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### Grazing Survey

For three years now the CDP has been involved in a project intended to shed light on the costs and returns to Wisconsin producers who utilize various grazing practices on their dairy farms. Financial data are being collected from approximately 30 farm families who have volunteered to be a part of this study.

A preliminary first year report, summarizing the cost and return characteristics of the survey farms, has been issued and the second year report is in progress. These reports should give interested producers some idea of whether grazing will allow them to achieve their financial goals. The plan is to continue this project so that it will be possible to monitor the financial performance of grazing operations over time.

### **MANAGEMENT INFORMATION SYSTEMS**

#### Agricultural Accounting And Information Management System (AAIMS)

The Agricultural Accounting and Information Management System (AAIMS) is a computerized agricultural accounting system maintained by members of the CDP. The program now comes in both a DOS and Windows version. Since its latest release in January of 1999, hundreds of copies have been distributed to Wisconsin managers.

#### Agricultural Budget Calculation Software

The CDP maintains a computerized system that is used to estimate the cost of producing various crops under various systems. This budget generator, known as the Agricultural Budget Calculation Software is used in evaluating the economics of various crop-related problems.

#### Dairy Pro-Forma

This computerized spreadsheet, developed by Gary Frank, is used to estimate the potential costs and returns for any dairy system a producer may be planning to use. The spreadsheet is used by county extension agents and financial consultants who are helping dairy producers put together financial plans for modernization and/or expansion. This decision-aid, which is available on the CDP web-site, complements the financial planning work that is being funded by the Wisconsin Department of Commerce.

### Cooperation with AgSource

The CDP is engaged in a project that is intended to make production data, compiled by AgSource/Dairy Herd Improvement, more useful to dairy producers. This year some prototype reports were generated which let a producer see how a particular production variable (i.e. milk production, % protein, % fat, culling rate, etc.) has varied over a twelve month period and compares to an average for a group of high performance producers. These reports will be shared with a test group of producers this year and then provided to all interested producers in future years.

In the coming year, steps will be taken to expand the AgSource reports so that they include information about labor usage on dairy farms. To do this, the CDP will work with AgSource to develop a reporting sheet that will account for producers' use of labor. This labor data will be reported on a per farm basis and an average farm basis so producers can get an idea of how effectively they are managing labor resources.

### Decision Aids

The CDP has developed a variety of computerized spreadsheets that may be used in making various management decisions. Enterprise budgets are available for dairy, replacement dairy stock, swine, and beef. Other spreadsheets are available for determining the value of silage, corn, and other feeds. These spreadsheets are frequently developed as producers and others who work with producers need assistance in making management decisions.

### WWW Home Page

The Center for Dairy Profitability's homepage has existed since 1995. This internet site has a wealth of information of value to dairy producers and professionals who advise dairy producers. CDP Online Resources is divided into several topics. "Software and CD-ROMS" lists software programs, spreadsheets, and CD-ROMs available through the CDP. The software is developed by CDP faculty, staff, and colleagues to improve the efficiency and profitability of Wisconsin's dairy industry. All spreadsheets and programs are available for order through the CDP and in some cases may be downloaded directly from the homepage. Under "Papers and Publications" a list of working papers by CDP staff and contributing dairy specialists on topics of financial management and dairy analysis is available. Papers are generally made available for online reading and in some cases may be downloaded for use in Microsoft Word or WordPerfect. There are also links to "Decision-Making" tools produced by CDP staff. All of these sections have been widely used by agricultural producers and professionals.

## **POLICY WORK**

The faculty and the staff of the CDP have been heavily involved in two policy issues that affect the potential profitability of Wisconsin dairy farms. One is the Wisconsin law that limits the price premiums that milk plants can pay to producers on the basis of the volume of milk shipments. The other issue concerns the new use-value assessment system that Wisconsin has adopted for levying property taxes on farm land.

### **Volume Premiums**

In 1998, Gary Frank of the CDP served as one of the state's expert witnesses in the lawsuit that challenged the "volume premium" law that is supposed to prevent price discrimination from occurring in Wisconsin. Frank's role in this lawsuit was to provide the court information about milk hauling costs so that it could be determined if there was any economic justification in the premiums that were being paid to producers who were shipping large volumes of milk to various plants.

## Use-Value Assessments

Bruce Jones serves on the Farm Land Advisory Council and has taken the lead in developing procedures for computing use-value assessments across the state. This work was in response to complaints by farmers in the northern region of the state that the income measures used to compute their use-value assessments were above the norm for their region. Jones reviewed these claims, found them to be true, and then developed a procedure for accounting for the lower rents that are typically earned on farm land in the northern and central regions of the state. These new procedures for computing use-values were adopted by the Farm Land Advisory Council for use in 1999.

## **OTHER PROGRAMMING ACTIVITIES**

### Dairy 2020

Bruce Jones worked with the Dairy 2020 Council on various dairy management issues. In the past he and David Williams, a county agent from Waukesha, developed a pamphlet that gave guidelines for selecting agricultural consultants. This pamphlet was put together at the request of the Dairy 2020 Council because the Department of Commerce wanted to give dairy producers guidance in hiring and working with consultants who aid in putting together expansion and modernization plans.

### Extension Teams

This past year the Agriculture and National Resource program area of the University of Wisconsin Cooperative Extension reorganized into a set of teams that will be responsible for specific programming activities. Two of these teams, the Dairy Team and the Business Management Team, are being led by faculty and staff of the CDP. The Dairy Team is being led by Bruce Jones and the Management Education Team is co-led by Gary Frank and Jenny Vanderlin.

The Dairy Team is responsible for coordinating all dairy extension programs for Wisconsin. This team has selected three programming priorities for the short-term, dairy modernization, cow care and herd health, and dairy business management.

The dairy modernization effort is intended to help dairy producers get access to the information they need for evaluating the options available for modernizing or expanding their dairy operations. This work is on-going and involves a number of issues such as farmstead planning, costs of parlor systems, costs of animal housing, manure storage and management, financial planning, and business arrangements. Efforts are now underway to organize and compile this type of information so that it can be distributed to interested individuals.

Work on dairy business management will be done in conjunction with the Business Management Team. This goal is to improve the business management skills of dairy producers. Financial analysis, marketing, personnel management, and strategic planning are some of the topics that will be addressed.

### **Dairy Farm Family of the Year**

The Dairy Farm Family of the Year recognition program is in its sixth year. Regional winners were selected across four regions of Wisconsin and a statewide banquet was held to honor the recipients for their accomplishments and contribution to Wisconsin's dairy industry. An overall winner was then named at the banquet. This program continues to be popular among dairy producers and it highlights the fact that it is indeed possible to succeed and prosper in the dairy industry.

Kraft continues to support this program which is open to any dairy family in Wisconsin. In addition, the Farm Credit Services of Wisconsin and the Wisconsin Milk Marketing Board elected to fund a portion of this program. As a part of this program, Kraft annually makes a \$2,500 contribution to the University of Wisconsin Foundation to support on-going educational programs for dairy farmers.

## B. Industrial and Economic Development Research Funds (I&EDR)

The office of University-Industry Relations (UIR) has responsibility for administering the I&EDR research funding program for the University of Wisconsin-Madison. During the 1997-98 competition, UIR changed the duration of funding under this program from three years to two. The office evaluated 56 research pre-proposals requesting a total of \$3,279,467 over a two-year period. During this fiscal year, 27 new research projects were funded, totaling \$397,047.

For the 1998-99 competition, UIR again changed the duration of funding, this time from two years down to one. Fifty-eight research pre-proposals were evaluated requesting a total of \$2,014,373 for the one-year period. UIR actually funded 16 of these new research proposals, totaling \$161,758.

### 1997-98

1. Identification of Genes of Economic Utility in Agriculture. Funds were requested to support a large-scale effort by two laboratories to identify plant genes of economic use. Specifically, insertional mutagenesis using *Agrobacterium* T-DNA, and deletion mutagenesis using fast neutron bombardment, was used to develop and screen large populations of mutated *Arabidopsis thaliana*, for an exhaustive application of "reverse genetics."
2. Utilization of Foundry Sand in Asphalt Concrete Mixtures. Foundry Sand (Green Sand) is a waste by-product of the foundry industry and, as a result, large quantities of foundry sand is currently being landfilled each year. However, this valuable material can be recycled and utilized in asphalt concrete mixtures, which is the focus of this study. The research objective was to assess the potential of using foundry sands in asphalt paving applications and to develop guidelines for design of paving asphalt concrete mixtures that incorporate foundry sands. The goals of this research were guidelines for economically feasible use of foundry sands in paving applications, which results in a better asphalt concrete mixture. The guidelines can be incorporated in the Wisconsin Department of Transportation Standard Specification for highways. Wisconsin foundries generate over 800,000 tons of by-products annually, many are interested in recycling foundry sands.
3. Contact Thermal Resistance of Plastic Films on High-Speed Electrically Heated Rollers. Heated rollers are used in the fabrication and lamination of polymeric films, paper, and other applications. Because they are usually heated by steam or oil, these systems have long startup times, are difficult to control, and are environmentally unsafe. The use of a self-regulating electrically-heated (ceramic or rubber coated) roller to take the place of a conventional system will save the user money, be more environmentally friendly and be cost efficient in terms of energy consumption. One major design variable that is not at all understood is the thermal contact, i.e. how hot the roller must be maintained, how far the web must be wrapped around the roller, and the roller rotational speed. The understanding of contact resistance between webs and both ceramic and rubber-covered rollers must be well understood in order to assure some degree of market development and commercial success.

4. A Novel Bioassay to Screen for Endocrine Disruption. The purpose of this study was to test the feasibility of a fast, efficient bioassay for screening endocrine disruptors utilizing an *in vivo Daphnia* reproduction bioassay. The reproduction bioassay for endocrine-disruption makes use of the short developmental time and unusual reproductive strategy of *Daphnia* (the water flea). There is a great opportunity for a bioassay that indicates endocrine-disruption, as well as survivorship, fecundity, and developmental integrity.

5. Sensor Fusion Techniques for Coin Discrimination. The purpose of this study was to develop a coin classification system capable of discriminating coins and tokens from around the world. Sensor fusion techniques were used to combine multiple sensor inputs (e.g. metallic properties, size). The system created has capabilities beyond any cash system currently available.

DeLaRue Cash Systems (former Brandt, Inc.) of Wisconsin is one of the major manufacturers of coin sorting products. Without improvements in the technologies used, these systems have limited use on the international market. None of the major coin equipment companies provide coin discrimination technology capable of performing error-free sorting of international coinage. A machine with the ability to sort coins from multiple countries will corner a large part of the cash system market.

6. Use of Dairy Based Futures Markets to Improve the Competitive Position of the Wisconsin Dairy Industry. The use of futures markets to hedge both input and output prices have existed for some time in grain and livestock markets, and hedging has become standard business practice for participants in these markets. The newness of the dairy-based futures contracts points to the need for the development of decision-making tools similar to those available to those segments of the agriculture sector with a history of futures markets. The primary objective of the proposed research was to develop such decision aids for the Wisconsin dairy industry. This project developed an integrated, comprehensive research and education program focused on the development of hedging strategies and decision aids for the Wisconsin dairy industry.

7. Micro-Mechanical Strain Sensors for In-Situ Characterization of Thin Films in High Volume Manufacturing Environments. The performance of microelectromechanical structures (MEMS) is rapidly degraded by variations in residual stress. Unfortunately, this mechanical property is very difficult to control in microfabrication processes, and must be carefully monitored. Existing strain sensors for micro-chip applications suffer from limitations in accuracy, complex readout, and complex fabrication. A new strain sensor design was proposed to address those problems. The strain can be sensed electronically, potentially at a resolution below 10 microstrain, before or after packaging the microstructure. The device is useful in monitoring the fabrication processes of and calibrating a number of different microsensors and microactuators. There is widespread industrial need for a device like this, and its development is intended to assist the incipient MEMS industry in Wisconsin.

8. Development of a Novel Insect Viral Vector System for Systemic Infection and Expression of Foreign Proteins in Plants. The goal of this work was to develop a highly efficient vector for the expression of foreign genes in transfected plants and to overcome the major limitations of the use of disease-causing plant viruses for this purpose. The study employed a simple RNA insect virus, Flock House Virus (FHV), for that purpose. The first steps in that effort were to enhance the cell to cell movement of FHV in inoculated leaves and to construct vectors containing foreign expressible marker genes. The goal of the study was to develop this vector as a model for (a) monitoring transient expression, (b) stable expression of foreign genes, and (c) rapid testing of resistance in plants against insects and plant pathogens. The major advantages of using FHV as a vector are the ease of inoculation (by simple rubbing of the virus or naked RNA onto the leaves) and sensitive assay of virus by plaque formation on monolayer of *Drosophila* cells. Any foreign protein expressed and packaged into FHV without altering the plaque forming ability of the virus can thus be quantitated by the number of plaque forming units.

9. Control of Insect Pests Using Satiety Inducing Peptides. The protection of harvest and post harvest agricultural products from insect damage is a complex economic and environmental issue. A greater understanding of these problems has led both university and industrial scientists to seek potential weak points in insect molecular or physiological systems that could be exploited for the purpose of control. An area that received considerable attention is that of insect antifeedants or repellants. Although many such compounds have been discovered, they are too specific for widespread agricultural use. This study sought the underlying physiological and biochemical basis for insect feeding that could make antifeedants useful on a broad spectrum of insect pests. If satiety in insects could be induced by leptin, a 16 kDa polypeptide from adipose tissue, or leptin-like compounds, the economic results would be enormous. First, insect food consumption would be minimized thus yielding greater harvests. Second, limited nutritional intake would reduce reproductive capacity and viability. More generally, the discovery of the underlying physiological and biochemical causes of insect satiety could lead to a means of broad-spectrum control. With collaborators at the Medical College of Wisconsin, this study focused attention on identifying the important signaling molecule in insects.

10. A General Approach for Discovery of Antibiotics. Successful management of infectious disease of humans, other animals, and plants is crippled by the recent development of widespread resistance to antibiotics. New approaches to disease control and to discovery of chemotherapeutic agents is required to avert the potential crisis in human health and food production resulting from the loss of effective antimicrobial agents. This study described a generic method for discovery of new antimicrobial agents from as yet undescribed soil bacteria, which was based on isolation of DNA directly from soil bacteria, cloning into vectors that replicate in diverse organisms, and screening for antibiotic activity. This method could re-open the field of antibiotic discovery by providing access to the metabolites of the vast communities of nonculturable bacteria in soil. The project has application in the pharmaceutical and agricultural sectors.



11. Introduction of a Commercially Viable System to Estimate Crude Protein Degradation in Forages to the Wisconsin and United States Dairy Industry. Each year in the United States 90,000 dairy producers purchase 1.9 billion dollars of protein supplement to feed their dairy cows. The 1989 Nutrient Requirements for Dairy Cattle, published by the National Academy of Science, defines that protein fed to dairy cows needs to contain an optimum ratio of ruminally degraded protein vs. ruminally undegraded protein (RUP). Despite universal understanding, there are no commercial laboratory tests to estimate the RUP content of feedstuffs fed to dairy cattle. Development of such a test would be considered a "breakthrough" in ruminant protein nutrition. A three-year research effort resulted in a promising new test for RUP in legume grass silages (LGS) using near infrared reflectance spectroscopy (NIRS) technology. Three new research projects designed to transfer the RUP test for forages technology to the dairy industry were proposed. These projects provided solid scientific evidence that NIRS technology can accurately measure the RUP content of forages fed to dairy cows and to demonstrate the acceptance and viability of a NIRS forage RUP test under field conditions.

12. Development of a Manure Application System Using Variable Rate Technology to Protect Water Quality and Improve Farm Profitability. Livestock producers do not feel confident in the rate of nutrient application when applying manure to cropland. Consequently, they take little credit for these nutrients and apply commercial fertilizers in excess of rates needed when manure is also applied. This results in excess fertilizer cost and nutrient loss to the environment with resultant water quality reduction. A side discharge manure spreader was developed which is automatically controlled to spread at a rate set by the operator. The advent of global positioning technology and grid sampling of soils allows an automatically controlled manure spreader to be developed which can vary the manure application rate based on location in the field to meet crop nutrient needs. This project combines global positioning technology with the controlled rate manure spreader currently under development. If the technology is developed by a manufacturer, widely adopted by livestock producers and properly managed, another result is more efficient nutrient management with resultant savings in purchased fertilizer and improved water quality. Wisconsin companies manufacture load cells and manure spreaders, which are distributed nationwide. By marketing a more effective manure spreader, these companies may expand their sales in Wisconsin and nationwide.

13. Determination of Neuron Targeting Sequences of Botulinal Neurotoxin Using Synthetic Mimetic Compounds. The neurotoxins produced by *Clostridium botulinum* have long been of concern to the food industry due to their extreme toxicity and potency. This research constructed chimeric proteins of botulinal neurotoxin and ricin A chain. A significant drawback to the use of intact heavy chain is its instability following separation from the light chain. This effectively prevents conjugation with prospective pharmaceuticals. The purpose of this study was the identification of those regions of the heavy chain responsible for motor neuron binding. The ultimate goal was the generation of stable heavy chain constructs that enable efficient coupling of pharmaceutical compounds for efficient delivery to the cytosol of motor neurons. This study, in conjunction with Ophidian Pharmaceuticals, Inc. of Madison, WI and Dr. Byron Anderson, a consultant of Ophidian Pharmaceuticals, Inc. developed methodologies for detecting types A, B, and E botulinal neurotoxins using mimetic compounds. The belief is that development of a stable botulinal heavy chain provides a means for targeting a variety of pharmaceutical compounds to the cytosol of motor neurons.
14. Enhancing Mineral Nutrient Availability in Maize Through Microbial Associations and Genetic Optimization of Uptake. This study yielded a number of important observations and developed tools that allowed us to make rapid progress towards attaining the following objectives: first, analysis of host genes involved in mycorrhizal associations by quantitative trait locus mapping, analysis of candidate genes, and characterization of maize mutants altered in mycorrhizal responsiveness and/or infections; second, determining whether endophytic diazotrophic bacteria provide fixed N to maize; and third, assessment of agricultural production practices and systems which will be important in exploiting beneficial microbes and optimized genotypes in limited fertilization situations. The study expected to result in products for maize agriculture including bacterial and mycorrhizal inoculants as well as new maize germplasm to enhance the nutrient efficiency of maize. These products are of significant interest to inoculum and seed companies in Wisconsin. In addition, the economic benefits to corn growers in the state is significant as fertilization is the highest on-farm cost of corn production.
15. Design Alternatives to Improve the Energy Efficiency of Residential Refrigerators. This research investigated design changes that resulted in improved energy efficiency for residential refrigerators. The program, which involved a graduate student in mechanical engineering and engineers at Sub-Zero Freezer Company, developed a simulation program for evaluating proposed design changes. The simulation program was used to estimate the energy use resulting from a number of new and previously proposed design changes. These changes are needed to reduce refrigerator energy use by 22 to 30% to comply with proposed 1998 minimum Federal performance standards.

16. Active Damping of Piezoelectric Actuator by Current Feedback Control. Piezoelectric actuators are capable of producing mechanical displacements with subatomic resolution, and are naturally vital elements in nanotechnology, where ultimate accuracy is being sought. This study actively pursued technologically viable ways to accommodate velocity state feedback in piezo devices. This study proposed to develop a method to estimate the velocity state based on the transient electric current through the active piezo element. This scheme is applicable even to situations in which no external sensors are available and is easily adopted to existing piezoelectric devices. A low-cost, compact, and modular controller, allowing a vast increase in speed that is retrofittable to existing platforms, can find a way to commercialization in Wisconsin.

17. Development of SMAD-DNA Binding Assays for Small Molecule Drug Screening. The function or dysfunction of TGF- $\beta$  pathways has been implicated in several major diseases, including cancer, vascular disease, Alzheimer's disease and a variety of fibrotic diseases. The discovery of Smad-DNA interactions holds promise for the development of therapeutic drugs that function by inhibiting or activating TGF- $\beta$  signal transduction. As potential targets for drug discovery, TGF- $\beta$  pathways have recently attracted a great deal of interest from the pharmaceutical and biotechnology industries. The objective of this study was to develop multi-component assays for Smad-DNA and Smad-cofactor interactions that are adapted for industrial high-throughput screening of chemical diversity libraries. Purified Smad proteins, interacting cofactors and DNA oligonucleotides were used to develop assays for gene-specific Smad-DNA and Smad-cofactor interactions. The aim was to develop assays that are rapid, sensitive and able to detect compounds that inhibit or stimulate Smad-cofactor-DNA complexes.

18. Rapid and Economically-Feasible Propagation of Goldenseal, A Valuable New Crop for Wisconsin. Goldenseal or yellowroot is a low perennial herb native to the U.S. that is rare due to over-collection from the wild. The plant is valued for its medicinal properties and has been collected and utilized on a worldwide basis for more than a century. UW received requests from potential and current growers for assistance in developing methodologies for procuring reliable planting stock at reasonable cost as they are limited in their ability to respond to market demand because of this factor. This project used modern biotechnological techniques invented at UW-Madison to develop a cloning protocol for goldenseal and transferred this technology to a small UW spin-off plant biotechnology company in Wisconsin, which upscaled the technology for testing directly in a grower's field. The latter two organizations contributed their services at no cost to UW-Madison, effectively matching any UIR grant with in-kind services.

19. Nuna Beans: A New Specialty Crop for Wisconsin. Nuna beans are a type of common bean (*Phaseolus vulgaris*) native to the Andean region of South America which possess the unusual characteristic of "popping" or expanding their cotyledonary tissue when heated in either hot oil or a microwave oven. This study developed nuna popping bean lines that are adapted to Wisconsin, and the seed of these lines can be used to evaluate the commercial potential of nuna beans. Nuna popping beans may be processed directly as a snack food; however, the "pre-cooked" beans may offer greater potential as a processed crop for canning or paste. The purpose of this study was to evaluate the agronomic characteristics of the nuna bean lines already developed to optimize cultural practices for production in Wisconsin, and to cooperate with industrial partners in an evaluation of nuna beans as processed bean products. In addition, the potential for developing nuna lines, which combine both higher expansion coefficients and popping percentages, was also evaluated.

20. Hybrid Canola for Wisconsin. Canola is a major source of vegetable oil in the American diet, and represents a potential alternative crop to diversify Wisconsin agriculture. However, crop yields in Wisconsin have been too low to recommend canola production as an alternative to other crops. Using new DNA markers technologies, this study showed that introgression of genes from unadapted winter-type canolas into spring-type canolas dramatically increases the yields of spring-type F<sub>1</sub> hybrids over standard open-pollinated and spring x spring hybrid cultivars. The purpose of this study was to introduce a genetically engineered pollination control system into these introgression lines that can be used for commercial hybrid seed production, and to determine if our different sources of winter germplasm provided different genes for heterosis, and if these genes are linked to genes for canola quality. Information on gene mapping describes how to combine different genes for heterosis in order to obtain canola quality hybrids with maximum yields.

21. Controlling Dimensional Stability in Printed Circuit Boards through Process Simulation and Optimization. As the printed circuit board industry moves toward more demanding and competitive markets, maintaining dimensional stability of the copper-clad laminates at reduced process cycle times becomes one of the most critical aspects. Today, dimensional stability is maintained by introducing lengthy post-baking cycles after molding the copper-clad laminates used to manufacture the printed circuit boards. A post-baking cycle is also required when molding multi-layered printed circuit boards. The objective of this study was to develop constitutive equations and process models to optimize the manufacturing process without the need of the two-hour long post-baking required for stress relaxation. The models were tested and implemented at the Allied Signal Laminate Systems Plant in La Crosse, Wisconsin. This project was partially funded by Allied Signal Advanced Materials Division.

22. Electrical Demand Reduction in Refrigerated Warehouses. The project investigated the potential of using the thermal mass of warehouse-stored products as a means to shift cooling demands to electric utility off-peak periods. By operating warehouse refrigeration equipment to pre-cool a warehouse prior to the start of utility on-peak periods, it is possible for the refrigeration system to remain idle during the entire on-peak period with minimal change in the warehouse ambient environment. The result is a significant operating cost savings to the warehouse owner and much-needed peak demand reduction for electric utilities.

23. Production: Planning and Scheduling. The goal of this project was to develop methodologies and techniques for efficiently solving complex scheduling and resource allocation problems. This project was strongly motivated by many planning, scheduling, and control problems encountered in industry such as job scheduling, machine allocation, inventory control, and facility planning problems. Many realistic scheduling problems are stochastic in nature. Owing to the complexity inherent in these systems, the design of allocation and scheduling policies can be a very difficult task. This study developed a generic optimization framework for stochastic optimization. The new method, the Nested Partitions (NP) method, can be applied to many planning and scheduling problems. Preliminary results show that the method is efficient and robust. This project investigated issues related to the implementation of the NP method to many scheduling and resource allocation problems provided by industrial partners. This study expanded on previous results by developing a comprehensive methodology for planning and scheduling problems and quickly transferring research results to software tools that can be used in industry.

24. Understanding potentials of SAG12 transgenic plants for horticultural use. This study has transgenic plants of *Nicotiana glauca* (ornamental tobacco) that were transformed with the construct P<sub>SAG12</sub>-IPT made of a chimeric gene IPT encoding isopentenyl transferase (the rate-limiting enzyme in cytokinin biosynthesis) and attached to a senescence-specific promoter, which resulted in suppression of senescence by production of cytokinin. It has diverse and far-reaching implications in horticulture such as lengthening the growing season for foliage plants, increasing longevity of cut-flowers, and reducing the heavy use of nitrogen fertilizers. The goal of this study was to pursue characterization of P<sub>SAG12</sub>-IPT and to determine its commercial significance. Experiments were conducted to elucidate mechanisms underlying the delay of senescence in the transgenic plants, stabilize the gene pool in transgenics over generations in order to determine if they can be propagated at a commercial level and characterize the transgenic plants and design the handling protocol for longevity in intact plants/cuttings. An implication of this research was that Wisconsin is able to grow vegetables for a longer duration due to a lengthening of the growing season. Also, the transgenic plants thrive well in areas with poor water supply, which promotes more acreage of land under cultivation. Another implication was that seed quality for propagation purposes were enhanced, which resulted in increased profits for seed banks. Currently, the flower industry uses heavy metals to extend post-harvest longevity of cut flowers; however, the transgenic plants eliminate the use of these metals and thus make post-harvest handling more environmentally conscious.

25. Fully Automated DNA Sequencing Using Primer Walking and Ligation of Hexamers. The objective of this study was to develop an automated sequencing procedure, which is ten or one hundred times more rapid and efficient than the present methods. The method, with acronym SPEL-6 (sequential primer elongation employing ligation of 6-mers), was based on primer walking, with each cycle consisting of primer-initiated sequencing of 300-600 nt followed by synthesis of the next primer, as based on sequence of 3' end of the just determined sequence. The latter primer was then used for the next round of 300-600 nt sequencing. The crucial advantage of such primer walking was that it enabled automation for the rapid sequencing of the 50-100-kp DNA fragments, end-to-end, and avoided the necessity of subcloning into the M13 based vectors. Such subcloning was a laborious step, which was not readily amenable for automation. The subsequent sequencing, using instrumentation developed by the Wisconsin-based Company (GenSys Technologies, Sauk City), produced a totally automated readout of the nucleotide sequence. In collaboration, this study was able to develop a commercial product, much superior to any other existing method, and thus highly relevant to economic development and industrial competitiveness in Wisconsin.

26. Development of Tissue-Mimicking Material for Three-Dimensional Imaging Systems, and Multi-Modality Image Fusion and Radioactive Implant Optimization Algorithms. Currently, there are three rapidly developing aspects in medicine, the explosive expansion of radioactive implants in radiation therapy for cancer, the realization of image-based, three dimensional, computerized treatment planning in radiation therapy and the recent development of materials that simultaneously mimic soft tissues for ultrasound (US) and computer-assisted tomography (CT), that almost certainly can be modified to include magnetic resonance imaging (MRI). The research project had three parts, which included the development of materials that simultaneously mimic human tissue for ultrasound, magnetic resonance imaging, and computer-assisted tomography, and of an anatomic-like phantom made from these materials; the development of automated image registration algorithms for fusing the images from the different imaging modalities and the development of computerized algorithms to optimize treatment plans based on earlier imaging studies; and re-optimize the earlier plans correcting for changes in patient position as seen on images at the time of the implementation procedure. The results were the development of materials that simultaneously mimic soft tissues for the three imaging modalities and of an anatomically relevant phantom containing structures useful for both facilitating and measuring the accuracy of fusion of images from the various modalities. Two marketable commodities resulted from this research, which included the tissue-mimicking materials that could be used in quality assurance test tools that cut across imaging-modality distinctions. The company interested in this material is RMI/Gammex, Inc., of Middleton, Wisconsin. Also, the fusion and optimization programs addressed problems clinicians had executing well-designed implants. The company most interested in this approach was ADAC Corporation, which has its main developmental facility in Madison.

27. Wearable Radio Telemetry Receiver to Display, Record and Analyze Data transmitted from an Implanted Glucose Sensor. The purpose of this study was to develop a radiotelemetry receiver unit to monitor data from an implanted glucose sensor. The readout device was designed and four prototype instruments constructed by the engineering staff of the Updike University of Wisconsin Hospital biomedical engineering laboratory. The instrument included variable high and low alarm and LCD readout of tissue glucose and glucose trend data. This implantable, continuous glucose-monitoring project offers the potential of preventing the complications of diabetes, and a potentially important business opportunity for the state of Wisconsin.

1998-99

1. Assays for Angiogenesis. Angiogenesis, the formation of new blood vessels, is of fundamental importance in both normal and pathological processes. One of the urgent needs in the field is to have more quantitative and reliable in vivo assays for angiogenesis and its inhibition. The purpose of the study is to develop modified and new in vivo assays that will allow more rapid screening of new reagents and will permit ready quantitation, which is essential for dose/response type of screening. Such assays will provide a much-needed tool for pharmaceutical companies, including those in Wisconsin, that are engaged in developing reagents that can be used to augment or inhibit angiogenesis.

2. Man-Machine Interface Through the Tongue. This development is a generic man-machine interface with many potential applications such as in aviation and underwater exploration. The plan is to develop an attractive portable prototype of the tactile vision substitution system using the tongue man-machine interface, for presentation at trade shows and other licensing opportunities. WARF has recently applied for a patent, and encouraged the establishment of a company, Wicab, Inc., to license and develop aspects of this technology.

3. DNA Vaccination Against Bacterial Pneumonia in Cattle. Respiratory disease, pneumonia, is one of the most significant problems for dairy and beef cattle producers in Wisconsin. An exciting new technology for vaccinating against infectious diseases utilizes injection of DNA from an infectious agent to elicit an immune response. In the proposed study, we plan to develop a DNA vaccine to prevent or reduce the severity of pneumonia in cattle. The proposed work will involve a collaboration with a Madison-based company, Powder-Ject, that uses a novel delivery system to administer DNA as a vaccine or therapeutic agent.

4. Stabilization of Biological Materials through the Use of Novel Formulations. The preservation of cells during storage in the frozen or dried states is a complex topic, which affects much of the pharmaceutical, biotechnology, and food industries. The research proposed here is aimed at supporting work to preserve bacterial lines of economic importance to two major suppliers of frozen and dried bacterial cultures here in Wisconsin, Chr. Hansen, Inc. and Rhodia, Inc. This group recently developed an aqueous formulation of trehalose with borate ions which has been shown to dramatically increase the temperature at which the solution becomes a glass. This work will have an immediate impact for the companies that we are currently talking to and if we can increase the shelf stability of their products, this should translate into an immediate boost to their bottom line.
5. Lysine/methionine and Lysine Rich Proteins from Xenorhabdus. A feasibility study of exploiting the bacterial proteins rich in the essential amino-acids methionine, lysine, and cysteine as a direct feed supplement for animals. The study involves using the proteins as a feed supplement to young chickens as a dietary replacement for essential amino acids. If the cjp protein supplement is effective in supplying the required amino acids needed by the birds for normal nutrition, we will determine the cost feasibility of replacing protein supplements now being used as animal nutrition supplements. The study is of potential importance to Wisconsin, and Dow AgroSciences continues to express interest in working out details of an agreement to try to express the cloned genes for the protein directly into plants.
6. A Proposal to Liaison the CAD-IT Consortium with Wisconsin-based Industries Complex Artifactual Design through Integration of Information Technologies. The current proposal presents a plan for developing industrial liaison, collaboration and membership between Wisconsin-based product design and manufacturing companies and the newly established CAD-IT (Complex Artifactual Design through Integration of Information Technology) Consortium. The Consortium will provide an opportunity for Wisconsin-based industrial partners to collaborate with the University of Wisconsin's research and educational programs in information technology. The consortium works on the development of advanced algorithms, software architectures and software tools that allow virtual designing and prototyping of complex artifacts/products to be performed within an organization's integrated product information infrastructure framework. Typical applications include automotive design, aircraft/aerospace system design, electro-mechanical appliance design and engine design.
7. Development of an In-vitro RNA Capping System Utilizing the 40K Region of the Mammalian Reovirus Lambda 2 Protein. To efficiently generate capped mRNA using an in vitro transcriptional kit the addition of chemically synthesized cap analog is required. The goal of the proposed research is to utilize the 40K amino portion of the reovirus lambda 2 protein to generate cap analog within a transcription reaction. The cap generation system will be the foundation for a system to synthesize methylated cap structures in vitro utilizing the G7 and 2OH methyltransferase activities of a proposed multimerized central 56K region of the lambda 2 protein. The transcription reaction will be commercially viable due to its low cost relative to a transcription reaction with added synthetic cap analog.



8. Development of a Chromium Recovery Technology for Leather Industries. A commercial alkaline hydrolysis facility treats chromium-containing leather waste to extract proteins and generates approximately 2000 pounds of sludge cake per ton of shavings, which must be landfilled as a final disposal. Also, approximately 24% of the leather processed in the United States are tanned in Wisconsin. An economical and practical method will be developed through a series of laboratory-scale experiments to recover chromium from the hydrolysis sludge and to reuse chromium during leather tanning. In addition, the quality criteria for chromium reuse will be developed and other possible beneficial uses of chromium-free hydrolysis sludge will be identified. Based on this study, a full-scale process will be built which results in the elimination of waste products from being disposed to landfills.

9. Highly Filled Formaldehyde-free Renewable Fiber Thermoplastic Composites. Considerable interest has been generated in the use of lignocellulosic fibers and wastes as fillers and reinforcements in thermoplastics. A new technique has been developed that allows very high fiber loading. We have processed composites up to about 90% to 95% by weight of fiber in polypropylene. The primary objective of this research is to characterize the mechanical and physical behavior of the additives on the properties of the composites. Industry in Wisconsin could utilize these new composite materials where solid wood and formaldehyde-based wood composites are presently used in some applications, for example the furniture industry. In the long range, we will have the advantage of efficient industrial methods coupled with the large-scale use of a renewable and sustainable agricultural material.

10. Soil Moisture and Strength Sensing System for Precision Agriculture. As tillage and planting equipment operate in a farm field that has variability, their performance changes. To insure maximum productivity, the operator must change the operating depth with changes in the soil conditions. A traveling sensing system, which provides information about the soil moisture and strength conditions, will be developed. This information will be used by the operator to adjust the equipment or by a control system to automatically adjust the machine for changing conditions while operating in a field. The proposed sensing system would be useful on equipment produced by three tillage manufacturers and one planting machinery manufacturer in Wisconsin.

11. Flexible Resource Scheduling in Production Systems. This study aims at expanding the production scheduling function to reflect workforce changes that have occurred in many manufacturing firms, namely the increased importance of workforce flexibility and cross-training of workers. This study will investigate issues related to the formulation of the flexible-resource for various production environments, to quantify the value of resource flexibility and to develop optimization methodologies and algorithms for obtaining optimal production schedules. In particular, the research will apply a novel optimization framework developed by the PI to the scheduling problem and will test the proposed algorithm to real scheduling problems provided by industrial partners.

12. Development of an Adiabatic Vaporization System to Re-Hydrate Dry Hay in Arid Climates. Commercial hay production is growing in the arid climates of the western United States. For instance, hay production in this region is expected to exceed 46 million tons by 2004, an increase of over 15% from today. Although forage production is steady in the Midwest, dairy farms in states like Wisconsin are purchasing an increasing amount of dry hay from these arid western regions. A cost-effective system, which allows farmers to control the hay re-hydration process, would allow commercial hay producers in arid climates to have greater control of the haying system. Such a system would allow for baling during daytime hours, improve labor scheduling and efficiency, greatly increase the daily harvesting window, improve productivity and possibly improve hay quality. Researchers at the University of Wisconsin, in cooperation with John Deere, will be evaluating one such system this summer in Utah. Harvest Tec, a manufacturer of hay harvesting systems located in Hudson, Wisconsin, has proposed an alternative system which both the UW and John Deere would like to evaluate in parallel. This study deals with that issue and outlines a research plan to evaluate the technology.

13. Development of a System for Fractionated Stereotactic Radiotherapy/Tomotherapy that Allows Online Patient Repositioning. This study intends to develop an automated patient repositioning system that has application in both Fractionated Stereotactic Radiotherapy and Tomotherapy. The proposed system will be minimally invasive and will use a custom made bite plate that attaches to the maxillary dentition. The bite plate will be linked to an array of noncolinear passive markers for patient localization. An optical camera tracking system will be used to identify the position of each of the passive markers in space. The positions of the noncolinear passive markers will be processed using a computer algorithm so that differences between the actual and desired position of the bite plate passive marker can be resolved within 0.2mm of translation and 0.2 degrees of rotation. In treatment mode these differences will be fed back to a couch mounted multi-axis-positioning system, which will reposition the patient automatically once he/she has moved out of a predetermined tolerance band. The new concept to be developed in this study will likely lead to at least one invention disclosure to UIR.

14. Coupling Photocatalysis with Electromagnetic Energy for the Enhanced Degradation of Organic Contaminants. The removal of an organic contaminant from a process feed stream is being significantly improved in our laboratory during in situ experiments in which a feed stream containing a gas-phase contaminant within air is passed through a photocatalytic oxidation (PCO) reactor that is positioned within an electromagnetic radiation field (EMRF). The primary goal of the study is to demonstrate enhanced degradation kinetics of a select organic contaminant by a reactor system that couples PCO and EMRF. A second goal is to compare the anti-microbial effectiveness of a PCO-EMRF-coupled reactor with that of a reactor operated either the PCO-only or EMRF-only mode. The novel technology employed in the PCO-EMRF-coupled reactor would improve the national and international competitiveness of Wisconsin businesses that manufacture and market those reactors. Some markets that would benefit from PCO-EMRF-coupled clean air systems include the HVAC systems of housing and health-care facilities, commercial, institutional, and educational buildings, and transportation vehicles.

15. E-Commerce Consortium. The recent, wide variety and rapidly changing nature of E-Commerce technologies are presenting companies with technical and organizational challenges in strategy development, impact assessment, economic justification, implementation, and change management. This has created a need for an unbiased information exchange and collaborative learning forum that brings together these companies and experts from academia and industry known for excellence and innovation in the development and deployment of E-Commerce technologies. This E-Commerce Consortium is a university-industry collaborative initiative for education, research, and transfer of emerging E-Commerce technologies, business processes and corporate strategies to enhance the competitiveness of manufacturing and architectural, engineering, and construction industries.

16. Area-Wide Management of Vegetable Production Crops Using GPS and GIS Technology. The Wisconsin potato and vegetable industry is nationally competitive because it has proactively developed and adopted new technologies to improve crop production and pest management. In order to remain economically viable, however, the industry must continue to attract and retain a strong food-processing component based on Wisconsin's ability to produce high quality raw product at economically competitive prices. This study proposes a pilot project, which will form a cooperative of vegetable producers and processors, to demonstrate the potential application of GPS and GIS technology to improve crop production and pest management using area-wide approaches. The study anticipates short-term and long-term benefits through implementation of management decisions based on spatial analysis of whole farm and area-wide data on production practices and pest populations.

### C. Applied Research Program

Applied Research Program projects are funded through a competitive process administered by the UW System Office of Academic Affairs. All proposals were first evaluated by an institutional review panel before being submitted to UW System Administration.

In 1997-98, a total of 32 proposals requesting \$1,209,829 were submitted for review to the UW System. For 1998-99, a total of 43 proposals requesting \$1,724,931 were submitted. Each proposal was then reviewed and rated by a UW System review panel comprised of five representatives of UW System institutions, a representative from the Wisconsin Department of Development, and a staff member from the UW System Office of Academic Affairs.

In addition to the quality of the research design and likelihood of successful completion, a major criterion for selection was the potential impact of the project on Wisconsin's economy.

#### 1997-98

1. Improvement of Manufactured Stain-Resistant Glass in Wisconsin. The objective of this project was to measure optical absorbance of treated samples from the manufacturing line and relate these measurements to the stain resistance of glass. Research indicated that there is a high correlation between humidity at the time of manufacture and the percentage of stained samples. Researchers were able to propose methods for reducing the incidence of staining.
2. Cloning Novel Insecticidal Toxins for Crop Protection. The aim of this project was to clone genes encoding insecticidal proteins that could then be engineered into transgenic plants to protect them from insects. The research done under this grant showed that the encoded genes were toxic to caterpillar pests. In collaboration with Dow AgroSciences of Indianapolis, WARF filed a joint patent on the use of these genes and on the toxins themselves. Dow now reports they have produced transgenic plants containing one of these genes that can kill insects.
3. Preventative Strategies to Reduce the Risk of Fungicide Resistance in the Cranberry Cottonball Pathogen. Cottonball, caused by the fungus *Monilinia oxycocci*, is the most important disease of cranberries occurring during the growing season in Wisconsin. The objective of this research was to determine how sensitive this fungus is to certain fungicides and to find ways to extend that sensitivity. Research indicated that changes in spraying practices can reduce the incidence of cottonball. The new information is being delivered to growers through newsletters, extension bulletins, one-on-one contacts and the Wisconsin Cranberry School.

4. Use of Near Infrared Reflectance Spectroscopy (NIRS) and Polymerase Chain Reaction (PCR) for Screening Alfalfa Germplasm for Resistance to Bacterial and Fungal Pathogens. The objectives of this research were to compare the efficiency of various techniques for the detection of specific vascular pathogens in alfalfa and to determine the impact of symptomless infection on plant health. Research found that PCR is an effective way to determine the presence of the targeted pathogens in alfalfa, even when there were no visible symptoms. Current breeding practices result in selection of plants that may harbor populations of vascular pathogens with no visible symptoms. The presence of these pathogens may have long-term negative effects.

5. Improving the Competitiveness of Superconducting Magnetic Energy Storage in the Power Quality Market. This project proposed research into development of a cryogenically improved version of available superconducting magnetic energy storage products. In collaboration with American Superconductor Corporation in Madison, researchers were able to recommend improvements, which were incorporated into assembly procedures. As a result of these improvements, production costs have been significantly reduced.

6. HLA Typing for Unrelated Bone Marrow Transplantation. The purpose of this project was to develop and adapt technologies to provide in-house high resolution HLA typing services for the Bone Marrow Transplant Program of the University of Wisconsin Hospital and Clinics. As a result of this research, the precision and turn-around time of the typing process were significantly improved. These improvements result in better service to critically ill patients and optimization in the time and cost of donor searching.

7. Direct Transfer of Cryopreserved IVM/IVF Produced Bovine Embryos. This project conducted research into the *in vitro* maturation and fertilization of dairy cattle ova. The objectives were to increase the implantation success rate and the pregnancy rate. The results for implantation success were good, and the results on pregnancy were encouraging, but still incomplete. These results provide preliminary evidence that *in vitro* maturation and fertilization have an economically attractive place in the reproductive repertoire for today's livestock producers.

8. Utilization of Synthetic Lubricant Technology to Enhance the Performance of Wisconsin Air Compressors. The goal of this project was to determine the energy conservation that can be obtained through the use of advanced synthetic lubricants. Research indicates that the synthetic lubricant, Royal Purple, provides net energy savings when compared to other lubricants commonly used in air compressors. Research also indicates that environmental parameters, such as exit air pressure and air humidity, are important factors in lubricant efficiency.

9. Advanced Design for High-Capacity Thermal Fluid Balance System. The research objective was to apply the result of the fundamental research to develop a computer-aided-design code for the advanced design of a high-capacity thermal fluid control system. The results from this project include findings that can improve the production of flow-control devices manufactured in Wisconsin.

10. Improved Method for Fabricating Microwave Susceptors. Microwave susceptors are devices that absorb the energy of a microwave oven and convert it into heat to "brown" or "crisp" the surface of foods. The objective of this research was to reduce the production costs of microwave susceptors currently used in food packaging. Materials developed in the course of this research represent improvements in both performance and production costs when compared to materials currently in use.

11. Dynamic Mechanical Analysis of Polymers: Developing a Polymer Physics Testing Laboratory for Western Wisconsin. This project successfully met its goals of installing an operational dynamic mechanical analyzer for material testing, describing the role of molecular structure and morphology on the mechanical properties of polymers and involving industry. The research project established polymer research protocols and also established on-going collaboration with local manufacturers.

12. Application of Process Technology to Advance the Development of Commercial Deer Farming in Wisconsin. The research project was based on the premise that deer hides double split (suede on two sides) would produce a leather that was as washable and dryable as other textile garments. The results of the study indicate that launderability does not vary for different species of deer and that marketing can effectively increase the utilization of deer hides in clothing.

#### 1998-99

1. Thermal Management in High Speed Aluminum Machining. The objective of the research was to develop enabling technology for a new paradigm in the machining of aluminum components in a high speed environment using an ultra-high pressure cooling system. This research resulted directly in the advancement of high speed machining technology. The benefit of this research was to move this new technology one step closer to use in production.

2. Development of a New Fiber Resource by Identification of Disease-Resistant Poplars. The overall goal of this project was to enable development of a new and much-needed fiber resource for the paper industry in Wisconsin by identifying disease resistance in clonally propagated hybrid poplars. The screening techniques developed as part of this research have significant commercial implications and are in the process of being implemented by the paper industry.

3. Reducing Risk of Fungicide Resistance in the Cranberry Cottonball Pathogen. The objectives of this research were to establish optimal measures and procedures for the application of fungicides to control the cottonball pathogen in cranberries. The knowledge gained from this research is now being used by cranberry growers in Wisconsin to control cottonball and greatly reduces the expense to growers of fungicide application.

4. Improved Genetic Diagnosis through a Novel Nucleic Acid. The objective of this project was to evaluate a technology developed by Third Wave Technologies, Inc., for the detection of mutations in genes associated with inherited disorders leading to thrombosis and hereditary hemochromatosis. Work on this project led to reductions in time and cost compared to the current process. In addition, findings from this research provided the validation necessary to begin commercialization of this new technology.
5. PC-Based X-Ray Imaging System. The purpose of this research was to design a high-quality PC-based medical imaging system, which would encompass several advanced image processing and conditioning algorithms. The research produced several improvements in both real-time and stored imaging for medical use and successfully demonstrated potential commercial value. This research will continue with funding from Camtronics Medical Imaging Systems.
6. Evaluation of Insect Resistance in Fast Growing Trees. This project was funded to identify sources and mechanisms of resistance to insect pests among hybrid poplar clones, fast growing trees with high potential for fiber and biomass production. The vulnerability of poplars to pest problems reduces their commercial value. Research findings indicate that a combination of genotypic selection and timing of treatment can reduce insect pests and enhance the commercial value of the tree crop.
7. Multi-Level Converters in Power Converter Systems. The purpose of this project was to study novel multi-level converter topologies. The improvement of power conversion systems' efficiency can reduce energy costs in many applications. For this reason, manufacturers of power converter systems are making increasing use of multi-level converters. The primary contribution of this work was the experimental validation of a power converter system being considered by MagneTek for use in a high-power motor drive application.
8. Evaluation of a Dedicated Coil for Clinical Applications of Functional MRI. The purpose of this study was to evaluate the performance of a head coil designed for clinical as well as research application in mapping brain function. This research demonstrated that the new head coil design has a much-improved signal-to-noise ratio over the currently used GE coil. The information provided by the University of Wisconsin at Madison was invaluable to the IGC-Medical Advances marketing effort to generate interest in the potential product as well as to accelerate the product development process.
9. Develop Production Processes and Equipment for a New Welding Platen. The objectives of this project were to determine the optimal materials for reducing distortion, to conduct trial runs in five Wisconsin companies, and to research black oxide as a possible coating. The results of the research included several improvements in the design and construction of welding platens. Wisconsin companies have incorporated these improvements into their marketed products.

10. Improvement of Manufacturing Extrusion Dies in Wisconsin. The purpose of this research was to evaluate different numerical methods used to design prototypes for extrusion molds. In addition to the advances in research in the area of mold design, this project produced tangible benefits for extrusion producers in the Eau Claire area.
11. Potential of Cranberry Juice to Improve Cardiovascular Health. This project sought to determine whether the consumption of cranberry juice might promote a reduction in cardiovascular disease risk factors in human smokers and rats. The research determined that long-term consumption of cranberry juice by spontaneously hypertensive rats may promote improved vascular dilation and plasma antioxidant capacity. The study of smokers showed that cranberry juice was unable to promote measurable improvements in antioxidant capacity.
12. An Innovative Invertebrate Screen for Endocrine Disrupting Chemicals in Water. The objective of this research was to demonstrate the use of bioassay as an effective way of testing for the presence of herbicides in drinking water. The research process allowed for significant reduction in the time needed to conduct the bioassay and increase test reliability. Given the current concern about possible consequences of herbicides in the environment, this research has continuing implications for the development of the biological testing industry in Wisconsin.



Appendix A

New Industrial and Economic Development Research Awards (UIR)  
1997-98

<u>Principal Investigator Title</u>	<u>Department</u>	<u>Period (years)</u>	<u>1997-98 Budget</u>	<u>Total Budget</u>
Richard Amasino <i>Identification of Genes of Economic Utility in Agriculture</i>	Biochemistry	2	\$36,600	\$73,200
Hussain Bahia <i>Utilization of Foundry Sand in Asphalt Concrete Mixtures</i>	Civil & Environmental Engineering	1	\$36,245	\$36,245
William Beckman <i>Contract Thermal Resistance of Plastic Films on High-Speed Electrically Heated Rollers</i>	Solar Energy Lab	2	\$29,185	\$37,110
Stanley Dodson <i>A Novel Bioassay to Screen for Endocrine Disruption</i>	Zoology	1	\$21,870	\$21,870
Nicola Ferrier <i>Sensor Fusion Techniques for Coin Discrimination</i>	Mechanical Engineering	1	\$2,000	\$23,891
Randall Fortenbery <i>Use of Dairy Based Futures Markets to Improve the Competitive Position of the Wisconsin Dairy Industry</i>	Agriculture & Applied Economics	1	\$35,861	\$35,861
Yogesh Gianchandani <i>Micro-Mechanical Strain Sensors for In-Situ Characterization of Thin Films in High Volume Manufacturing Environments</i>	Electrical & Computer Engineering	1	\$2,500	\$33,447

<u>Principal Investigator Title</u>	<u>Department</u>	<u>Period (years)</u>	<u>1997-98 Budget</u>	<u>Total Budget</u>
<b>Robert Goodman</b> <i>Development of a Novel Insect Viral Vector System for Systemic Infection and Expression of Foreign Proteins in Plants</i>	Plant Pathology	1	\$4,000	\$36,407
<b>Walter Goodman</b> <i>Control of Insect Pests Using Satiety Inducing Peptides</i>	Entomology	1	\$9,000	\$27,000
<b>Jo Handelsman</b> <i>A General Approach for Discovery of Antibiotics</i>	Plant Pathology	1	\$21,500	\$21,500
<b>Patrick Hoffman</b> <i>Introduction of a Commercially Viable System to Estimate Crude Protein Degradation in Forages to the Wisconsin and United States Dairy Industry</i>	Dairy Science	1	\$13,380	\$24,510
<b>Brian Holmes</b> <i>Development of a Marine Application System Using Variable Rate Technology to Protect Water Quality and Improve Farm Profitability</i>	Agricultural Research Stations	2	\$18,348	\$33,573
<b>Eric Johnson</b> <i>Determination of Neuron Targeting Sequences of Botulin Neurotoxin Using Synthetic Mimetic Compounds</i>	Food Microbiology & Toxicology	1	\$2,200	\$32,345
<b>Shawn Kaepler</b> <i>Enhancing Mineral Nutrient Availability in Maize Through Microbial Associations and Genetic Optimization of Uptake</i>	Agronomy	1	\$5,000	\$36,126

<u>Principal Investigator Title</u>	<u>Department</u>	<u>Period (years)</u>	<u>1997-98 Budget</u>	<u>Total Budget</u>
Sanford Klein <i>Design Alternatives to Improve the Energy Efficiency of Residential Refrigerators</i>	Solar Energy Lab	2	\$12,569	\$25,809
Max Lagally <i>Active Damping of Piezoelectric Actuator by Current Feedback Control</i>	Materials Science & Engineering	1	\$3,000	\$34,000
Allen Laughon <i>Development of SMAD-DNA Binding Assays for Small Molecule Drug Screening</i>	Medical Genetics	1	\$5,000	\$21,230
Brent McCown <i>Rapid and Economically-Feasible Propagation of Goldenseal, a Valuable New Crop for Wisconsin</i>	Horticulture	2	\$24,534	\$57,166
James Nienhuis <i>Nuna Beans: A New Specialty Crop for Wisconsin</i>	Horticulture	2	\$8,000	\$15,000
Thomas Osborn <i>Hybrid Canola for Wisconsin</i>	Agronomy	1	\$8,000	\$8,000
Timothy Osswald <i>Controlling Dimensional Stability in Printed Circuit Boards through Process Simulation and Optimization</i>	Mechanical Engineering	2	\$30,561	\$59,213

<u>Principal Investigator Title</u>	<u>Department</u>	<u>Period (years)</u>	<u>1997-98 Budget</u>	<u>Total Budget</u>
Douglas Reindl <i>Electrical Demand Reduction in Refrigerated Warehouses</i>	Engineering Professional Development	2	\$13,880	\$32,529
Leyuan Shi <i>Production: Planning and Scheduling</i>	Industrial Engineering	1	\$2,000	\$26,393
Dennis Stimart <i>Understanding Potentials of SAG 12 Transgenic Plants for Horticultural Use</i>	Horticulture	1	\$12,224	\$23,199
Waclaw Szybalski <i>Fully Automated DNA Sequencing Using Primer Walking and Ligation of Hexamers</i>	Oncology	1	\$3,450	\$30,950
Bruce Thomadsen <i>Development of Tissue-Mimicking Material for Three-Dimensional Imaging Systems, Multi- Modality Image Fusion and Radioactive Implant Optimization Algorithms</i>	Medical Physics	2	\$1,000	\$38,704
Stuart Updike <i>Wearable Radio Telemetry Receiver to Display, Record and Analyze Data Transmitted from an Implanted Glucose Sensor</i>	Medicine	1	\$35,140	\$35,140

The balance of the 1997-98 UW-Madison Industrial & Economic Development Research funds (118) were committed during the previous 1995-96 and 1996-97 funding competitions.

Appendix B

New Industrial and Economic Development Research Awards (UIR)  
1998-99\*

<u>Principal Investigator Title</u>	<u>Department</u>	<u>Period (years)</u>	<u>1998-99 Budget</u>	<u>Total Budget</u>
Robert Auerbach <i>Assays for Angiogenesis</i>	Zoology	1	\$5,000	\$23,869
Paul Bach-y-Rita <i>Man-Machine Interface through the Tongue</i>	Rehabilitation Medicine	1	\$24,783	\$24,783
Charles Czuprynski <i>DNA Vaccination Against Bacterial Pneumonia in Cattle</i>	Pathobiologic Sciences	1	\$2,500	\$26,388
Juan de Pablo <i>Stabilization of Biological Materials through the use of Novel Formulations</i>	Chemical Engineering	1	\$30,000	\$30,000
Jerald Ensign <i>Lysine/Methionine and Lysine Rich Proteins from Xenorhabdus</i>	Bacteriology	1	\$16,194	\$16,194
Rajit Gadh <i>A Proposal to Liaison the CAD-IT Consortium with Wisconsin Based Industries Complex Artifactual Design through Integration of Information Technologies</i>	Mechanical Engineering	1	\$10,000	\$10,000
Max Nibert <i>Development of an In Vitro RNA Capping System Utilizing the 40K Region of the Mammalian Reovirus Lambda 2 Protein</i>	Biochemistry	1	\$6,615	\$6,615
Jae Park <i>Development of Chromium Recovery Technology for Leather Industries</i>	Civil & Environmental Engineering	1	\$2,000	\$30,942

<u>Principal Investigator Title</u>	<u>Department</u>	<u>Period (years)</u>	<u>1998-99 Budget</u>	<u>Total Budget</u>
Anand Sanadi <i>Highly Filled Formaldehyde-Free Renewable Fiber Thermoplastic Composites</i>	Biological Systems Engineering	1	\$2,500	\$28,200
Ronald Schuler <i>Soil Moisture and Strength Sensing System for Precision Agriculture</i>	Biological Systems Engineering	1	\$4,800	\$30,812
Leyuan Shi <i>Flexible Resource Scheduling in Production Systems</i>	Industrial Engineering	1	\$3,000	\$23,242
Kevin Shinnars <i>Development of an Adiabatic Vaporization System to Re-Hydrate Dry Hay in Arid Climates</i>	Biological Systems Engineering	1	\$9,000	\$9,000
Wolfgang Tome <i>Development of a System for Fractionated Stereotactic Radiotherapy/Tomotherapy that Allows Online Patient Repositioning</i>	Human Oncology	1	\$29,902	\$29,902
Dean Tompkins <i>Coupling Photocatalysis with Electromagnetic Energy for the Enhanced Degradation of Organic Contaminants</i>	Civil & Environmental Engineering	1	\$3,464	\$26,000
Raj Veeramani <i>E-Commerce Consortium</i>	Industrial Engineering	1	\$2,000	\$2,000
Jeffrey Wyman <i>Area-Wide Management of Vegetable Production Crops Using GPS and GIS Technology</i>	Entomology	1	\$10,000	\$15,000

The balance of the 1998-99 UW-Madison Industrial & Economic Development Research funds (118) were committed during the previous 1996-97 and 1997-98 funding competitions.

\*All awards are for one year. Discrepancies between 1998-99 and Total Budget figures indicates start up funding that is still part of the 12 month budget.

## Appendix C

### Applied Research Program Awards 1997-98

<u>Principal Investigator</u>	<u>Campus</u>	<u>Award</u>	<u>Title</u>
Donald Ballegeer	UW-Eau Claire	\$33,598	<i>Improvement of Manufactured Stain-Resistant Glass in Wisconsin</i>
R. French-Constant	UW-Madison	\$34,499	<i>Cloning Novel Insecticidal Toxins for Crop Protection</i>
Patricia McManus	UW-Madison	\$24,960	<i>Preventative Strategies to Reduce the Risk of Fungicide Resistance in the Cranberry Cottonball Pathogen</i>
C. R. Grau	UW-Madison	\$24,166	<i>Use of Near Infrared Reflectance Spectroscopy (NIRS) and Polymerase Chain Reaction (PCR) for Screening Alfalfa Germplasm for Resistance to Bacterial and Fungal Pathogens</i>
John M. Pfothner	UW-Madison	\$37,273	<i>Improving the Competitiveness of Superconducting Magnetic Energy Storage in the Power Quality Market</i>
David I. Watkins	UW-Madison	\$34,649	<i>HLA Typing for Unrelated Bone Marrow Transplantation</i>
Jack J. Rutledge	UW-Madison	\$34,126	<i>Direct Transfer of Cryopreserved IVM/IVF Produced Bovine Embryos</i>
John R. Reisel	UW-Milwaukee	\$42,718	<i>Utilization of Synthetic Lubricant Technology to Enhance the Performance of Wisconsin Air Compressors</i>
Shih-Hung Chan	UW-Milwaukee	\$43,423	<i>Advanced Design for High-Capacity Thermal Fluid Balance System</i>
Charles P. Gibson	UW-Oshkosh	\$18,606	<i>Improved Method for Fabricating Microwave Susceptors</i>
James Madsen	UW-River Falls	\$46,283	<i>Dynamic Mechanical Analysis of Polymers: Developing a Polymer Physics Testing Laboratory for Western Wisconsin</i>
Betsy Henderson	UW-Stout	\$36,689	<i>Application of Process Technology to Advance the Development of Commercial Deer Farming in Wisconsin</i>

## Appendix D

### Applied Research Program Research Awards 1998-99

<u>Principal Investigator</u>	<u>Campus</u>	<u>Award</u>	<u>Title</u>
Tien-Chien Jen	UW-Milwaukee	\$40,349	<i>Thermal Management in High Speed Aluminum Machining</i>
Glen Stanosz	UW-Madison	\$25,000	<i>Development of a New Fiber Resource by Identification of Disease Resistant Poplars</i>
Patricia McManus	UW-Madison	\$35,513	<i>Reducing the Risk of Fungicide Resistance in the Cranberry Cottonball Pathogen</i>
Karl Voelkerding	UW-Madison	\$43,232	<i>Improved Genetic Diagnosis through a Novel Nucleic Acid</i>
Ali Reza	UW-Milwaukee	\$31,006	<i>PC-Based X-Ray Imaging System</i>
Kenneth Raffa	UW-Madison	\$2,679	<i>Evaluation of Insect Resistance in Fast Growing Trees</i>
Keith Corzine	UW-Milwaukee	\$47,533	<i>Multilevel Converters in Power Converter Systems</i>
James Sorenson	UW-Madison	\$46,625	<i>Evaluation of a Dedicated Coil for Clinical Applications of Functional MRI</i>
David Fly	UW-Stout	\$43,392	<i>Develop Production Processes and Equipment for a New Welding Platen</i>
Mohamed Elgindi	UW-Eau Claire	\$31,956	<i>Improvement of Manufacturing Extrusion Dies in Wisconsin</i>
Ted Wilson	UW-La Crosse	\$12,703	<i>Potential of Cranberry Juice to Improve Cardiovascular Health</i>
Stanley Dodson	UW-Madison	\$2,250	<i>An Innovative Invertebrate Screen for Endocrine Disrupting Chemicals in Water</i>





## Legislative Fiscal Bureau

One East Main, Suite 301 • Madison, WI 53703 • (608) 266-3847 • Fax: (608) 267-6873

November 29, 1999

TO: Senator Brian Burke, Senate Chair  
Representative John Gard, Assembly Chair  
Joint Committee on Finance

FROM: Bob Lang, Director

SUBJECT: University of Wisconsin-Madison Intercollegiate Athletics

This memorandum is to inform you of the status of the UW-Madison Division of Intercollegiate Athletics' (Division's) 1999-01 budget request and other financial materials required to be submitted by the Division to the Committee and the Department of Administration (DOA) on or before October 31, 1999.

At the Committee's April, 1999 s. 13.10 meeting, the Committee, by a vote of 12-4, required the Division to report to DOA and the Committee by October 31, 1999, the following: (a) the five-year financial forecast for the Division; (b) the results of a detailed review of all athletic budgets, including a list of expenditures that could be reduced, and an overall profile of all the sports teams including a summary of eligible services and/or expenses that would be associated with each sport; (c) any other long-term budget actions reviewed, developed or implemented by the Athletics Board that could affect future budgets for the Division; and (d) its 1999-01 budget request. DOA was directed by the Committee to submit its recommendations on the Division's 1999-01 budget request to the Committee by November 30, 1999. The Committee would then review the request and DOA's recommendations under the 14-day passive review process and take action on the request as part of its December, 1999 s. 13.10 meeting, if needed.

On November 11, 1999, the Vice Chancellor for Administration of UW-Madison submitted a copy of the Division's five-year financial plan and indicated that the plan includes the initial review of individual athletics' budgets and incorporates long-term budget actions reviewed and developed by the Division. No information was provided regarding the Division's 1999-01 budget. The reasons cited for not providing the required budget information included: (a) pay plans for employees had not been submitted to or approved by the Joint Committee on Employment Relations (JCOER); and (b) neither the Athletics Board nor Board of Regents have approved system unit

budgets for 2000-01, which would include nonresident tuition rates that affect athletic scholarships. The Vice Chancellor did indicate that a projected 1999-00 budget would be provided to the Committee and DOA the following week in order to meet the schedules and times adopted by the Committee at its April meeting.

On November 19, 1999, additional material, which is attached to this memorandum, was submitted to this office and DOA relating to the Division's 1999-00 budget. However, as indicated in the UW's cover letter, the budget material provided was not formally submitted for Committee approval because JCOER has not approved the pay plan and the Board of Regents has not approved the budget amounts.

Because the UW has not submitted the information required by the Committee and the data provided on November 19, 1999, is not a formal request suitable for analysis by this office or DOA, it appears reasonable at this time not to expect DOA to make recommendations related to this information by November 30, 1999. The Vice Chancellor indicates that the Board of Regents will review the 1999-00 athletics' budget at its December meeting. Presumably the Division will submit its final budget request to DOA and this Committee soon after the Board of Regents' decision. Under the time line approved by the Committee in April, DOA would then have 30 days to forward its recommendations to the Committee, which will then review the recommendations under the 14-day passive review process.

It should be noted that, according to s. 20.001(3)(a) of the statutes, until the Legislature through separate legislation or the Committee acting under s. 13.10 or s. 16.515 modify the Division's budget, the Division may not expend more than the amounts appropriated under Chapter 20 of the statutes from its sum certain appropriations. If the Division does not submit a 2000-01 budget, the amounts under Chapter 20 will also govern spending in that year. Under the 1999-01 budget bill, the Division was provided with an additional \$794,000 in 1999-00 and \$1,616,500 in 2000-01 for 3.0% salary increases and a 2.5% increase for supplies and services. In any event, the Division can always return to the Committee and request additional expenditure authority under the s.13.10 or 16.515 process, if needed.

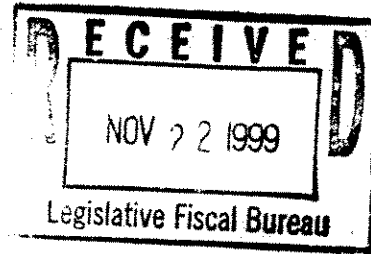
If you have any questions regarding this matter, please contact this office.

TC/BL/lah  
Attachments

cc: Members, Joint Committee on Finance  
President Katharine Lyall  
Chancellor David Ward  
John Torphy, Vice Chancellor of Administration  
Richard Chandler, Department of Administration

UNIVERSITY OF  
**WISCONSIN**  
M A D I S O N

November 19, 1999



**MEMORANDUM**

To: Richard Chandler  
Robert Lang

From: John Torphy

Subject: Division of Intercollegiate Athletics - 1999-2000 Budget

Pursuant to my letters to the DOA Secretary and the co-chairs of the Joint Finance Committee, I am forwarding to you our current estimate of the 1999-2000 budget for the Division of Intercollegiate Athletics. As my letter noted, without JCOER-approved pay plans, this budget is subject to future revisions. Consequently, it is not formally submitted for your approval.

Therefore, I have not included a summary of the expenditure authority increases needed in Fund 528 - s.20.285(5)(h) - based on the adopted 1999-2000 budget plus previously approved increases by the Joint Committee on Finance which were not included in Chapter 20. We can do so if the DOA and the Committee wish to take action prior to JCOER approval of compensation plans. (That might require our return to the Committee after pay plans are finally approved.)

The attached budget does assume a 5.2% unclassified pay plan and 2% classified pay plan. It also reflects the tuition increases adopted by the Regents in August 1999.

In the event that you wish to take action on this budget, it will require Regent approval since the budget exceeds that which the Regents approved last spring, due to the fact that tuition increases was not yet set and pay plan estimates were not resolved. Therefore, in case you do wish to take action, this budget will be submitted to the Regents for their approval at the Board's December meeting. I will seek their approval to make any other changes resulting from the final pay plan approved by JCOER.

Finally, let me note that I have attached a copy of a financial statement presented to the Athletic Board's Finance Committee for the first four months of the fiscal year. It shows that the projected \$600,000 deficit has been eliminated and that our current best estimate is a \$45,000 surplus.

JT:ns

**Attachments**

cc: Erin Kalinosky  
Tricia Collins  
Robert Hanle  
David Lappnow

Vice Chancellor for Administration

**Intercollegiate Athletics**  
**1999-00 Proposed Spending Authority**

	<u>123</u>	<u>501</u>	<u>528</u>	<u>530</u>	<u>533</u>	<u>Total</u>
Athletics*	\$3,102,851	\$498,442	\$33,513,960	\$300,000	\$3,837,817	\$41,253,070
Golf Course			\$4,275,000		\$85,000	\$4,360,000
Camps & Clinics			\$1,500,000			\$1,500,000
<b>Total</b>	<b><u>\$3,102,851</u></b>	<b><u>\$498,442</u></b>	<b><u>\$39,288,960</u></b>	<b><u>\$300,000</u></b>	<b><u>\$3,922,817</u></b>	<b><u>\$47,113,070</u></b>

\*These amounts represent projections as of 10/31/99; they are not equal to the budget approved by the Athletic Board in February, 1999.

	<u>123</u>	<u>501</u>	<u>528</u>	<u>530</u>	<u>533</u>	<u>Total</u>
Salaries		\$496,642	\$11,047,595		\$838,813	\$12,383,050
Fringe Benefits			\$3,184,072		\$264,435	\$3,448,507
Supplies & Expense		\$1,800	\$24,218,879		\$616,391	\$24,837,070
Capital			\$777,814		\$400,778	\$1,178,592
Aid to Individuals			\$25,000	\$300,000	\$1,802,400	\$2,127,400
Special Purpose	\$3,102,851		\$35,600			\$3,138,451
<b>Total</b>	<b><u>\$3,102,851</u></b>	<b><u>\$498,442</u></b>	<b><u>\$39,288,960</u></b>	<b><u>\$300,000</u></b>	<b><u>\$3,922,817</u></b>	<b><u>\$47,113,070</u></b>

**UNIVERSITY OF WISCONSIN**  
**Division of Intercollegiate Athletics**  
**FINANCIAL STATEMENTS**

	1998-99	1999-00			Variance
	Actual	Budget	as of 10/31/99	Projection	
<b>OPERATING REVENUE</b>	\$38,451,848	\$39,009,788	\$20,685,007	\$40,743,821	\$1,734,033
<b>OPERATING EXPENDITURES</b>					
Sports	\$13,735,944	\$15,210,856	\$3,486,450	\$15,127,947	\$82,909
Net Athletic Scholarships	\$2,012,628	\$1,929,902	\$709,466	\$2,127,400	(\$197,498)
Administration	\$6,611,383	\$6,369,206	\$2,242,790	\$7,313,087	(\$943,881)
Other Team Costs	\$3,379,833	\$3,565,213	\$1,239,821	\$3,887,053	(\$321,840)
Facilities/Operations	\$7,450,566	\$8,323,594	\$1,760,702	\$7,975,859	\$347,735
Debt Service	\$4,127,093	\$4,211,017	\$1,388,626	\$4,199,946	\$11,071
Total Expenditures	\$37,317,447	\$39,609,788	\$10,827,855	\$40,631,292	(\$1,021,504)
<b>NET OPERATING MARGIN</b>	<u>\$1,134,401</u>	<u>(\$600,000)</u>	<u>\$9,857,152</u>	<u>\$112,529</u>	<u>\$712,529</u>
<b>CAPITAL PROJECTS</b>					
Revenue	\$409,856	\$386,500	\$0	\$554,500	\$168,000
Expenditures	\$2,637,529	\$386,500	\$37,833	\$621,778	(\$235,278)
<b>NET CAPITAL PROJECTS</b>	<u>(\$2,227,673)</u>	<u>\$0</u>	<u>(\$37,833)</u>	<u>(\$67,278)</u>	<u>\$403,278</u>
<b>NET MARGIN</b>	<u>(\$1,093,272)</u>	<u>(\$600,000)</u>		<u>\$45,251</u>	<u>\$1,115,807</u>
<b>OPERATING RESERVE</b>					
Operating Reserve 07/01/xx	\$3,915,792	\$2,822,520		\$2,822,520	
Net Margin	(\$1,093,272)	(\$600,000)		\$45,251	
Operating Reserve 06/30/xx	<u>\$2,822,520</u>	<u>\$2,222,520</u>		<u>\$2,867,771</u>	

**Note:**

These figures do not include the financial operations of the Division's Camps and Clinics or the University Ridge Golf Course.

# THE STATE OF WISCONSIN

SENATE CHAIR  
**BRIAN BURKE**

316-S Capitol  
P.O. Box 7882  
Madison, WI 53707-7882  
Phone: (608) 266-8535



ASSEMBLY CHAIR  
**JOHN GARD**

315-N Capitol  
P.O. Box 8952  
Madison, WI 53708-8952  
Phone: (608) 266-2343

## JOINT COMMITTEE ON FINANCE

### MEMORANDUM

To: Members  
Joint Committee on Finance

From: Senator Brian Burke  
Representative John Gard

Date: December 30, 1999

Re: Report on UW Management and Staff Positions

Attached is a copy of a report from the UW System, pursuant to s. 36.11 (33), Wis. Stats., which provides information on UW management and staff positions.

The report is being provided for your information only. No formal action is required by the Committee. Please feel free to contact us if you have any questions.

Attachment

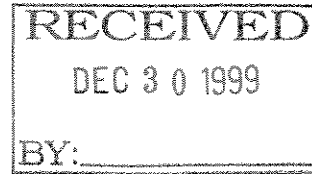
BB:JG:dh



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December 28, 1999



Senator Brian Burke, Co-Chair
Joint Committee on Finance
State Capitol, Suite 316 S
P.O. Box 7882
Madison, WI 53707-7882

Representative John Gard, Co-Chair
Joint Committee on Finance
State Capitol, Suite 315 N
P.O. Box 8952
Madison, WI 53708-8952

Dear Senator Burke and Representative Gard:

Please find attached a report to the Joint Committee on Finance on Management and Staff Positions, as required by s. 36.11 (33), Wis. Stats.

The enclosed report of FTE positions follows the format used for the last several years. It contains four parts to coincide with the statutory requirement:

Part I provides the definition of "management" and "staff" adopted by the Board of Regents. It uses the federal AA/EEO reporting definitions for executive, administrative and managerial positions. These positions constitute only 4.36% of all UW System FTE.

Part II lists all unclassified and classified titles that the UW System is allowed to assign to employees under Regent Policy and civil service law.

Part III explains that the criteria for assigning staff to "management" or "staff" categories are the official unclassified title definitions and classified job specifications.

Part IV provides tables of the number of employees in each management and staff category (and sub-category) by campus. The campus reports are preceded by a Systemwide summary that includes all UW institutions.

Because institution missions, programs and student mix vary, campus organizational management structures also vary. Nonetheless, it is important to note that the report shows only 4.36% of the UW System's total workforce is assigned to executive, administrative and managerial positions. That is another indicator of our very low administrative overhead. A related report on expenditures considered by the Board of Regents a year ago at their November 1998 meeting showed the UW System spends 5.8% of its budget on administrative costs. This is about half (10.5%) of what 18 other public university systems spend. In fact, the General Accounting Office on "Higher Education: Tuition Increases and Colleges' Efforts to Contain Costs" cited the UW System as an example of cost efficiencies among public universities.

Sincerely,
Katharine C. Lyall
President

Attachments

cc: Chancellors

management & staff report to JFC99

## **PART I: Definition of Management and Staff**

### **DEFINITION OF "MANAGEMENT"**

For purposes of reporting to the Joint Committee on Finance pursuant to s. 36.11(33)(b), Wis. Stats., the University of Wisconsin System defines "management" as employees who perform activities described by the following Affirmative Action/Equal Employment Opportunity federal reporting category:

#### **Executive, Administrative and Managerial:**

Include all persons whose assignments require primary (and major) responsibility for management of the institution, or customarily recognized department or subdivision thereof. Assignments requiring the performance of work directly related to management policies or general business operations of the institution, department or subdivision, etc. It is assumed that assignments in this category customarily and regularly require the incumbent to exercise discretion and independent judgment, holding such titles as President, Vice President, Dean, Director or the equivalents, as well as officers subordinate to any of these administrators of academic departments (chairperson, heads, or the equivalent) if their principal activity is administrative.

NOTE: Supervisory personnel of the technical, clerical, craft, and service/maintenance force will be reported within the specific categories.

### **DEFINITION OF "STAFF"**

For purposes of reporting to the Joint Committee on Finance pursuant to s. 36.11(33)(b), Wis. Stats., the University of Wisconsin System defines "staff" as employees who perform activities described by the following Affirmative Action/Equal Employment Opportunity federal reporting categories:

#### **Faculty:**

Include all persons whose specific assignments customarily are made for the purpose of conducting instruction, research, or public service as a principal activity (or activities), and who hold academic rank titles of professor, associate professor, assistant professor, instructor, lecturer, or the equivalent of any one of these academic ranks. Report in the category Deans, Directors, or the equivalents, as well as Associate Deans, Assistant Deans, and executive officers of academic departments (chairpersons, heads, or the equivalent) if their principal activity is instructional. Do not include student teaching or research assistants.

#### **Professional Non-faculty:**

Included in this category are persons whose assignments would require either college graduation or experience of such kind and amount as to provide a comparable background. Included would be all staff members with assignments requiring specialized professional training who should not be reported under Activity 1 (Executive) or Activity 2 (Faculty), and who should not be classified under any of the four "non-professional" categories of activities.



#### Clerical and Secretarial:

Include all persons whose assignments typically are associated with clerical activities or are specifically of a secretarial nature. Include personnel who are responsible for internal and external communications, recording and retrieval of data (other than computer programmers) and/or information and other paper work required in an office, such as bookkeepers, stenographers, clerk typists, office-machine operators, statistical clerks, payroll clerks, etc. Include also sales clerks such as those employed full-time in the bookstore and library clerks who are not recognized as librarians.

#### Technical and paraprofessional:

Include all persons whose assignments require specialized knowledge or skills which may be acquired through experience or academic work such as is offered in many 2-year technical institutes, junior colleges, or through equivalent on-the-job training. Include computer programmers and operators, drafters, engineering aides, junior engineers, mathematical aides, licensed practical or vocational nurses, dietitians, photographers, radio operators, scientific assistants, technical illustrators, technicians (medical, dental, electronic, physical sciences), and similar occupational-activity categories but which are institutionally defined as technical assignments.

Include persons who perform some of the duties of a professional or technician in a supportive role, which usually require less formal training and/or experience normally required for professional technical status. Such positions may fall within an identified pattern of staff development and promotion under a "New Careers" concept.

#### Skilled Craft:

Include all persons whose assignments typically require special manual skills and a thorough and comprehensive knowledge of the processes involved in the work, acquired through on-the-job training and experience or through apprenticeship or other formal training programs. Include mechanics and repairers, electricians, stationary engineers, skilled machinists, carpenters, compositors, typesetters, and upholsterers.

#### Service/maintenance:

Include persons whose assignments require limited degrees of previously acquired skills and knowledge and in which workers perform duties which result in or contribute to the comfort, convenience and hygiene of personnel and the student body or which contribute to the upkeep and care of buildings, facilities or grounds of the institutional property. Include chauffeurs, laundry and dry cleaning operatives, cafeteria and restaurant workers, truck drivers, bus drivers, garage laborers, custodial personnel, gardeners and groundskeepers, refuse collectors, construction laborers, and security personnel.

**PART II: Position Titles in Each Category**  
**Unclassified**

**Category 1: Admin, Exec, Mngrl**

TITLE NAME	TITLE CODE
PRESIDENT	A00NN
EXEC VICE PRESIDENT	A01NN
SR VICE PRES-ACAD AFF	A02NN
SR VICE PRES-ADMIN	A03NN
VICE PRESIDENT	A04NN
CHANCELLOR	A10NN
PROVOST	A15NN
DEAN	A20NN
DIVISION CHAIRPERSON	A21NN
CAMPUS DEAN (CENTERS)	A22NN
ASSOC VICE PRESIDENT	A30NN
ASST VICE PRESIDENT	A31NN
SECY OF THE REGENTS	A32NN
ASST SECY OF REGENTS	A33NN
TRUST OFFICER	A34NN
ASST TRUST OFFICER	A35NN
VICE CHANCELLOR	A40NN
ASSOCIATE CHANCELLOR	A41NN
ASSOC VICE CHANCELLOR	A42NN
ASSISTANT CHANCELLOR	A43NN
ASST VICE CHANCELLOR	A44NN
ASSOCIATE DEAN	A51NN
ASSISTANT DEAN	A52NN
ASSOC CAMPUS DEAN/CTR	A53NN
ASST CAMPUS DEAN/CTR	A54NN
SUPERINTENDENT	A70DN
SR ASSOC SUPT	A71NN
ASSOC SUPERINTENDENT	A72FN
ASSIST SUPERINTENDENT	A73LN
ACAD PROGRAM DIRECTOR	B10DN
ASSOC ACD PGM DIR	B10FN
ASST ACD PGM DIR	B10LN
GENERAL COUNSEL	J10NN
BURSAR (L)	J20DL
BURSAR (M)	J20DM
ASSOCIATE BURSAR (L)	J20FL
ASSOCIATE BURSAR (M)	J20FM
ASSISTANT BURSAR (L)	J20LL
ASSISTANT BURSAR (M)	J20LM

Category 1: Admin, Exec, Mngrl

TITLE NAME	TITLE CODE
CONTROLLER (L)	J22DL
CONTROLLER (M)	J22DM
CONTROLLER (S)	J22DS
ASSOC CONTROLLER (L)	J22FL
ASSOC CONTROLLER (M)	J22FM
ASSOC CONTROLLER (S)	J22FS
ASST CONTROLLER (L)	J22LL
ASST CONTROLLER (M)	J22LM
ASST CONTROLLER (S)	J22LS
DEAN OF STUDENTS (L)	J24DL
DEAN OF STUDENTS (M)	J24DM
DEAN OF STUDENTS (S)	J24DS
ASSOC DEAN OF STD (L)	J24FL
ASSOC DEAN OF STD (M)	J24FM
ASSOC DEAN OF STD (S)	J24FS
ASST DEAN OF STD (L)	J24LL
ASST DEAN OF STD (M)	J24LM
ASST DEAN OF STD (S)	J24LS
REGISTRAR (L)	J26DL
REGISTRAR (M)	J26DM
REGISTRAR (S)	J26DS
ASSOC REGISTRAR (L)	J26FL
ASSOC REGISTRAR (M)	J26FM
ASSOC REGISTRAR (S)	J26FS
ASST REGISTRAR (L)	J26LL
ASST REGISTRAR (M)	J26LM
ASST REGISTRAR (S)	J26LS
UNIVERSITY PHYSICIAN	J28DN
ASSOC UNIV PHYSICIAN	J28FN
ASST UNIV PHYSICIAN	J28LN
STATE CARTOGRAPHER	J30DN
ASSOC ST CARTOGRAPHER	J30FN
ASST ST CARTOGRAPHER	J30LN
COMMISSIONER OF ATHL	J38DN
ASSOC COMM OF ATHL	J38FN
ASST COMM OF ATHL	J38LN
DIR, ACAD ADV (L)	J42DL
DIR, ACAD ADV (M)	J42DM
ASSOC DIR, ACD ADV/L	J42FL
ASSOC DIR, ACD ADV/M	J42FM
ASST DIR, ACD ADV(L)	J42LL
ASST DIR, ACD ADV(M)	J42LM
DIR, ACAD COMP SERV/L	J44DL
DIR, ACAD COMP SERV/M	J44DM
DIR, ACAD COMP SERV/S	J44DS
ASSOC DIR,ACD CMP S/L	J44FL
ASSOC DIR,ACD CMP S/M	J44FM
ASST DIR, ACD CMP S/L	J44LL
ASST DIR, ACD CMP S/M	J44LM

Category 1: Admin, Exec, Mngrl

TITLE NAME	TITLE CODE
DIR, ACAD PERSONNEL/L	J46DL
ASSOC DIR,ACD PRSNL/L	J46FL
ASST DIR, ACD PRSNL/L	J46LL
DIR, ACTG SV/ASC CTRL	J48DN
ASC DIR,ATG SV/ASC CT	J48FN
AST DIR,ATG SV/ASC CT	J48LN
DIR, ADM COMP SRV (L)	J52DL
DIR, ADM COMP SRV (M)	J52DM
DIR, ADM COMP SRV (S)	J52DS
ASSOC DIR,ADM CMP S/L	J52FL
ASSOC DIR,ADM CMP S/M	J52FM
ASSOC DIR,ADM CMP S/S	J52FS
ASST DIR, ADM CMP S/L	J52LL
ASST DIR, ADM CMP S/M	J52LM
ASST DIR, ADM CMP S/S	J52LS
DIR, ADMISSIONS (L)	J54DL
DIR, ADMISSIONS (M)	J54DM
DIR, ADMISSIONS (S)	J54DS
ASSOC DIR, ADMISS (L)	J54FL
ASSOC DIR, ADMISS (M)	J54FM
ASSOC DIR, ADMISS (S)	J54FS
ASST DIR, ADMISS (L)	J54LL
ASST DIR, ADMISS (M)	J54LM
ASST DIR, ADMISS (S)	J54LS
DIR, ADMISS/RCDS (L)	J56DL
DIR, ADMISS/RCDS (M)	J56DM
DIR, ADMISS/RCDS (S)	J56DS
ASSOC DIR,ADM/RCD (L)	J56FL
ASSOC DIR,ADM/RCD (M)	J56FM
ASSOC DIR,ADM/RCD (S)	J56FS
ASST DIR, ADM/RCD (L)	J56LL
ASST DIR, ADM/RCD (M)	J56LM
ASST DIR, ADM/RCD (S)	J56LS
DIR, AFFIRM ACTION(L)	J62DL
ASSOC DIR, AFF ACT(L)	J62FL
ASST DIR, AFF ACT(L)	J62LL
DIR, ALUMNI REL(L)	J72DL
DIR, ALUMNI REL(M)	J72DM
ASSOC DIR,ALUMNI RL/L	J72FL
ASSOC DIR,ALUMNI RL/M	J72FM
ASST DIR, ALUMNI RL/L	J72LL
ASST DIR, ALUMNI RL/M	J72LM
DIR, ARCH/ENGR SERV	J75DN
ASC DIR, ARCH/ENGR SC	J75FN
AST DIR, ARCH/ENGR SV	J75LN
DEPUTY DIR, ATHL (L)	J77NL

Category 1: Admin, Exec, Mngri

TITLE NAME	TITLE CODE
DIR, ATHLETICS (M)	J78DM
DIR, ATHLETICS (S)	J78DS
ASSOC DIR, ATHL (L)	J78FL
ASSOC DIR, ATHL (M)	J78FM
ASSOC DIR, ATHL (S)	J78FS
ASST DIR, ATHL (L)	J78LL
ASST DIR, ATHL (M)	J78LM
ASST DIR, ATHL (S)	J78LS
DIR, AUX OPER (L)	J82DL
DIR, AUX OPER (M)	J82DM
ASSOC DIR, AUX OPER/L	J82FL
ASSOC DIR, AUX OPER/M	J82FM
ASST DIR, AUX OPER(L)	J82LL
ASST DIR, AUX OPER(M)	J82LM
DIR, AUX OPER (UWS)	J84DN
ASSOC DIR,AUX OP/UWS	J84FN
ASST DIR, AUX OP/UWS	J84LN
DIR, BUDGET (L)	J92DL
DIR, BUDGET (M)	J92DM
DIR, BUDGET (S)	J92DS
ASSOC DIR, BUDGET (L)	J92FL
ASSOC DIR, BUDGET (M)	J92FM
ASSOC DIR, BUDGET (S)	J92FS
ASST DIR, BUDGET (L)	J92LL
ASST DIR, BUDGET (M)	J92LM
ASST DIR, BUDGET (S)	J92LS
DIR, BUDG PLNG & DEV	J94DN
ASSOC DIR, BUDG P & D	J94FN
ASST DIR, BUDG P & D	J94LN
DIR, BUSINESS SERV(L)	J96DL
DIR, BUSINESS SERV(M)	J96DM
ASSOC DIR, BUS SERV/L	J96FL
ASSOC DIR, BUS SERV/M	J96FM
ASST DIR, BUS SERV(L)	J96LL
ASST DIR, BUS SERV(M)	J96LM
DIR, CAPITAL BUDGET	K02DN
ASC DIR, CAPITAL BDGT	K02FN
AST DIR, CAPITAL BDGT	K02LN
DIR, CAREER PLN&PLC/L	K04DL
DIR, CAREER PLN&PLC/M	K04DM
DIR, CAREER PLN&PLC/S	K04DS
ASSOC DIR,CAREER PL/L	K04FL
ASSOC DIR,CAREER PL/M	K04FM
ASSOC DIR,CAREER PL/S	K04FS
ASST DIR, CAREER PL/L	K04LL
ASST DIR, CAREER PL/M	K04LM

Category 1: Admin, Exec, Mngrl

TITLE NAME	TITLE CODE
DIR, CHILD CARE (L)	K06DL
DIR, CHILD CARE (M)	K06DM
DIR, CHILD CARE (S)	K06DS
ASSOC DIR, CHILD CR/L	K06FL
ASSOC DIR, CHILD CR/M	K06FM
ASSOC DIR, CHILD CR/S	K06FS
ASST DIR, CHILD CR(L)	K06LL
ASST DIR, CHILD CR(M)	K06LM
DIR, COMPUTER SRV (L)	K10DL
DIR, COMPUTER SRV (M)	K10DM
DIR, COMPUTER SRV (S)	K10DS
ASSOC DIR, CMPTR SV/L	K10FL
ASSOC DIR, CMPTR SV/M	K10FM
ASSOC DIR, CMPTR SV/S	K10FS
ASST DIR, CMPTR SV(L)	K10LL
ASST DIR, CMPTR SV(M)	K10LM
ASST DIR, CMPTR SV(S)	K10LS
DIR, COMPUTING SERV	K12DN
ASSOC DIR, COMP SERV	K12FN
ASST DIR, COMP SERV	K12LN
DIR, CONT EDUC (L)	K14DL
DIR, CONT EDUC (M)	K14DM
DIR, CONT EDUC (S)	K14DS
ASSOC DIR, CONT ED(L)	K14FL
ASSOC DIR, CONT ED(M)	K14FM
ASSOC DIR, CONT ED(S)	K14FS
ASST DIR, CONT ED(L)	K14LL
ASST DIR, CONT ED(M)	K14LM
ASST DIR, CONT ED(S)	K14LS
DIR, COUNSEL SERV (L)	K16DL
DIR, COUNSEL SERV (M)	K16DM
ASSOC DIR, CNSL SRV/L	K16FL
ASSOC DIR, CNSL SRV/M	K16FM
ASST DIR, CNSL SRV(L)	K16LL
ASST DIR, CNSL SRV(M)	K16LM
DIR, DEVELOPMENT (L)	K22DL
DIR, DEVELOPMENT (M)	K22DM
ASSOC DIR,DEVELOPMT/L	K22FL
ASSOC DIR,DEVELOPMT/M	K22FM
ASST DIR, DEVELOPMT/L	K22LL
ASST DIR, DEVELOPMT/M	K22LM
DIR, DEVEL & ALUMNI/M	K24DM
ASSOC DIR, DEV&ALUM/M	K24FM
ASST DIR, DEV&ALUM(M)	K24LM

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TITLE NAME	TITLE CODE
DIR, EDUC SUPP SRV(L)	K34DL
DIR, EDUC SUPP SRV(M)	K34DM
DIR, EDUC SUPP SRV(S)	K34DS
ASSOC DIR,ED SUPP S/L	K34FL
ASSOC DIR,ED SUPP S/M	K34FM
ASSOC DIR,ED SUPP S/S	K34FS
ASST DIR,ED SUPP S(L)	K34LL
ASST DIR,ED SUPP S(M)	K34LM
DIR, ENVIRONMNTL SERV	K36DN
ASSOC DIR, ENVIR SERV	K36FN
ASST DIR, ENVIR SERV	K36LN
DIR, EXT DEGREE PRG/M	K38DM
ASSOC DIR,EXT DEG P/M	K38FM
DIR, FINAN AID (L)	K44DL
DIR, FINAN AID (M)	K44DM
DIR, FINAN AID (S)	K44DS
ASSOC DIR,FIN AID (L)	K44FL
ASSOC DIR,FIN AID (M)	K44FM
ASSOC DIR,FIN AID (S)	K44FS
ASST DIR,FIN AID (L)	K44LL
ASST DIR,FIN AID (M)	K44LM
ASST DIR,FIN AID (S)	K44LS
DIR, FINANCIAL REPORT	K46DN
ASSOC DIR, FINAN RPT	K46FN
ASST DIR, FINAN RPT	K46LN
DIR, FOOD SERVICE/M	K48DM
ASSOC DIR, FOOD SRV/M	K48FM
ASST DIR, FOOD SRV/M	K48LM
DIR, GENERAL SERV (M)	K62DM
DIR, GENERAL SERV (S)	K62DS
ASSOC DIR, GEN SV (M)	K62FM
ASSOC DIR, GEN SV (S)	K62FS
ASST DIR, GEN SV (M)	K62LM
ASST DIR, GEN SV (S)	K62LS
DIR, HLTH SCI PUB AFF	K72DN
ASSOC DIR,H SCI P AFF	K72FN
ASST DIR, H SCI P AFF	K72LN
DIR, HOSP ADMISSIONS	K74DN
ASSOC DIR, HOSP ADM	K74FN
ASST DIR, HOSP ADM	K74LN
DIR, HOSP FISCAL AFF	K76DN
ASSOC DIR,HOSP F AFF	K76FN
ASST DIR, HOSP F AFF	K76LN
DIR, HOSP FOOD SERV	K78DN
ASSOC DIR,HOSP FOOD S	K78FN
ASST DIR, HOSP FOOD S	K78LN
DIR, HOSP INFO SYSTEM	K82DN
ASSOC DIR,HSP INF SYS	K82FN
ASST DIR, HSP INF SYS	K82LN

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TITLE NAME	TITLE CODE
DIR, HOSP PERSONNEL	K84DN
ASSOC DIR, HOSP PERS	K84FN
ASST DIR, HOSP PERS	K84LN
DIR,INDIRECT COST STU	K92DN
ASC DIR, IND COST STU	K92FN
AST DIR, IND COST STU	K92LN
DIR, INTERNAL AUDIT/L	K94DL
DIR, INTERNAL AUDIT/M	K94DM
ASSOC DIR,INTRL AUD/L	K94FL
ASSOC DIR,INTRL AUD/M	K94FM
ASST DIR, INTRL AUD/L	K94LL
ASST DIR, INTRL AUD/M	K94LM
DIR, INTRNL AUD (UWS)	K96DN
ASSOC DIR, IN AUD/UWS	K96FN
ASST DIR, IN AUD/UWS	K96LN
DIR, INTL EDUC PGM(M)	K97DM
ASSOC DIR,INTL ED P/M	K97FM
ASST DIR,INTL ED P(M)	K97LM
DIR, INTRAMURAL SP(L)	K98DL
DIR, INTRAMURAL SP(M)	K98DM
ASSOC DIR,INTRML SP/L	K98FL
ASSOC DIR,INTRML SP/M	K98FM
ASST DIR, INTRML SP/L	K98LL
ASST DIR, INTRML SP/M	K98LM
DIR, LIBRARY (L)	L12DL
DIR, LIBRARY (M)	L12DM
DIR, LIBRARY (S)	L12DS
ASSOC DIR, LIBR (L)	L12FL
ASSOC DIR, LIBR (M)	L12FM
ASSOC DIR, LIBR (S)	L12FS
ASST DIR, LIBR (L)	L12LL
ASST DIR, LIBR (M)	L12LM
ASST DIR, LIBR (S)	L12LS
DIR, MGMT ENGR&REG SV	L22DN
ASC DIR,MGT ENG&RG SV	L22FN
AST DIR,MGT ENG&RG SV	L22LN
DIR, MAT MGMT & DIST	L24DN
ASSOC DIR, MAT M & D	L24FN
ASST DIR, MAT M & D	L24LN
DIR, MEDICAL RECORDS	L26DN
ASSOC DIR,MED RECORDS	L26FN
ASST DIR, MED RECORDS	L26LN



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TITLE NAME	TITLE CODE
DIR, MEDIA DEVEL (L)	L28DL
DIR, MEDIA DEVEL (M)	L28DM
DIR, MEDIA DEVEL (S)	L28DS
ASSOC DIR, MEDIA DEV/L	L28FL
ASSOC DIR, MEDIA DEV/M	L28FM
ASSOC DIR, MEDIA DEV/S	L28FS
ASST DIR, MEDIA DEV/L	L28LL
ASST DIR, MEDIA DEV/M	L28LM
DIR, NEW STUDENT SV/L	L32DL
DIR, NEW STUDENT SV/M	L32DM
DIR, NEW STUDENT SV/S	L32DS
ASSOC DIR, NEW STD S/L	L32FL
ASSOC DIR, NEW STD S/M	L32FM
ASSOC DIR, NEW STD S/S	L32FS
ASST DIR, NEW STD S/L	L32LL
ASST DIR, NEW STD S/M	L32LM
DIR, NURSING	L36DN
ASSOC DIR, NURSING	L36FN
ASST DIR, NURSING	L36LN
ASST TO PRES-EQUAL OP	L42NN
DIR, PAYROLL & BENEF	L52DN
ASSOC DIR, PAY & BENEF	L52FN
ASST DIR, PAY & BENEF	L52LN
DIR, PERSONNEL (L)	L54DL
DIR, PERSONNEL (M)	L54DM
ASSOC DIR, PERSNNL (L)	L54FL
ASSOC DIR, PERSNNL (M)	L54FM
ASST DIR, PERSNNL (L)	L54LL
ASST DIR, PERSNNL (M)	L54LM
DIR, PERSONNEL SERV	L56DN
ASC DIR, PERSONNEL SV	L56FN
AST DIR, PERSONNEL SV	L56LN
DIR, PHARMACY	L58DN
ASSOC DIR, PHARMACY	L58FN
ASST DIR, PHARMACY	L58LN
DIR, PHYSICAL PLANT/L	L62DL
DIR, PHYSICAL PLANT/M	L62DM
DIR, PHYSICAL PLANT/S	L62DS
ASSOC DIR, PHYS PL(L)	L62FL
ASSOC DIR, PHYS PL(M)	L62FM
ASSOC DIR, PHYS PL(S)	L62FS
ASST DIR, PHYS PL (L)	L62LL
ASST DIR, PHYS PL (M)	L62LM
ASST DIR, PHYS PL (S)	L62LS
DIR, PLAN & CONST (L)	L64DL
ASSOC DIR, PL & CON/L	L64FL
ASST DIR, PL & CON(L)	L64LL

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TITLE NAME	TITLE CODE
DIR, PLANT ENGINEER	L66DN
ASSOC DIR, PLANT ENGR	L66FN
ASST DIR, PLANT ENGR	L66LN
DIR, PRE-AUDIT	L68DN
ASSOC DIR, PRE-AUDIT	L68FN
ASST DIR, PRE-AUDIT	L68LN
DIR, PROTECTIVE SRV/L	L72DL
DIR, PROTECTIVE SRV/M	L72DM
ASSOC DIR, PROT SRV/L	L72FL
ASSOC DIR, PROT SRV/M	L72FM
ASST DIR, PROT SRV(L)	L72LL
ASST DIR, PROT SRV(M)	L72LM
DIR, PUBLIC INFORM(L)	L74DL
DIR, PUBLIC INFORM(M)	L74DM
ASSOC DIR, PUB INF(L)	L74FL
ASSOC DIR, PUB INF(M)	L74FM
ASST DIR, PUB INF (L)	L74LL
ASST DIR, PUB INF (M)	L74LM
DIR, PUBLICATIONS (L)	L76DL
DIR, PUBLICATIONS (M)	L76DM
ASSOC DIR, PUBLCTNS/L	L76FL
ASSOC DIR, PUBLCTNS/M	L76FM
ASST DIR, PUBLCTNS(L)	L76LL
ASSR DIR, PUBLCTNS(M)	L76LM
DIR, PURCHASING (L)	L78DL
DIR, PURCHASING (M)	L78DM
DIR, PURCHASING (S)	L78DS
ASSOC DIR, PURCHASE/L	L78FL
ASSOC DIR, PURCHASE/M	L78FM
ASSOC DIR, PURCHASE/S	L78FS
ASST DIR, PURCHASE(L)	L78LL
ASST DIR, PURCHASE(M)	L78LM
DIR, RADIO/TV (L)	L82DL
DIR, RADIO/TV (M)	L82DM
ASSOC DIR, RADIO/TV-L	L82FL
ASSOC DIR, RADIO/TV-M	L82FM
ASST DIR, RADIO/TV(L)	L82LL
ASST DIR, RADIO/TV(M)	L82LM
DIR, REHAB SERVICES	L86DN
ASSOC DIR, REHAB SERV	L86FN
ASST DIR, REHAB SERV	L86LN
DIR, RESEARCH ADMIN/L	L88DL
DIR, RESEARCH ADMIN/M	L88DM
ASSOC DIR, RES ADM(L)	L88FL
ASSOC DIR, RES ADM(M)	L88FM
ASST DIR, RES ADM (L)	L88LL
ASST DIR, RES ADM (M)	L88LM