Agricultural biotechnology has the potential to safeguard human life and underpin the economic future of the worldwide food industry worldwide. It is in the state's interest to support agricultural biotechnology research, a scientific tool offering cost-effective solutions to food safety and food production problems. Kansas State University has a world-class faculty and excellent facilities for meeting the known challenges of today and the unknown challenges of the future through scientific research, education and public service.

"APPENDIX 2"

AG BIOTECH FACULTY

FACULTY MEMBER	DEPARTMENT	BIOTECHNOLOGY THRUSTS			
		Animal	Bioengineering	Molecular	Plant
Baker, James	Entomology			X	
Baybutt, Rick	Foods and Nutrition	X			
Beeman, Dick	Entomology			X	
Bhandari, Alok	Civil Engineering		X		
Blecha, Frank	Anatomy and Physiology	X			
Bowden, Bob	Plant Pathology				X
Brown-Guidera, Gina	USDA/ARS				X
Buszek, Keith	Chemistry			X	
Chapes, Steven	Biology			X	
Chengappa, M.M.	Diagnostic Medicine			X	
Chowdhury, S.	Diagnostic Medicine	X			
Chung, Do Sup	Biological and Agricultural Eng.		X		
Clem, Rollie	Biology	X			
Conrad, Gary	Biology	X			
Consigli, Dick	Biology			X	
Davis, Duane	Biochemistry			X	
Davis, Larry	Biochemistry				X
Denell, Rob	Biology			X	
Dover, Barry	Entomology				X
Dowdy, Alan	Entomology				X
Erickson, Larry	Chemical Engineering		X		
Fan, L.T.	Chemical Engineering		X		
Fellers, John	USDA/ARS				X
Fenwick, Brad	Diagnostic Medicine	X			
Freeman, Lisa	Anatomy and Physiology			X	
Friebe, Bernd	Plant Pathology				X
Fu, Zhen Fang	Diagnostic Medicine	X			
Fung, Daniel	Foods and Nutrition			X	
Ganta, Roman	Diagnostic Medicine			X	
Gehrke, Stevin	Chemical Engineering		X		

FACULTY MEMBER	DEPARTMENT	BIOTECHNOLOGY THRUSTS			
		Animal	Bioengineering	Molecular	Plant
Gill, Bik	Plant Pathology				X
Glasgow, Larry	Chemical Engineering		X		
Grieger, David	Animal Sciences	X			
Guikema, Jim	Biology				X
Heaton, Louis	Plant Pathology				X
Hedgcoth, Charlie	Biochemistry			X	
Herman, Michael	Biology			X	
Higgins, Randy	Entomology				X
Hosni, Mo	Inst. for Environmental Research		X		
Huang, Bingru	Horticulture				X
Hudson, Bill	Electrical and Computer Eng.		X		
Hulbert, Scot	Plant Pathology			X	
Jaishree, C.M.	Plant Pathology				X
Johnson, Lowell	Plant Pathology				X
Johnson, Terry C.	Biology			X	
Kambhampati, Srinivas	Entomology				X
Kanost, Mike	Biochemistry			X	
Kapil, Sanjay	Diagnostic Medicine			X	
Kramer, Karl	Biochemistry			X	
Krishnamoorti, Ramaswamy	Biochemistry			X	
Leach, Jan	Plant Pathology				X
Leslie, John	Plant Pathology				X
Liang, George	Agronomy				X
MacRitchie, Finley	Grain Science				X
Madl, Ron	Wheat Research Center				X
Marchin, George	Biology			X	
Marcus, Daniel	Anatomy and Physiology	X			
Marsden, James	Animal Sciences	X			
McAllister, Rick	Anatomy and Physiology	X			
Minocha, Harish	Diagnostic Medicine			X	

FACULTY MEMBER	DEPARTMENT	BIOTECHNOLOGY THRUSTS			
		Animal	Bioengineering	Molecular	Plant
Minton, Ernie	Animal Sciences	X			
Montelone, Beth	Biology			X	
Mosier, Derek	Diagnostic Medicine	X			
Musch, Tim	Anatomy and Physiology	X			
Muthukrishnan, Subbaratnam	Biochemistry				X
Nagaraja, T.J.	Diagnostic Medicine	X			
Oberst, Richard	Diagnostic Medicine			X	
Oehme, Fred	Diagnostic Medicine	X			
Okot-Kotber, Moses	Grain Science				X
Oppert, Brenda	Entomology			X	
Phebus, Randy	Animal Sciences			X	
Pickar, Joel	Anatomy and Physiology	X			
Poole, David	Anatomy and Physiology	X			
Prakash, Om	Biochemistry			X	
Ramaswamy, Sonny	Entomology				X
Reddi, Lakshmi	Civil Engineering		X		
Reeck, Gerald	Biochemistry			X	
Reese, John	Entomology				X
Rintoul, Dave	Biology	X			
Roche, Tom	Biochemistry			X	
Roe, Judy	Biology			X	
Roozeboom, Kraig	Agronomy				X
Ross, Chris	Anatomy and Physiology			X	
Rozell, Tim	Animal Sciences	X			
Schaffer, Vernon	Agronomy				X
Sears, Rollie	Agronomy				X
Seib, Paul	Grain Science				X
Shah, Jyoti	Biology			X	
Skinner, Dan	Agronomy				X
Sloderbeck, Phil	SW Area -- Entomology				X

FACULTY MEMBER	DEPARTMENT	BIOTECHNOLOGY THRUSTS			
		Animal	Bioengineering	Molecular	Plant
Smith, Mike	Entomology				X
Smith, Paul	Biochemistry	X		X	
Spooner, Brian	Biology	X			
St. Amant, Paul	Agronomy				X
Stewart, George	Diagnostic Medicine			X	
Strouts, Daryl	Kansas Crop Improvement				X
Takemoto, Dee	Biochemistry			X	
Takemoto, Larry	Biology	X			
Tang, Xiaoyan	Plant Pathology				X
Thompson, Curtis	SW Area -- Agronomy				X
Tilley, Katherine	Grain Science				X
Todd, Scott	Biology	X			
Tomich, John	Biochemistry			X	
Trick, Harold	Plant Pathology				X
Troyer, Deryl	Anatomy and Physiology	X			
Tuinstra, Mitchell	Agronomy				X
Upton, Steve	Biology			X	
Urban, Jim	Biology				X
Wang, Xuemin	Biochemistry				X
Wangemann, Philine	Anatomy and Physiology			X	
Weiss, Mark	Anatomy and Physiology			X	
White, Frank	Plant Pathology				X
Wilkerson, Melinda	Diagnostic Medicine	X			
Wong, Peter	Biology			X	
Zeigler, Robert	Plant Pathology				X
Zhou, Jian-min	Plant Pathology				X
Zhu, Kun Yan	Entomology				X
Zolkiewska, Anna	Biochemistry			X	
Zolkiewski, Michal	Biochemistry			X	



KSTATE
Kansas State University

RESEARCH AND

FOOD SAFETY NEWS

Food Safety NEWS

Food Safety **CURRENT NEWS**

Consumers use risky practices

In a survey of nearly 20,000 consumers in eight states during 1995-1996, about half reported using at least one risky food-handling or cooking practice.

During the preceding 12 months, 50 percent reported eating undercooked eggs, 24 percent reported eating home-canned vegetables, 20 percent reported eating pink hamburgers, 8 percent reported eating raw oysters, and more than 1 percent reported drinking raw milk. Nineteen percent said they did not wash hands with soap after handling raw meat or chicken and did not wash a cutting board with soap or bleach after using it to cut raw meat products. Only 45 percent reported seeing safe food-handling label information on raw meat products.

Data were collected by the Behavioral Risk Factor Surveillance System.

— Yang, S. et al. *Morbidity and Mortality Weekly Report*, 47(SS-4):33-41, 1998.

On the World Wide Web

New Food Safety Site
<http://www.FoodSafety.gov>

Food Irradiation
The National Food Safety Database
<http://www.foodsafety.org/ga/ga022.htm>

K-State Research and Extension
Food Safety Website:
www.oznet.ksu.edu/foodsafety

FSIS clarifies policy on *E.coli* O157:H7

The U.S. Department of Agriculture's Food Safety and Inspection Service has clarified the policy on adulterated beef and will be accepting comments on the topic until late March.

FSIS decided to expand existing policy due to the low infective dosage of *E.coli* O157:H7 associated with foodborne outbreaks and the severe consequences of such an infection. Previously, under the Federal Meat Inspection Act, raw ground beef products contaminated with *E.coli* O157:H7 were considered adulterated unless the ground beef was to be further processed to destroy the pathogen.

FSIS has expanded the

policy to non-intact raw beef products contaminated with *E.coli* O157:H7. Non-intact beef products include beef injected with solutions; mechanically tenderized by needling, cubing or pounding devices; or reconstructed into formed entrees, such as beef scored to incorporate a marinade. Intact cuts of beef to be further processed into non-intact cuts before being distributed for consumption must be treated in the same manner as non-intact cuts.

FSIS does not plan to expand its sampling and testing program to include all types of non-intact beef products or intact cuts of muscle that are to be further processed into non-

intact products. The FSIS may reconsider its sampling and testing program, and the scope of products deemed adulterated, in response to public comment.

FSIS will accept comments until March 22. One original and two copies of written comments may be submitted to FSIS Docket Clerk, Docket No. 97-068N, U.S. Department of Agriculture, Food Safety and Inspection Service, Room 102, Cotton Annex, 300 12th St. SW, Washington, DC 20250-3700.

— *Federal Register*, 9 CFR, 64 (11): 2803-2805, 1999.
<http://www.fsis.usda.gov/OA/fr99-1123.htm>

Listeria outbreaks reported to CDC

Recently, 72 illnesses relating to *Listeria monocytogenes*, serotype 4b, were reported to the Centers for Disease Control and Prevention in Atlanta. Within the 14 states that reported cases between early August 1998 and January 1999, 16 adults died and five women had miscarriages.

The outbreak vehicle of transmission was identified as hot dogs and possibly deli meats produced by Bil Mar Foods. In December, the manufac-

turer voluntarily recalled specific production lots of potentially contaminated products. The CDC later isolated the outbreak strain of *Listeria monocytogenes* from an opened and a previously unopened package of hot dogs manufactured at a plant in Zeeland, Mich. A different strain of *Listeria monocytogenes* was isolated from unopened packages of deli meats produced at the plant.

Recalled products carry the codes "EST

P261" or "EST 6911." Products include deli meats and hot dogs with the brand names Ball Park, Bil Mar, Bryan Bunsizer, Bryan 3-lb Club Pack, Grillmaster, Hygrade, Mr. Turkey, Sara Lee Deli Meat, and Sara Lee Home Roast brands. Packages for the above stated brand names that carry other establishment numbers are not affected by the recall, nor are non-meat Sara Lee products.

On January 15, 1999, the Food Safety and
(continued on page 3)

FAQ's

What foods are associated with *Listeria* infections?

Outbreaks have been associated with such foods as cole slaw, pasteurized milk, raw milk and dairy products, soft cheeses, meat paté, hot dogs, cold cuts, improperly cooked chicken, and smoked mussels.

Who is most at risk?

Individuals most sensitive to *Listeria monocytogenes* are pregnant women and unborn fetuses; infants; elderly people with reduced immunity; people who take special medications, such as steroids and chemotherapy; and individuals who are immunodeficient from serious illness, such as AIDS or cancer.

What are the symptoms?

Initial symptoms include nausea, vomiting, abdominal cramps, diarrhea, fever, and severe headache. A *Listeria* infection during pregnancy may cause influenza-like illness, with fever and chills. The infection may lead to the loss of the fetus. Illness can begin two to eight weeks after consuming the contaminated food.

On occasion, a *Listeria* infection may cause meningitis and encephalitis. Individuals who are not immunocompromised or pregnant rarely develop severe illness from *Listeria monocytogenes*.

How do you protect yourself?

The Centers for Disease Control recommends that immunocompromised individuals and pregnant women cook leftover or ready-to-eat foods, such as hot dogs, until steaming hot. Pregnant women may also choose to avoid cold cuts or thoroughly reheat cold cuts before eating them.

— *Multistate Outbreak of Listeriosis—United States, 1998*;

<http://www.cdc.gov/epo/mmwr/preview/mmwrhtml/00056024.htm>

— Ray, Bibek. *Fundamental Food Microbiology*. CRC Press, Inc. 1996.

Food Safety RESEARCH

Awareness of irradiated poultry studied

A 15-question survey of 300 consumers in Texas examined food safety awareness and consumer acceptance of irradiated raw poultry. Researchers interviewed 50 consumers in two supermarkets in each of three cities: Bryan-College Station, El Paso, and Houston.

Differences in populations among cities affected the perception of which meat contained the most harmful bacteria. Respondents from El Paso (those with a high school education, GED, or no degree, Hispanics, other minorities, and those who were surveyed in Spanish) all identified pork as the meat containing the most harmful bacteria. Caucasian respondents from Bryan-College Station and Houston rated poultry highest in harmful bacteria. These respondents had a technical, associate, or college degree, and responded in English.

A majority of all groups surveyed responded that poultry meat was generally safe. Caucasian

and English-speaking respondents from Bryan-College Station had a high trust in poultry safety, with 82 to 92 percent reporting such trust. El Paso respondents who were Hispanic and those who responded in Spanish were not as confident, with 57 to 72 percent classifying poultry as generally safe.

Age, city of residence, education level, ethnicity, the language of the survey, and gender affected the acceptance of irradiated raw poultry. Approximately 69 percent of respondents under age 18, and 13 to 42 percent of adult respondents were not familiar with irradiation. Of the adult respondents who knew what irradiation was, 28 to 44 percent were willing to eat irradiated poultry. Generally, willingness to eat irradiated poultry increased with education level. A majority of females said they would refuse to eat irradiated poultry, while most male respondents said they would eat it.

A correlation between

food safety perceptions and the acceptance of irradiated poultry was discovered. Respondents who believed either beef or pork contain the most harmful bacteria were less likely to accept irradiated poultry. On the other hand, the respondents who believed poultry contains the most harmful bacteria were more likely to accept irradiated poultry. The groups that seemed most opposed and unfamiliar with irradiation were adult minorities, particularly Spanish-speaking El Paso residents, Hispanics, and those who had at most a high school degree. The survey suggested that education on food irradiation would be most effective in Hispanic and Spanish-speaking communities, and at the high school level, since 70 percent of Texas children under age 18 are unfamiliar with irradiation.

— Maciorowski, K.G., S.C. Ricke, S.G. Birkhold, *Dairy Food, and Environmental Sanitation*, 19(1): 18-28, 1999.

Characteristics of *Listeria monocytogenes*

Gram-positive, nonsporulating motile rod.

Optimum growth at 25°C. (77°F.), but can grow at 2 to 4°C. (36° to 39°F.).

Can survive for long periods of time in many different environments.

Ubiquitous: found in soil, sewage, water, and dead vegetation.

Infective dose estimated to be 100 CFU/g, but lower doses could cause infection.

Doyle, Michael R. *Food Microbiology Fundamentals and Frontiers*, 1997.

Salmonella enteritidis PT6 increasing

In the United States, the most common phage types (PT) of *Salmonella enteritidis*, which causes egg-borne *Salmonella* infections, have been identified as PT8 and PT13a. In the United Kingdom and Western Europe, the predominant phage type responsible for egg-borne *Salmonella* infection is *Salmonella enteritidis* PT4. Recently, scientists reported a possible emergence of a new egg-associated *Salmonella* phage type in the United Kingdom.

Three *Salmonella enteritidis* PT6 food outbreaks were investigated in 1997. The first outbreak took place in Cardiff, Wales, where three out of five individuals affected were positive for *Salmonella enteritidis* PT6.

A batch of fish cakes that had been dipped in raw eggs before being fried was found to be the source of the outbreak. The cooking process was reproduced, and it was found that the fish cakes were too thick to be properly fried by the shallow frying method.

Two residents of a nursing home and two staff members infected with *Salmonella enteritidis* PT6 were affected by the second outbreak. Its source was not found, but raw eggs were regularly used at the nursing home. It was suggested that the outbreak was caused by cross-contamination. The third outbreak took place in a small Italian restaurant, where eight customers were infected with *Salmonella enteritidis* PT6. A dessert was identified as the source.

In all three outbreaks, it was difficult to trace the source of the eggs, because of poor egg labeling and because of the complex network of suppliers and distributors involved. Eggs involved in all three outbreaks were thought to be from different sources.

The rise in the appearance of *Salmonella enteritidis* PT6 suggested to the authors that this phage type may have found a new niche, and contamination has spread rapidly throughout a basic food commodity. However, it is not certain that *Salmonella enteritidis* PT6 is egg-borne.

— *Evans, Meirion R., Will Lane, and C. Donald Ribeiro, Emerging Infectious Diseases, 4(4): 667-669, 1998.*

Researchers study gloves vs. hands

Within food service establishments, food handlers are significant vectors for the transmission of foodborne disease to consumers. Methods of preventing this channel of contamination have been intensely debated. One side states that bare hand contact with ready-to-eat foods must be eliminated. The other side suggests that proper hand washing and sanitizing is sufficient.

Wearing gloves to provide a barrier between the food handler and the food product seems ideal, but has had limited success. Factors that contribute to the failure of this method include poor glove quality, with high defect and leakage

rates. The use of gloves also may give food handlers a false sense of cleanliness. They may not consider the frequency with which gloves



must be changed or cleanliness of their hands before using the gloves.

A recent study supports the use of bare hands with a regimen of proper hand washing and sanitizing, which provides a significantly higher hand sanitiza-

tion level than the use of gloved hands, hourly glove changes and hand washing. The use of gloves to prevent transmission of foodborne diseases may require stringent employee training followed by continuous enforcement of proper usage. Disadvantages may outweigh the advantages of the gloved method.

— *Fendler, Eleanor J., Michael J. Dolan, and Ronald A. Williams, Dairy, Food and Environmental Sanitation 18 (12): 814-823, 1998.*

— *Fendler, Eleanor J., Michael J. Dolan, Ronald A. Williams, and Daryl S. Paulson, Dairy, Food and Environmental Sanitation 18 (12): 824-829, 1998.*

Listeria outbreaks

(continued from page 1)

Inspection Service announced another product recall for the possible presence of *Listeria monocytogenes*. A report of illness in Kansas City, Mo., prompted testing of intact packages of an Oscar Mayer product. After the products tested positive, Oscar Mayer Foods recalled 28,313 pounds of deli meat that may have been contaminated: Oscar Mayer All American Variety Pack, 10 oz., and Oscar Mayer Club Sandwich Variety Pack, 9 oz. Recalled packages are labeled "JAN 12" and bear establishment numbers "EST 537A" or "P-1449." They were shipped nationwide or exported.

A third recall was announced January 22. Thorn Apple Valley's Forrest City, Ark., meat processing plant voluntarily recalled all frankfurter and lunch combination products produced since July 6, 1998, because of potential contamination with *Listeria monocytogenes*.

All meat and poultry products bearing "EST 13529" or "P-13529" are subject to the recall. Numerous brands are involved. Products could include lunch combinations (products containing various luncheon meats) and frankfurters. The products were distributed nationwide or shipped abroad.

At press time, FSIS did not have evidence linking this product to the nationwide listeriosis outbreak, still under investigation. Consumers who purchased products with these code numbers should return them to the point of purchase.

Illnesses suspected to be related to the products should be reported to a physician immediately.

— *Update: Multistate Outbreak of Listeriosis;*

<http://www.cdc.gov/od/oc/media/pressrel/r990114.htm>

— <http://www.fsis.usda.gov/OA/whatsnew>

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K-State, County Extension Councils, Extension Districts,
and U.S. Department of Agriculture Cooperating

All educational programs and materials are available
without discrimination on the basis of race, color,
religion, national origin, sex, age, or disability.

Upcoming Events

March 3-4, 1999

Second Kansas Conference
on Food Protection
Wichita, KS
Contact: Stephen Paige
(785) 296-0189

April 12-13

Serving Safe Food, Wichita, KS
Contact: Teresa Lang
(316) 722-7721

April 12 & 19

Serving Safe Food, Emporia, KS
Contact: Angela Cichocki
(316) 341-3220

April 14, 21, 28; May 5, 12

Serving Safe Food, Salina, KS
Contact: Sherrie Mahoney
(785) 826-6645

May 12-13

Serving Safe Food
Overland Park, KS
Contact: Nada Thoden
(913) 764-6300

May 18 & 20

Serving Safe Food
Leavenworth, KS
Contact: Denise Sullivan
(913) 684-0475

June 8-9

Serving Safe Food
Lawrence, KS
Contact: Susan Krumm
(785) 843-7058

June 15-16

Serving Safe Food, Topeka, KS
Contact: Cindy Evans
(785) 232-0062

June 22-23

Serving Safe Food
Garden City, KS
Contact: Linda Walter
(316) 272-3670

June 29-30

Serving Safe Food, Ottawa, KS
Contact: Rebecca Dillard
(785) 229-3520

July 6-7

Serving Safe Food
Atchison, KS
Contact: Diane Nielson
(913) 833-5450

July 12-13

Serving Safe Food
Wichita, KS
Contact: Teresa Lang
(316) 722-7721

July 14 & 21

Serving Safe Food
Salina, KS
Contact Sherrie Mahoney
(785) 826-6645

July 9-16, 1999

19th International
Rapid Methods
and Automation
in Microbiology Workshop
Manhattan, KS
Contact: Daniel Fung
(785) 532-5654

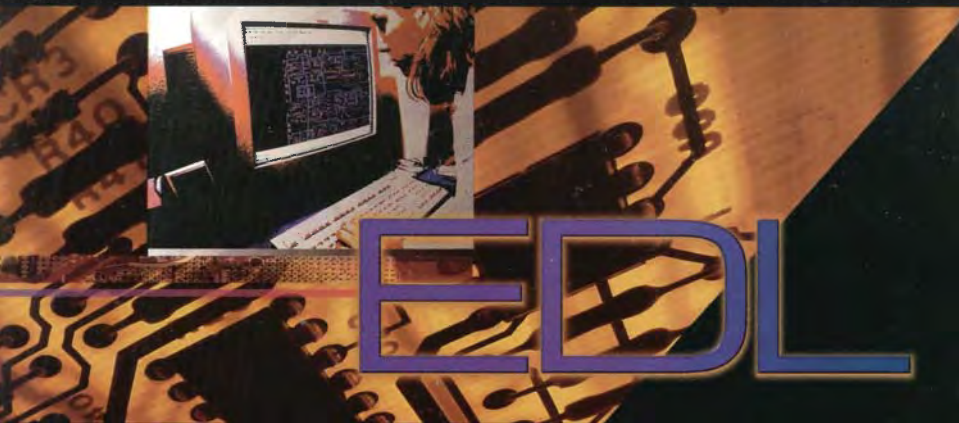
KANSAS STATE UNIVERSITY
ELECTRONICS DESIGN LABORATORY



"APPENDIX 4"
EDL BROCHURE



EDDL



EDL provides full-time engineering support for

research and teaching at Kansas State University

through development of advanced

instrumentation, data acquisition systems, sensors,

and other high-end electronics.

KSTATE
Kansas State University

Creating technology support for researchers on campus and for business users

Established in 1996, the Electronics Design Laboratory (EDL) provides researchers with access to advanced electronics, assists with integrating electronics technology into research and teaching programs, and aids in electronics technology transfer to users by providing ongoing technical support. EDL works in cooperation with many diverse academic departments, allowing a symbiotic approach to problem solving.

By delegating technical electronics issues to EDL, investigators free themselves to focus more fully on core research and teaching objectives.

EDL is headed by an experienced electrical engineer who supervises a full-time technical staff and a number of graduate and undergraduate interns.

Some specific capabilities include:

- Custom instrumentation design and development.
- Consulting for grounding, shielding, and noise.
- Electrostatic discharge controlled workspaces.
- Professional computer-aided design and simulation tools.
- Programmable logic device (PLD) design.
- Electronics prototyping and packaging.
- Light mechanical fabrication and packaging.
- In-house multi-layer printed wiring board (PWB) design.
- Circuit and system debugging and testing.
- Network, spectrum, and impedance analysis to 1.8 GHz.
- Arbitrary waveform generators for complex system testing.
- In-house single- and double-sided PWB fabrication.





The Electronics Design Laboratory is available to all members of the KSU research and teaching communities, and, by special arrangement, to other Kansas universities and businesses. Director Tim Sobering welcomes all inquiries and will provide free feasibility, cost, and time estimates for projects.



About the Director

EDL director Tim Sobering, a KSU alumnus, assumed his position in 1996 after spending twelve years on the technical staff at Sandia National Laboratories in Albuquerque, NM. While at Sandia, Sobering specialized in low-noise high-performance analog design for electro-optical instrumentation, including transducer interfacing, signal conditioning, analog-to-digital conversion, and power distribution. Other work involved digital circuit

design, digital signal processing, system requirements definition, radiometric analyses, performance trade studies, system modeling, and system testing.

Sobering completed a number of team leader and project management assignments for national defense and arms control verification projects. He is experienced in working with federal and state funding agencies, national laboratories, and universities.

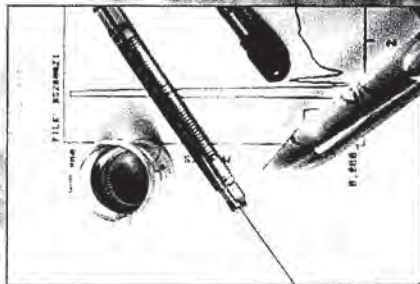
Examples of EDL Projects and Technologies

- Upgrade of data acquisition electronics and control circuitry, including precision calibration of bias supplies, for a large electron spectrometer.
- Design of high speed signal conditioning electronics and central computer data acquisition system for a photomultiplier tube array used in combustion physics research.
- Development of digital interface and power control subsystem for a multi-million dollar research collaboration between KSU and Fermi National Accelerator Laboratory.
- Implementation of a simplified data acquisition system interface and method of synchronizing electromyographic (EMG) data to limb position.
- Design of a simplified, low-cost, sonic anemometer for use in boundary layer characterization.
- Construction of high speed amplifier interface for use in measuring optical characteristics of semiconductor films.
- Development of NIM analog processor module for use within position sensitive detectors to perform electron beam alignment.
- Development and deployment of automated wire tension measurement system for drift chamber test and construction.
- Design of simulator for use in characterizing thermal abscess detection in cattle.
- Consulting on interference reduction and noise suppression in instrumentation systems.
- Design of low-noise, high-speed, impedance matched transimpedance amplifier for drift chamber readout.

Contact:

Tim Sobering, Director
Electronics Design Laboratory
Kansas State University
124 Burt Hall
Manhattan, KS 66506-0400
phone: 785-532-7826 fax: 785-532-2092
e-mail: ksuedl@ksu.edu • website: <http://www.ksu.edu/ksuedl>

NANTEK
INC.



**Meeting Customer
Needs Through
Advanced Chemistry**

1500 Hayes Drive
Manhattan, KS 66502
Phone: 785-537-0179
FAX: 785-537-0226

ABOUT NANTEK...

Nantek, Inc., was founded in 1995 to develop and commercialize reactive nanoparticles (RNPs) and other related technologies. RNPs are extremely small particles of matter having extraordinary physical and chemical properties which hold promise for meeting a wide range of needs in both civilian and military markets.

Reactive nanoparticles and related technologies were developed at Kansas State University (KSU) under the direction of Dr. Kenneth J. Klabunde, University Distinguished Professor of Chemistry. An internationally recognized pioneer in the emerging field of nanoparticle chemistry, Dr. Klabunde is a founding director and currently Nantek's Chief Technology Officer. Over the last two decades, Dr. Klabunde's research team has conducted extensive studies in this field and has published over 250 scientific papers on related subjects.

In 1997, Nantek received the *Technology of the Year Award* from the Silicon Prairie Technology Association. In accepting this award Dr. Klabunde remarked "We are honored to receive this



Kenneth J. Klabunde

recognition....Exciting days lie ahead, and we look forward to generating the kind of business results that will justify the confidence placed in our technology by the Silicon Prairie Technology Association."

Through an agreement with the KSU Research Foundation, Nantek has exclusively licensed a portfolio of related KSU patents and patent applications. In cooperation with KSU and its Research Foundation, Nantek was organized under the auspices of Mid-America Commercialization Corporation (MACC). MACC is a joint venture between KSU, the Kansas Technology Enterprise Corporation, the City of Manhattan, and the regional business community. MACC's mission is to facilitate the commercialization of new technologies, particularly those arising from research at KSU.

ABOUT NANOPARTICLES...

Comprised of very tiny clusters of atoms, nanoparticles derive their name from their size, which is in the order of a few nanometers ($1 \sim 10^{-9}$ meters). Occupying a spectrum of matter between individual atoms and more common micro- or macro-particles, nanoparticles exhibit remarkable optical, magnetic, electrical, thermal, and chemical properties.

... and specifically Nantek's Reactive Nanoparticles

Nantek is an industrial leader specifically concerning nanoparticles which have enhanced chemical reactivity. These reactive nanoparticles (RNPs) are comprised of metals, metal oxides, organometallic compounds, and various combinations thereof. Using proprietary

processes and product technologies, Nantek can produce a variety of nanoparticles well below 20 nanometers in size. These materials are generally characterized by high



Representation of reactive magnesium-oxide nanoparticle

ABOUT NANTEK'S CAPABILITIES...

Located in a business park near Kansas State University, Nantek's state of the art laboratory and pilot plant facility incorporates unique analytical and process equipment and capabilities. In this facility, Nantek undertakes contract research for the Department of Defense and other major clients. Nantek is also involved in **custom product development** to meet specific civilian customer needs. Nantek can produce a wide range of nanoparticles and other specialty chemicals as well as evaluate their utility in diverse applications.

Using proprietary processes and methodologies, Nantek currently is developing a wide range of novel products for use in the following applications:

- detoxification of hazardous substances in environmental remediation applications;
- air and water purification;
- protective and decontamination systems for use against highly toxic substances, including chemical warfare agents;
- catalysts for chemical, and particularly petrochemical processing industries;

- acid gas scrubbing; and
- advanced materials for use in semiconductor, superconducting and other advanced technology industries.

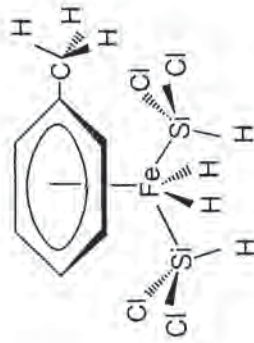
The expertise and experience of Nantek's professional and scientific staff are unsurpassed in its fields of advanced chemistry. Accordingly, Nantek has extraordinary skills for developing solutions for customer problems.

Nantek welcomes opportunities to establish strategic alliances and undertake cooperative work to develop products tailored to meet specific customer needs.

TO FIND OUT MORE about how Nantek can meet your needs, contact the General Manager at:

NANTEK
INC.

1500 Hayes Drive
Manhattan, KS 66502
Phone: 785-537-0179
FAX: 785-537-0226



$(\eta^6\text{-toluene})\text{Fe}(\text{H})_2(\text{SiHCl}_2)_2$
One of many organometallic compounds that Nantek is able to synthesize.

porosity and surface area. Nantek's nanoparticles are differentiated from those produced by others due to their unique morphologies that generate extraordinary catalytic and reactive properties.

For example, certain "common in nature" metal oxides such as calcium or magnesium oxide are relatively non-reactive and chemically stable. However, in "reactive nanoparticle" form, their chemical reactivity is dramatically enhanced. Through a demonstrated process known as destructive adsorption, RNPs can be used to **detoxify extremely hazardous substances** such as chlorinated hydrocarbons, polychlorinated biphenyls (PCBs), insecticides, acid gases, organophosphorous compounds, and even military chemical agents.



Your Food Safety, Quality & Technology Partner

Reliable Chemical and Microbiological Testing Services

HACCP Validation and Verification

Scientifically Sound Experimental Designs

Professional Scientific Team

ABOUT FOODLABS

FoodLabs, Inc., was founded in 1997 by a group of private investors and food industry experts to establish the nation's premier research and analytical laboratory.

Since our founding, the company has established state-of-the-art laboratory facilities in Manhattan, KS, providing a full range of microbiology and analytical chemistry services. Importantly, FoodLabs is quickly developing a reputation as a quality applied research laboratory – designing and implementing science-based experimental protocols to meet our client's product and process development and HACCP validation needs.

While a new company, FoodLabs was founded on a wealth of relevant experience, expertise and resources. These core resources are continually strengthened through the company's strategic relation-

ships with proven and respected organizations, namely AIB International and Kansas State University.

FoodLabs seeks to become your partner to help you meet the challenges ahead and to contribute in meaningful ways to the profitable growth of your business.

FoodLabs' Founding Directors framed the vision of creating a world-class food laboratory, building on regional expertise, to meet the new challenges facing the food industry. Those directors include:

Dr. Ata Baroudi
Dr. Calvin Drake
Mr. David Frey
Dr. Daniel Y. C. Fung
Dr. James Marsden
Dr. Randall Phebus
Dr. Jack Riley
Dr. Ron Sampson
Mr. Jim Weaver

MICROBIOLOGY



FoodLabs' microbiology laboratory is staffed and fully equipped to perform a wide array of routine analyses on food and feed products for the detection of pathogens, bacteria, yeast, and molds. From monitoring sanitation in a processing plant to evaluating the quality and safety of finished products, we are prepared to meet the needs of the food and feed industries.

ANALYTICAL CHEMISTRY

FoodLabs' chemistry laboratory offers a wide array of proximate/additive, nutrient, quality monitoring, and special chemistry analyses for food and feed products. FoodLabs' can also perform sophisticated drug and chemical analyses of plant and animal tissue, medicated pre-mixes, and animal feeds. Our chemists and food scientists can be relied on to meet your diverse needs, from routine and specialty analyses to nutrition label development.



RESEARCH SERVICES

FoodLabs, Inc., is setting itself apart from other food laboratories as a *preferred* provider of applied research services, aimed at assisting its valued food industry clients with development and regulatory acceptance of new technologies. FoodLabs specializes in the development of *science-based* experimental protocols that balance your corporate objectives and budgetary constraints. We have assembled a renowned staff of microbiologists and food scientists with the expertise, responsiveness and professionalism to meet diverse industry needs.

A formal alliance with *Kansas State University* provides access to a full range of resources and expertise that enables FoodLabs to provide turnkey solutions – from research to regulatory acceptance of your unique equipment, processes and products.

We are committed to providing the data necessary to obtain both *regulatory* and *market* acceptance of your unique processes and products. Importantly, FoodLabs delivers comprehensive and timely results on a confidential basis.

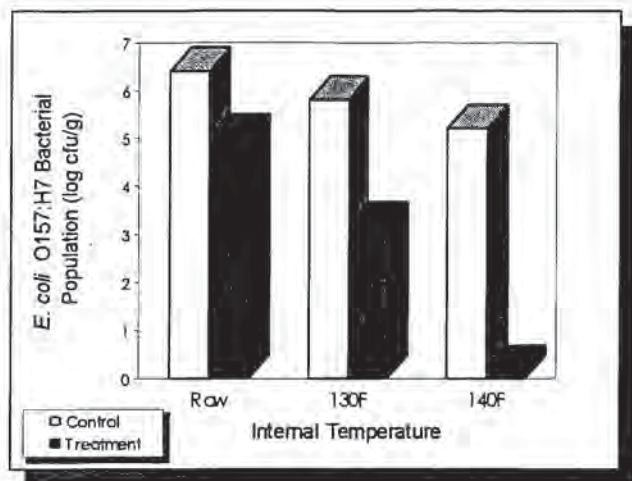
HACCP SUPPORT

Through a unique, collaborative relationship with AIB International, FoodLabs can support your HACCP development, implementation and verification needs.

Under the alliance, FoodLabs and AIB International pool their respective strengths to offer a cost-effective, comprehensive support system. AIB International will take the lead in SSOP development, facility audits, and HACCP training either on-site or at the institute. FoodLabs provides expertise, particularly for microbiological hazard risk assessment, the scientific validation of critical control points (CCP) and critical limits (CL), and ongoing HACCP verification support.

Together, AIB International and FoodLabs can deliver a quality HACCP program.

Enclosed is information on some of our programs and capabilities. Please contact us for more specific information on how we might best serve you.



Kansas State University Collaborative Relationship

A formal alliance with *Kansas State University* provides access to a full range of resources and expertise that enables FoodLabs to provide turnkey solutions – from research to regulatory acceptance of your unique equipment, processes and products.

Scientifically-Sound Research

FoodLabs specializes in the development of *science-based* experimental protocols that balance your corporate objectives and budgetary constraints. Our staff of microbiologists and food scientists can assist from the initial phase of objective definition through final acceptance of the results by FDA, USDA and your customers.

Quality Results

Upon successful execution of a project, FoodLabs delivers a final report summarizing objectives, methodologies and results meeting the highest standards of professionalism. Our clients routinely forward these comprehensive reports to their customers to support market claims and to regulatory agencies for process or product approval.

FoodLabs, Inc., is setting itself apart as a *preferred* provider of applied research services, aimed at assisting its valued food industry clients with development and regulatory acceptance of new technologies. We have assembled a renowned staff of microbiologists and food scientists with the expertise, responsiveness and professionalism to meet diverse industry needs.

Some of the Many Research Services Offered

FoodLabs' validation and technology development services include:

- In-plant and pilot plant HACCP validations;
- Pilot plant fermented sausage validations;
- Antimicrobial evaluations of ingredients, treatments, and processes;
- Microbiological rapid method comparisons;
- Sensory evaluations;
- Shelf-life and inoculation studies;
- Thermal death evaluations;
- and much more.

Commitment to Excellence

We are committed to providing the data necessary to obtain both *regulatory* and *market* acceptance of your unique processes and products. Working with our colleagues at Kansas State University, a team of food safety experts can be assembled to overcome the important technological and regulatory hurdles facing your company.

Importantly, FoodLabs delivers *comprehensive, timely* results on a *confidential* basis.

Contact our office today to receive more information on how we can meet your research and validation needs



Your Food Safety, Quality & Technology Partner

HACCP SUPPORT & CONSULTATION

Through a unique, collaborative relationship with AIB International, FoodLabs can support your HACCP development, implementation and verification needs.

Under the alliance, FoodLabs and AIB International pool their respective strengths to offer a cost-effective, comprehensive support system to meet your HACCP plan development and implementation needs.

FoodLabs' Primary Role

FoodLabs provides expertise, particularly for microbiological hazard risk assessment, the scientific validation of critical control points (CCP) and critical limits (CL), and ongoing HACCP verification support. FoodLabs strongly believes in science-based HACCP solutions and can tailor CCP validation studies to meet your technical and budgetary needs. We can develop preliminary experiments to help assess microbial levels in your products and processes. More comprehensive HACCP validation can be performed by either utilizing special pilot plant processing facilities or through in-plant evaluations of your process technologies.

AIB International's Primary Role

AIB International will take the lead in SSOP development, sanitation and HACCP audits, and HACCP training either on-site or at the Institute. For over 75 years, AIB International has provided third-party auditing for dairy, meat, processed vegetables, baking and other food companies as part of its rigorous auditing program. The Institute's 50 auditors have served 5600 clients in 50 countries and are unmatched in the industry in their ability to deliver quality audit and training services.

HACCP Principles

- Principle 1* Conduct a hazard analysis
- Principle 2* Determine and validate critical control points (CCP)
- Principle 3* Establish critical limits (CL)
- Principle 4* Establish monitoring procedures
- Principle 5* Establish corrective actions
- Principle 6* Establish verification procedures
- Principle 7* Establish record keeping and documentation procedures

Contact our office today regarding this exciting new program designed specifically to meet your regulatory, food safety, market and due diligence needs.

Together, FoodLabs and AIB International can deliver a quality HACCP program.



Your Food Safety, Quality & Technology Partner

DRY AND FERMENTED SAUSAGE VALIDATIONS

FoodLabs' Sausage Validation Program

FoodLabs' in collaboration with *Kansas State University* has developed an exciting new program—delivering a tailored scientifically-sound study to meet your process validation needs.

FoodLabs will take the lead in conducting a tailored validation study for your unique processes using experimental approaches that have been developed and proven by *Kansas State University* scientists. Under this collaboration, specialty process equipment will be utilized that is capable of simulating your unique process conditions on a pilot-scale basis.

Consistent with HACCP principles, such a scientific validation provides the best and most cost effective means for meeting this regulatory requirement.

Background ... The Current Regulatory Environment

Currently, the USDA, Food Safety and Inspection Service (FSIS) requires the use of a "validated manufacturing process" for the production of ready-to-eat dry and semidry fermented and acidified sausages. The current regulation mandates use of a process that delivers a 5 log reduction in *E. coli* O157:H7 populations.

More recently, preliminary discussions have been reported on possible application of a 7D requirement for *Salmonella* as well as requirements for *Listeria monocytogenes*.

FoodLabs can either perform your *E. coli* O157:H7 testing using the latest rapid methods, or provide the data needed to demonstrate that your proprietary process meets the 5 log reduction requirements.

Program Advantages

- Use of specialized equipment provides cost and time savings;
- Collaboration with *Kansas State University's* distinguished food scientists;
- Confidentiality of your proprietary process and product information;
- Professional, scientific team with a proven track record for delivering *high quality* and *timely results*; and
- Interpretation of results by a panel of experts – capable of supporting process modifications if needed to meet the regulatory requirement.

Typical Process Validation Project

Using specialized inoculation facilities, your product will be inoculated with high levels of a target pathogen (typically *Salmonella*, *E. coli* O157:H7, and/or *Listeria monocytogenes*). The product will then be processed using specialized pilot plant equipment that can simulate your specific process conditions. Microbiological populations of the target populations will be enumerated using standard techniques, appropriate sampling plans, and experimental replications.

At the completion of the validation, you will receive a complete, professional final report summarizing study objectives, materials, methods, data interpretations and major findings that can support your regulatory and HACCP requirements.

Microbiology

Our highly trained, experienced microbiologists can conduct a wide range of quantitative microbiological analyses to help you determine the stability and safety of your food product or process. Such analyses include:

- Aerobic plate count (total plate count)
- Anaerobic plate count
- Clostridium perfringens* count
- E. coli* (generic) count
- Enterobacteriaceae* count
- Lactic acid bacteria count
- Psychrotrophic plate count
- Spore count
- Staphylococcus aureus* count
- Total coliform count
- Yeast and Mold Count

Pathogen Detection

We realize that accurate and reliable microbiological results, as well as rapid turnaround, are critical to your operations. We utilize not only standard cultural methods for pathogen detection, but also the latest in rapid assay technologies. Our qualitative analysis capabilities include:

- Campylobacter*
- E. coli* O157:H7
- Listeria* spp.
- Listeria monocytogenes*
- Salmonella*
- Shigella*
- Staphylococcus enterotoxin*
- Yersinia*

In addition to microbiological testing for routine monitoring of raw materials, finished products, or processing environments, our expert food microbiologists can develop testing programs to meet your specialized needs. These programs can include supplier audit and quality monitoring, process validations, sanitation monitoring, efficacy studies, challenge studies, shelf life evaluations, and isolate identifications.

Analytical Chemistry

Our Chemistry Analytical Center offers a wide range of testing services at competitive rates with prompt, personal service. From verifying the safety and quality of incoming raw materials to ensuring the consistency of your finished product, we are equipped to meet your analytical needs.

FoodLabs' chemists use recognized methodologies, including AOAC, USDA, AACC, and AOCS. Our extensive Quality Program delivers accurate results.

- Product attribute testing (such as pH, titratable acidity, viscosity, water activity, tenderness, etc.)

- Antibiotic and pesticide residue testing

- Full nutrient determinations, including mandatory and voluntary nutrients

- Food and feed proximate analysis

- Sugar profiles

- Mineral content

- Cholesterol, fatty acids, TBAs, peroxide values

- Aflatoxins and mycotoxins

- And much more

The accuracy and reliability of your in-house analytical results are vital for achieving consistent product quality and safety. Our Check Sample Programs provide a **fast, economical,** and meaningful way to monitor and verify your internal analytical procedures and quality control. We offer you a choice of joining our standard Check Sample Programs, or having us customize a program to meet your company's specific needs.

The key to FASTCHEK is **rapid turnaround** so that you can identify and solve problems as soon as they occur. FoodLabs receives results from each of the program participants within one week of sample shipment. With this cooperation, FoodLabs promptly provides statistical results comparing your laboratory with the other numerous program participants.

Monthly FASTCHEK Program for Proximates

Over forty leading processors and laboratories are currently utilizing FoodLabs' monthly FASTCHEK Sample Program for Proximates.

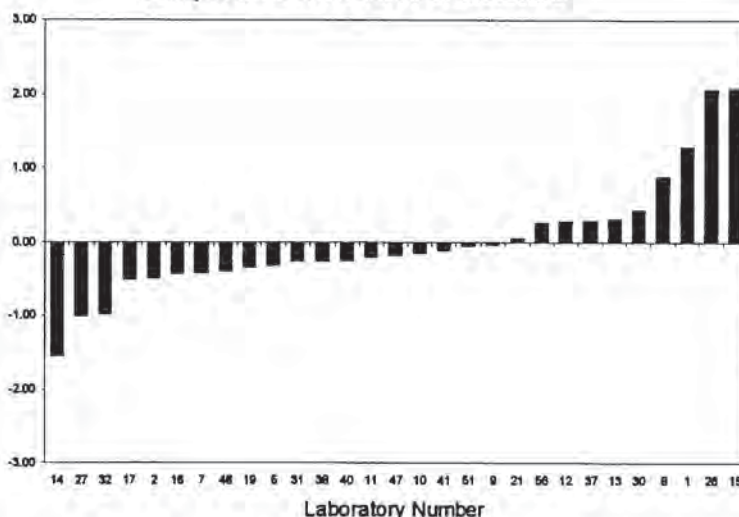
- FoodLabs ships three samples of whole cuts and/or processed meat products monthly.
- You perform moisture, fat, protein, and salt analyses and fax results to FoodLabs.
- FoodLabs' statisticians compile the results and provide comprehensive comparative data to each program participant within one week of initial sample shipment.
- Each participant receives means and standard deviations for each product as well as a composite z-score showing a ranked performance against other participants (see example below).
- All results are coded to ensure the strictest confidentiality.

FoodLabs' Check Sample Programs are Specially Designed to Economically Monitor Your Internal Analytical Procedures

Custom FASTCHEK Program Development

In addition to our standard programs, FoodLabs can customize a check sample program to meet your specific needs. Programs can target specific food products such as ground beef, eggs, milk, baked goods, etc. for both chemistry and microbiology.

Sample Z-Score Chart For Moisture



Nutrition Facts

Serving Size 1 oz. (30g)
Servings Per Container 8

Amount Per Serving		
Calories 180	Calories from Fat 140	
		% Daily Value*
Total Fat 16g		24%
Saturated Fat 6g		29%
Cholesterol 0mg		0%
Sodium 50mg		2%
Total Carbohydrate 7g		2%
Dietary Fiber 3g		12%
Sugars 2g		
Protein 5g		
Vitamin A 0%	•	Vitamin C 0%
Calcium 2%	•	Iron 8%
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:		
	Calories: 2,000	2,500
Total Fat	Less than 65g	80g
Saturated Fat	Less than 20g	25g
Cholesterol	Less than 300mg	300mg
Sodium	Less than 2,400mg	2,400mg
Total Carbohydrate	300g	375g
Dietary Fiber	25g	30g
Calories per gram: Fat 9 • Carbohydrate 4 • Protein 4		

Label Development

Obtaining accurate laboratory analysis is only the first step in developing a nutrition label for your product. Once the analysis is complete, all required and voluntary information must be placed as prescribed by FDA regulations. FoodLabs has the know-how to assist you in developing a label, including layout, to meet these regulatory guidelines. A camera ready label can be provided with each nutritional analysis.

Rely on FoodLabs to meet your nutrition label development needs.

Nutrition Labeling Services

Using the latest information available from the FDA and USDA, our team of trained, experienced professionals will piece together those components so integral to your nutritional labeling program — required analysis, label format, and health claims. Your product formulation in combination with our nutrition labeling analytical packages provides all the information necessary for FoodLabs to develop a comprehensive and accurate nutrition label.

Analysis and Data Review

FoodLabs has the expertise and facilities required to perform a full range of nutrient determinations on food products. Our highly-trained chemists are intimately familiar with the methods for analyzing both mandatory and voluntary nutritional labeling nutrients.

We use standard methodologies and the most advanced techniques to perform nutritional analyses according to FDA and USDA guidelines. All nutritional data is reviewed by highly trained food scientists as part of our comprehensive Quality Assurance Program. Our clients are assured of precise and accurate information.

NutriLabel Express

NutriLabel Express, a unique "first of a kind" nutrition labeling program, **can save you 20-40%** on the cost of running analyses alone. This "nutritional screen" combines **reliable** data base information and preparatory analytical testing of your product, in order to develop a preliminary nutrition label. Typically, FoodLabs will test for fat, moisture, protein, ash, carbohydrates, calories, sugar profile and sodium. Simultaneously, we will analyze the product formulation for saturated fat, dietary fiber, cholesterol, minerals, etc. using reliable database information. This translates into a direct cost savings on analytical services.

Quality Client Services

Confidentiality

We realize that control of your company's data and information is vital to meet your company objectives. As such, all information provided to or generated by the FoodLabs' staff is treated confidentially and will not be revealed to third parties without prior consent of the client.

Customer Service

Our administrative and laboratory personnel are available to assist you and respond to your specific needs, providing accurate, timely, and comprehensive results.

Turnaround Time

At FoodLabs, we realize that time is money. Therefore, we make every effort to assure rapid completion of analytical testing in an accurate and comprehensive manner.

Quality Results

Through a system of prevention, assessment and correction, FoodLabs' Quality Assurance Program has been designed to meet the strictest requirements. Elements of the program include:

- The use of recognized methodologies from AOAC, EPA, FDA, USDA, and other regulatory and presiding bodies;
- Employment of intra-laboratory check sample programs incorporating the use of samples of known value, spiked samples and appropriate duplicate analyses;
- Complete quality documentation system defining all laboratory methods and analyses performed; and
- Careful sample custody procedures which protect both sample and analysis integrity.

Sample Submission Instructions

The following guidelines should be followed when preparing samples for shipment.

1. Provide adequate amounts of the product to allow for sample compositing and testing. When collecting sub-samples, collect portions that accurately represent the whole.
2. Complete an Analysis Request Form detailing analytical testing required and clearly identify each sample with the type of product, analyses required, code numbers or dates, special instructions, and general company information. "Rush" orders can be accommodated with prior notification (a surcharge may apply).
3. The accuracy and reliability of test results depend on the quality and integrity of the incoming sample. Samples must be packaged and promptly shipped to the laboratory. Refrigerated or frozen samples

should be placed in a suitable insulated container with blue ice and forwarded via overnight delivery. We can provide shipping containers with cold packs, if needed.

4. If possible, please fax [(785) 537-0226] a copy of the completed Analysis Request Form on the date of sample shipment, so we can better meet your turnaround requirements.
5. Please ship all samples to the following street address:

FoodLabs, Inc.
1500 Hayes Drive
Manhattan, KS 66502
(785) 537-1862
6. Contact our office if you have any questions regarding proper shipping procedures or if you need a copy of our Analysis Request Form.



ANALYSIS REQUEST FORM

COMPANY NAME AND ADDRESS		FoodLabs, Inc. 1500 Hayes Drive Manhattan, KS 66502 Phone: (785) 537-1862 Fax: (785) 537-0226		FoodLabs USE ONLY Work Order No. _____ Entered By: _____ Date & Time: _____ Sample Condition: _____	
PHONE NUMBER	FAX NUMBER	ATTN: _____ PLEASE CHECK FOR ADDITIONAL SERVICES <input type="checkbox"/> Rush (Additional charge incurred - call for more information) <input type="checkbox"/> Fax Results <input type="checkbox"/> Telephone presumptive results <input type="checkbox"/> Send more analysis request forms <input type="checkbox"/> Other: _____			
SEND INVOICE TO (Indicate Name and Address if Different From Above)		SEND REPORT TO THE ATTN. OF:			
P. O. NUMBER	DATE SUBMITTED	SEND REPORT TO THE ATTN. OF:			
SAMPLE IDENTIFICATION & DESCRIPTION	NO. OF CONTAINERS	ANALYSIS REQUESTED		SPECIAL INSTRUCTIONS	
(Signature) Relinquished By:	DATE	TIME	Received By:	DATE	TIME
Relinquished By:			Received By:		
Relinquished By:			Received By:		
Relinquished By:			Received By:		

- ☐ [Agromedicine](#)
- ☐ [Community Health Council](#)
- ☐ [Youth Development](#)
- ☐ [Farm Transition and Stress \(coming soon\)](#)

- ☐ [Irrigation](#)
- ☐ [Tobacco](#)
- ☐ [Dairy](#)
- ☐ [Flu Shots](#)
- ☐ [National Network for Health](#)



Agromedicine

A New K-State / KU-Medical Center Collaboration

[How to get Agromedicine started in Kansas](#)

[Who to contact for more information](#)

[Memorandum of Understanding](#)

[Kansas Agromedicine Outreach Program](#)

Agromedicine is the name of a partnership between medical and Land Grant University professionals which promotes the health and safety of farm families and environments, agriculture workers, consumers of agricultural products and associated industries.



There are many problem areas in agriculture which require health professional resources to identify the causes and ways to prevent them. When farmer and related industry worker morbidity arises, prompt medical diagnosis and effective treatment is essential. Further, all of these problem areas require educational outreach to explain, reassure and train the public, the agriculture industry workers, and their families about morbidity etiology and the prevention as well as other relevant health and safety promotion.

Agromedicine partnerships

Agromedicine is a coordinated response to the needs listed above. Agromedicine is an interdisciplinary partnership that links the state's land grant and the medical universities' resources. The land grant university typically provides the agricultural and veterinary medicine expertise while the cooperative extension service provides the educational outreach and community based intervention programming. The KU medical college faculty provide the medical epidemiology as well as the diagnosis and treatment of cases in consultation with local practitioners.

Agromedicine partnerships are currently functioning in 17 states.

Alabama Delaware Florida Georgia Iowa
Kansas Kentucky Mississippi New York North Carolina
Pennsylvania South Carolina Tennessee Texas Virginia
West Virginia Wisconsin



The National Agromedicine Consortium

The state agromedicine partners are linked by a National Agromedicine Consortium.

Consortium members encouraged Kansas to join and to host the Spring, 1998 National Consortium meeting at K-State.

The Office of Community Health has been facilitating collaboration discussions among faculty at KU Medical College, K-State Research and Extension, and K-State Veterinary Medicine. Initial areas for partnering involve teaching, research and service on a range of topics including the epidemiology, prevention and treatment of problems associated with:

- agricultural chemicals (toxicity, oncology, teratology, etc.)
- trauma from farm machinery
- skin cancer
- stress associated with agricultural occupations
- insect and other animal transmitted diseases
- endocrinologic problems arising from agricultural production and food processing.

What Did it Take to Get Agromedicine Started in Kansas?

The answer is very simple. It took "only a few people of good will" at the land grant and at the medical university campuses. These people recognized the other as a professional with colleagues who have much to contribute to the multidisciplinary partnership. Also, it is important to recognize that Extension's clients are the patients of the medical professionals. Often, cooperation between the two groups is as simple as a phone call to share information, to refer a client or patient to additional medical or land grant university department services, or to set up joint training opportunities for professionals and consumer groups.

Agromedicine does not require new funding or a special grant to get started. It simply took faculty at the land grant and medical campuses willing to work together and to share resources for the benefit of Kansans.

How Can You Get Involved?

Persons interested in exploring agromedicine activities or obtaining more information may contact:



John Neuberger, Dr. P.H. at the KU-School of
Medicine Department of Preventive Medicine
jneuberger@kumc.edu or 913-588-2745

Fred Oehme, DVM, Ph.D. at K-State College of
Veterinary Medicine Comparative Toxicology
Laboratories oehme@vet.ksu.edu or 785-532-4334

**MEMORANDUM OF UNDERSTANDING
for the inter-university
Agromedicine Program
between the
Kansas State University
and the
University of Kansas Medical Center**

The purpose of this agreement is to facilitate research, teaching and service activities related to the inter-disciplinary professional field of Agromedicine among the faculty in various departments at Kansas State University and the University of Kansas Medical Center. Agromedicine is emerging as an integration of applied, basic and clinical sciences focused on health and safety issues involved in modern agriculture including farm families and environments, workers in agriculture associated industries, and consumers of agricultural products.

Agromedicine has many health and safety problems that require professional resources to identify their causes and ways to prevent them. For example, when morbidity in farmers and agribusiness workers rises, it is essential that timely epidemiological study, medical diagnosis and provision for effective treatment occur. Health and safety risk areas require educational outreach to explain, reassure and train the public, agribusiness workers, and their families about the etiology of specific diseases and prevention strategies.

Agromedicine in Kansas is a flexible interdisciplinary partnership that links resources at the state's land grant university and medical center. Faculty of the land grant university provide the agricultural and veterinary medicine expertise while the cooperative extension service provides the educational outreach and community-based intervention programs. Faculty of the medical center provide expertise in environmental and occupational medicine, occupational nursing, industrial hygiene, medical epidemiology, risk assessment, toxicology, and a broad range of clinical services that includes the diagnosis and treatment of cases in consultation with local practitioners. Effective collaborations may evolve in areas of shared expertise such as environmental sciences, toxicology and health and safety training.

To facilitate the collaborative purpose of this agreement, interested faculty and administrators at Kansas State University and the University of Kansas Medical Center agree to explore partnerships in teaching, research and service on a range of topics including the epidemiology,

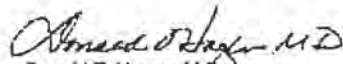
prevention and treatment of health and safety problems associated with (but not limited to) the following:

- Agricultural chemicals (toxicity, oncology, teratology, etc.)
- Poison control
- Trauma from machinery associated with food and fiber production and processing
- Skin and other cancers
- Stress associated with agricultural occupations and lifestyles
- Pest management
- Animal transmitted diseases
- Endocrinologic and other safety problems arising from food production
- Noise

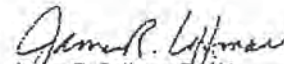
The agromedicine partners will also seek ways to provide the framework for collaborations including but not limited to the following:


- Maintaining regular communications via the world wide web and e-mail for faculty and community partners (e.g., local physicians and county extension agents)
- Creating a cultural exchange program including cross-campus visitations and presentations
- Developing research, learning and service experiences for agricultural professionals and students
- Following a calendar of events to foster professional and social relationships
- Participating in national and international conferences to promote the visibility of Kansas in agromedicine (including hosting of the Spring 1998 National Agromedicine Conference)
- Seeking joint funding for agromedicine research and development projects
- Releasing information and publishing data from joint projects when approved by all parties
- Maintaining coordinators for each university
- Facilitating interdepartmental team building as topical opportunities arise


In order to begin the Kansas Agromedicine collaborations, the undersigned acknowledge this Memorandum of Understanding.

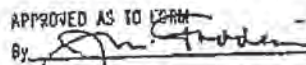

 Donald F. Hagen, M.D.
 Executive Vice Chancellor
 University of Kansas Medical Center

Dated: 5/12/97


 James R. Coffman, D.V.M.
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 H. Wilam Barkman, M.D., M.S.P.H.
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■ *Establishing our base...*

The Great Plains/Rocky Mountain Hazardous Substance Research Center, one of five such centers established and funded by the Environmental Protection Agency, located at and headed by Kansas State University, Manhattan, Kan., involves a consortium of 14 universities including:

Kansas State University	University of Wyoming	University of Nebraska
Montana State University	University of Missouri	University of Utah
Haskell Indian Nations University	University of Iowa	Utah State University
Lincoln University	University of Montana	South Dakota State University
Colorado State University	University of Northern Iowa	

The center serves ten states in two EPA Regions:

EPA Region 7

Iowa
Missouri
Kansas
Nebraska

EPA Region 8

Colorado
Montana
North Dakota
South Dakota
Utah
Wyoming

■ *Defining our mission...*

To conduct long-term and short-term environmental research related to key hazardous substance problems in this geographical area. These problems include soil and ground water remediation, waste minimization, and pollution prevention associated with agriculture, forestry, mining, and mineral processing. The emphasis is on contaminated soil remediation.

To enhance the movement of research results from the laboratory to commercial application through technology transfer programs.

■ *Broadening our efforts...*

MAIs

The initiative to involve faculty and students from Minority Academic Institutions (MAIs) in the centers began in 1994. Current projects include a video-delivered seminar series, an environmental education program, and student and faculty internship opportunities. The center has assigned a priority to projects with American Indian and Alaskan Native educational institutions.

TOSC

The Technical Outreach Services for Communities (TOSC) program began in 1994 with center professionals assisting communities in dealing with hazardous substance issues. The program provides an information hotline, workshops, technical and educational programs for communities, site assistance, and public education on hazardous substance issues.

TOSNAC

The TOSNAC program, TOSC support to Native American Communities, is national in scope and coordinated through the Haskell Environmental Research Studies Center at Haskell Indian Nations University. Its goal is to enhance the capacity of tribal members, groups, and governments to address environmental issues. TOSNAC coordinates support through federal and state regulatory agencies, HSRC consortium universities, and American Indian Higher Education Consortium universities.

Brownfields

Brownfields are abandoned, idled, or underused industrial and commercial properties where expansion or redevelopment is complicated by real or perceived contamination. In dealing with these sites under the TOSC program, the center's emphasis is on community participation strategies, site assessment and cleanup technologies, and redevelopment planning.

■ **Continuing our research endeavors...**

■ Field studies with poplar trees have demonstrated that vegetation can be effectively used to help prevent pollution from non-point sources. Poplar buffer zones are being used to mitigate agricultural run-off and protect surface water from non-point source pollution.

■ Research has shown that large microbial populations in the rhizosphere, sustained by root exudates and decaying root hairs, are beneficial in remediation of soil contaminated by petroleum compounds, anthracene and pyrene, and trichloroethylene.

■ Revegetation of metals-contaminated soils and mine tailings continues in the laboratory and at several field sites, resulting in a better understanding of the importance of micorrhizal fungi and soil amendments for the growth of vegetation in mine tailings.

■ Researchers have developed models for dissolution and bioremediation of soils contaminated with nonaqueous phase liquids, and have published the simulation results.

■ Laboratory investigators have developed new technology for a one-step destruction of chlorocarbons and organophosphorus compounds.

■ Center investigations have developed new approaches to identify and select chelators for separating heavy metals from soil. Quantitative structure-activity relationships and molecular descriptors can be incorporated into models which allow use of computers to help identify chelators.

■ The comprehensive approach to process synthesis and design developed through the center has been incorporated into spreadsheet software by a commercial firm and is now available for implementation by those who do process synthesis for chemical process industries.

■ Center investigators have demonstrated that Fenton reagent is effective for oxidation of a variety of contaminants including munitions compounds such as TNT. Recent work provides new information on the mechanisms of the oxidation process.

■ Field projects conducted through the center have demonstrated that bioremediation occurs in the field as predicted by laboratory studies. Availability of oxygen has shown to be an important consideration for contaminants which must biodegrade aerobically.

■ **Expanding our outreach...**

Conferences and Workshops

Center researchers and investigators meet annually for conferences on hazardous waste research. Oral presentations, posters, guest speakers, and exhibitors highlight the events where the latest research and development techniques in alleviating hazardous waste substances are discussed.

In conjunction with the conferences, the center sponsors various workshops covering topics from innovative remediation technologies, to regulatory considerations, to refresher courses for Hazardous Waste Operations and Emergency Response Training (HAZWOPER).

Publications

Center resources are increasingly available on the Internet. Conference proceedings, a research repository listing, the newsletter *HazTech Transfer*, and the center's annual report can be accessed through the World Wide Web at www.engg.ksu/HSRC/Publications.html. *Centerpoint* and other national five-centers' publications are also on-line at www.hsrg.org.

Research Repository

The Kansas State University Library, repository for center publications including theses and dissertations, and publications and volumes from sources outside the center, has over 1,000 holdings available through interlibrary loan.

Technology Development Partnerships

A variety of funding sources and flexible organizational structures allow us to cooperate as partners with federal, state, and private organizations. Special emphasis is on demonstrating performance and cost-effectiveness of research developments in the field.

On-line Journal

In 1996 the center began a project to publish the electronic, peer-reviewed [Journal of Hazardous Substance Research](#), to provide worldwide access to research articles on hazardous substance issues. It can be found at: www.engg.ksu.edu/HSRC/JHSR.



Kansas State University