INTRODUCTION

Background

The Robert Mondavi Institute for Food and Wine has nearly completed construction. This facility will provide new office and laboratory space for faculty and students of the Viticulture and Enology Department and the Food Science and Technology Department. Plans for the Institute have always envisioned an accompanying teaching and research winery, brewery, and food processing pilot plant as an integral part of the teaching, research and public service mission of the Departments. The proposed project will complete this vision.

The Department of Viticulture and Enology makes invaluable contributions to the culture of grapes and the creation and appreciation of fine wines. The Department has educated and trained many of the world's finest winemakers, grape growers, researchers and industry leaders. UC Davis has a long-standing tradition of excellence in teaching, scientific inquiry, and industry service. This combination of academic excellence, innovative research, and comprehensive programs of instruction makes the Department a world leader in viticulture and enology.

The Department of Food Science and Technology is the only food science program in the University of California system and the only food science Ph.D. program in the state. The Department provides the research, knowledge, and training to enable the food industry to produce competitive, value-added products. The department is multidisciplinary, including faculty with training in chemistry, biochemistry, engineering, microbiology, and sensory science. The campus produces the largest number of food science graduate students of any academic institution in the U.S. The Department has also graduated more than 100 students who work in the malting and brewing industry.

Project Description

The Viticulture & Enology Research & Teaching Winery and Anheuser Busch Brewery and Food Laboratory project would construct a single-story building containing approximately 17,500 gross square feet of new facilities the Department of Viticulture & Enology and 15,500 gross square feet of new facilities for the Department of Food Science and Technology.

The project would be co-located with the Robert Mondavi Institute for Wine and Food Science, currently under construction in the South Entry district of the Davis campus. A teaching and research vineyard is planned immediately adjacent to the Robert Mondavi Institute for Wine and Food Science and the proposed project.

The proposed project would provide flexible teaching facilities to demonstrate a variety of traditional and innovative production practices and would provide state-of-the-art research

facilities. In addition to student teaching and research activities, the project would provide a venue for extension teaching, industry outreach and university visitors. Innovative energy efficiency measures and sustainable construction and production practices would be integrated and demonstrated throughout the facility.

The winery would include a fermentation and press room adaptable to both teaching and large-scale research, four flexible temperature-controlled fruit storage and barrel aging cellars, a long-term barrel aging cellar, a 70,000 bottle aging cellar for research, a small donor bottle cellar, a class laboratory, a small analytical laboratory and two offices. The facility will include a high degree of environmental and process control to enable experimental reproducibility, demonstrate process monitoring and control, and mitigate environmental impacts.

The brewery would include a pilot brewery, a grain milling and dry storage room and a cooler. The food laboratory will include rooms for general food processing and specialized food processing, a blast freezer, a processing freezer and a large processing cooler. The brewery and food processing will share access to a small analytical laboratory, a teaching laboratory, one office and an equipment storage and material receiving area. The food laboratory will be designed as a highly flexible facility, adaptable to a wide variety of commodities and processes, including cheese-making, olive oil production and tomato analysis.

Sustainability features that would be incorporated into the building include daylighting of all major spaces, “night flush” summer cooling, highly insulated thermal massing, minimized thermal conditioning of non-critical spaces, zero landscaping irrigation and extensive utilities metering and control. In addition, the building would be designed to accommodate the future addition of other sustainable design features as funding permits, including a photovoltaic electrical system, a solar hot water heating system, a rainwater capture system to reduce the demand for reverse osmosis water and a greywater recycling system.

PILOT BREWERY

Introduction

The new facility will showcase the pilot brewery as a major element of the RMI Institute. The new facility is to be designed to provide a spacious, flexible, modern and hygienic environment to instruct students in the art and science of beer making and provide an introduction to common production practices.

The pilot brewery is currently operating in Cruess Hall. The facility is designed as a 1.5 barrel pilot brewery and currently brews about twelve times per year, mostly in the spring. It is anticipated that the production may be doubled or more in the new facility, with the capacity to have two brewing sessions in the same day.

Although additional fermentation tanks may be added over time, it is not anticipated that the area of the proposed brewery will require expansion in the foreseeable future.

Equipment

The existing brewing equipment will be relocated from Cruess Hall, with the exception of the glycol cooling system which is expected to be new. It is also anticipated that the existing mobile clean in place system will be replaced by a fixed and dedicated clean in place system.

The primary brewing process equipment consists of six vessels approximately two feet in diameter:

- Process Water Tank
- Mash Cooker
- Mash Tank
- Lauter Tub
- Brew Kettle
- Whirl Pool

Fermentation vessels include:

- 1.5 barrel / 62 gallon Fermenters (currently six, with up to six more planned)
- 100 gallon Fermenters (currently two)

Process Water and Mash Tanks

Process water is made with deionized water. Mashing water temperature is 95 to 105 degrees F. After mash in, the water temperature is raised to 170 degrees F to sparge the Lauter Tub. The grain in the Lauter Tub is used as a straining media for the liquid that is pumped to the Brew Kettle. This liquid is called wort.

Ground malt is mixed in the mash tanks at about 100 degrees F and then raised to the conversion temperature of about 150 degrees F. Mixing is critical as the malt solids will settle out and the liquid velocity across the heat surface is critical to maintain uniform temperatures in the mash. The Mash Tank has a bottom and side steam jacket.

The Mash Cooker has a bottom steam jacket and an internal copper coil and can be used for Mash or Adjunct Cooking. Adjuncts of rice or corn must be boiled to break down the carbohydrates. During adjunct boiling, over boiling can cause dangerous foam to occur if too much heat is applied.

After the rice or corn is boiled, it is pumped back to the Mash Tank. This operation must occur very smoothly through the pump because the rice or corn adjunct will solidify very quickly during the pump back process stops. After pump back, rinsing the vessel and lines is critical to prevent fouling or plugging.

Lauter Tub

Mash pumping to the Lauter Tub is not quite as difficult but the lines can plug quickly with the amount of solids in the mash if pumping and flushing is not a smooth operation. After mash off, the Mash Tank and lines need to be flushed to drain as the mash is now in the Lauter Tub for recirculation.

In the Lauter Tub, the grain bed forms a filtration media and the Lauter Tub pump re-circulates the wort until clarity is acceptable and the wort is pumped to the Brew Kettle. Rakes inside of the Lauter Tub aid in the wort filtration and can be used to break blind media if this occurs. Sparge process water is added to the Lauter Tub after mash off and recirculation, allowing the wort sugars to be extracted as this liquid is transferred to the Brew Kettle.

Brew Kettle

In the Brew Kettle, the wort is boiled with the dual calandria. The calandrias must be covered at the wort will burn and foul the heating tubes if they are not submerged when the steam is applied to the calandrias. Boiling wort flows upward through the tubes and hits the deflector plate, providing a very robust wort boiling. Too much heat can cause the wort to boil out in a dangerous foam and must be avoided. Emergency steam shut off stations are provided to kill the steam to the system. A Warrick probe in the top of the brew kettle will shut off the steam if high levels of boiling foam are detected.

Hops or extracts can be added via access door to the Brew Kettle and hops tend to help to reduce the foaming effect of over boil. Caution is required when opening the Brew Kettle access door for observation or adding hops.

Whirl Pool

After the wort has boiled in the Brew Kettle, the wort is pumped into the Whirl Pool where the circular motion of the wort allows trub or solids to settle on the bottom.

From the Whirl Pool, the work is cooled via two Alfa Laval plate and frame heat exchangers. The first exchange cools the 200+ degree F wort down to about 80 degrees F using single pass through domestic cold water. The second heat exchanger used cold glycol to cool the wort to a final temperature of about 50 degrees F.

The wort cooling is achieved by setting the water and glycol flows to pre-determined rates and using the positive speed wort pump to transfer the wort at a fixed speed. If any trim cooling is required, the water or glycol rotometers can be manually adjusted but heat transfer time is slow and cooling the wort to proper temperature should be manually set and empirical rates used to achieve the proper cooled wort temperature.

Because the domestic cold water temperature varies, the water flow rate will need a calibration curve to determine the correct water, glycol and wort flows to achieve the desired cold wort temperature. Controlling wort temperature is not an instantaneous control function of the water or glycol.

Fermenters

The cooled wort is then transferred via hose into one of six wheeled Fermenters. Air is injected into the wort as it is transferred to the Fermenters. Yeast is manually dumped into the top dome of the Fermenters where the wort will ferment into beer. As fermentation is an exothermic reaction, the Fermenters have bottom and side independent glycol cooling jackets to control fermentation temperature. Fermentation releases CO2 that is vented from the Fermenters via pressure regulators or backup safety relief on the tanks.

Once all the sugars have been consumed by the yeast, cooling the Fermenter with glycol will allow the yeast to settle to the bottom of the Fermenter where it can be drawn off prior to filtration.

The cooled beer is then filtered via a sheet filter as it is hosed to a second Fermenter acting as a filtered beer tank. The beer can then be packaged into bottles with the KHS filler and crowner. A portable pump is used for filtration and transfer to the filler.

Freezer

A small freezer room near the filler and crowner is required to store product at approximately 29 degrees F.

Malt Mill & Storage Room

A separate room is required for a small malt mill and the storage of malt storage bins and miscellaneous brewery equipment.

Analytical Equipment and Office

A separate office adjacent to the brewery room is required to provide an office for the brewery manager, to house brewery records and provide space for benchtop analytical equipment.

Cleaning Equipment

All process lines and tanks must be flushed after each use and cleaned in place to maintain a sanitary operation. The Process Water Tank and the process piping have been designed to allow flushing of each line after transfer between the process vessels.

One of the mash tanks can be used to clean in place the process vessels and heat up the cleaning solution for the system. In addition, the Process Water Tank has a circulation loop to all the vessels and also the ability to have rinse water in either the tank or directly from the filtered water source that feeds the pump suction. These tanks also provide the cleaning for the fermenters and the KHS Filler via hoses. A portable CSR pump is used to return the cleaning solution.

The new facility is to be designed to provide a separate room for a dedicated clean in place system.

RESEARCH and TEACHING WINERY

Introduction

UC Davis has a world-wide reputation as the leader in viticulture and enology research and teaching. The new research and teaching winery is intended to:

- Demonstrate California's leadership in wine experimentation and innovative technology
- Provide a teaching platform for leading technologies
- Serve as an extension and industry outreach showcase for experimentation & improved processing technologies
- Provide a leadership platform for sustainable winemaking

The product of the winery is educated graduates, reliable data and industry innovations. The new facility must provide for flexibility to adapt to various experimental protocols and processes, to demonstrate common production practices, show multiple techniques and allow for innovative practices. The need for experimental reproducibility requires precise and variable control of environmental conditions and closed systems to reduce cross-contamination. Advanced web-based process monitoring and control systems teach students concepts of process monitoring and allow precise control of experimental conditions and process scheduling. Access for students and visitors without disruption of operations, future expandability and a high level of efficiency and functionality are essential.

There are currently about 50 students in the Masters of Viticulture and Enology program and there is a greater demand for trained graduates than the existing facilities can accommodate. The instructional programs in Enology are designed to teach students the scientific principles that underlie making wine. The facility is to be a functional winery that serves as a class room and laboratory.

As a demonstration winery, a total of about 50 tons of grapes are received and processed by the students to simulate real practices in industry. Future instruction may emphasize bulk winemaking over the current small-lot focus. The students are taught how to use equipment used in various winemaking processes, including crusher/stemmers, various pumps, wine presses, filters, and bottling equipment. The Winery Manager/Staff Winemaker oversees the facilities operation and allocates its resources

The school is not bonded and is prohibited by law from producing or selling wine. Eighty percent of the wine produced is destroyed. The remainder is retained for research and teaching purposes.

Certain parts of the facility must be viewable by the public, including the fermentation areas, the laboratory, the long term barrel cellar, and the donation cellar. Visitors must be able to view into these areas without entering the areas or disrupting operations. An indoor or outdoor gathering area should be provided for tour assembly.

One of the principal goals of the facility is to be able to monitor its usage of water and energy, as well as its output of process waste. Therefore, the inputs and outputs have to be measured via meters that can be connected into electronic data collection systems, or at least provision must be made to allow addition of such meters in the future.

Academic Year

Fruit deliveries begin in late summer and continue into fall. The academic year consists of fall, winter and spring terms.

Summer: July to September:

Fruit deliveries begin as early as August 1st with the arrival of fruit from the campus vineyards. Harvest from remote vineyards can last through November. The fruit is processed for upcoming classes. Fruit may be processed for fermentation in cold storage. Research fruit is received and processed in accordance with a variety of study protocols. This is usually performed by 2 staff members, respective faculty and students.

Fall Term: October through December:

Students and instructors will be in the fermentation and barrel areas for up to 8 hours per day, five days a week for six to nine weeks. The maximum number of students, staff and faculty at any given time could be as high as 30 to 35, but would be typically be 15 to 20 students plus instructors.

Spring: January through March:

Teaching activities primarily consist of demonstrations of winery process equipment using bulk wines produced during fall quarter. Bottling will occur from February through August. Research activities involve processing the wine to bottle as directed by study protocol. The maximum number of students, staff and faculty at any given time could be as high as 30 to 35.

Spring: April to June:

Teaching activities primarily consist of demonstrations of winery process equipment using bulk wines produced during fall quarter. Research activities involve processing the wine to bottle as directed by study protocol. The maximum number of students, staff and faculty at any given time could be as high as 30 to 35.

Fruit Volume

Currently 50 tons of fruit are processed annually by the department for teaching and research but only about half is currently processed in the Davis campus winery. It is anticipated that the new facility will process 60 tons of red and 60 tons of white annually when opened, increasing to 100 tons of red and 100 tons of white with the future expansion.

A maximum of 15 tons of fruit would be processed in a single day. The fruit could be all red, all white or a combination. With future expansion, this would be increased to 30 tons maximum per day.

Some of this fruit is harvested and placed in long term storage off-site to be used during classes that begin October 1st. Approximately 20 tons of fruit is made into library wines that are used for teaching. Approximately 10 o 15 tons of fruit may be processed for research.

Fruit Delivery

The fruit will arrive on 20 foot long trailers and 6 ton flatbed trucks. Currently the facility receives a maximum of 6 to 8 tons of fruit per day. That volume will expand to a maximum of 14 to 15 tons per day, arriving in 1/2-ton, 24-A-S MacroBins or 1/4-ton, 16-FV MacroBins. In addition, a maximum of forty 30 lb. containers will arrive stacked in the 1/2-ton MacroBins. On the average, 50% will be white and 50% will be Red, but in a single day, all of the fruit coming in could be either red or white.

Approximately 500 gallons of juice could be delivered during harvest as well. It would be stored in a tank in the winery.

The Winery Service Yard must also be able to accommodate a 60 foot long semi tractor trailer rigs, about 6 times a year. No loading dock is necessary. No provision for the delivery or

storage of inert gasses is necessary. The yard must accommodate bin washing under a covered area on a concrete slab sloped to a process waste drain. Bins will be stored off-site.

There should be a fenced site in the winery yard for the disposal of approximately 6 yards of organic solid waste per day from harvest and fermentation. There will be two 3-yard drop boxes for pomace waste on a sloped concrete slab with a process waste drain below it, in addition to dumpsters for normal waste disposal. The solid waste will be removed every day.

Fruit Cooling

A Fruit Cellar capable of cooling 16 tons of fruit from 85 degrees F to 50 degrees F within twelve hours is required. It should be accessible from opposite sides so that small lots can be placed in and removed with ease, and located so that fruit can flow through from the harvest yard to the fermentation room. The bins will be stacked two high and two deep with adequate area around the bins to allow for air circulation.

Sorting & De-stemming

For red wine, the sorting/destem line will consist of a bin dumper, a sorting table allowing four to six people to sort, a destemmer and then a conveyor to the top of the fermentation tanks. The red teaching wine sorting/destem line will move from fermenter to fermenter. The red research wine line will be stationary and the research fermenter will be brought to the line.

For white wine, the fruit will move to the bin dumper to the sorting line to the destemmer and then conveyed to the press. The juice will be pumped from the press into the fermentation tanks. For white wine, the line will be stationary. The sorting/destem line will typically be located in the fermentation area, but this function should be able to be accommodated in the covered area of the yard.

Fermentation

There will be fourteen 2,000 liter stainless steel tanks arranged along either side of a central catwalk. Twelve of the tanks will be closed top; 2 will be open top. The open top fermenters will have a height:diameter ratio on the order of 1:1. The catwalk should be mounted 42" below the tops of the tanks. These tanks will be approximately 14 feet high with the legs. The tank door height must be adequate to place a ½ ton MacroBin under the tank to facilitate pomace removal. The tanks must be bolted to the floor for resistance to seismic loading but should be detachable.

There will be approximately one hundred and fifty 55-gallon research fermenters. They will be mounted in pairs on 3 foot by 5 foot pallets and stand about 4 feet high. Each will hold about 45 gallons of pomace/juice or 30 gallons of wine.

All fermentation tanks will be jacketed and insulated. The tall teaching tanks will have two jackets for heating and cooling, plumbed together to act as one jacket. It is important that all of the research fermenters be equal in performance and capable of being monitored.

The data from the fermenters will be transferred to the managing winemaker's lab. Pumpovers will be accomplished with the use of a side of tank mounted pump or manual pumpovers. If adopted, the punch downs on the open top tanks will be carried out using a pneumatically controlled device yet to be designed but based upon examples currently in use by industry. The framework would be free standing and bolted to the floor.

The tanks will have 2 to 3 fermentations each harvest. The closed top tanks can be used for bulk storage and blending when not in use for fermentation..White wines will be fermented in barrels in addition to the stainless steel fermenters.

The Fermentation Room will be a large, flexible, open high-bay space of 6,000 square feet. Dust control, CO2 control and minimum ventilation rates are required but precise temperature and humidity control is not required. Floors must be sloped to trench drains without any ponding. Wall and floor finishes will be subject to frequent washdown and must withstand impact from forklifts and equipment. Doors shall insulated and of sufficient width and height for forklift traffic.

CO2 Recovery from the Fermentation Room

Federal/OSHA industrial standards for CO2 allow up to 5,000 ppm average over 8 hours and a peak of not more than 30,000 ppm over 15 minutes. Sensors and fans are required to remove CO2 from the Winery Fermentation Room and the Winery Cellars to maintain CO2 levels below the code limit. Fans and warning lights should automatically be activated if CO2 levels rise above code limits.

Closed top fermenters will typically be used and the CO2 that is generated will be piped off and captured. CO2 recovery from the closed fermenters can be carried out by ducting the breather vent to the CO2 recovery/venting system. CO2 will be recovered by running through a CaOH scrubber. The CaOH is evaporated in the sun.

Cleaning

Fermenters will be cleaned using a clean in place system to reduce usage of water, energy and chemicals. The system will require a separate room adjacent to the fermentation room for the storage of equipment and chemicals. Piping distance to the fermentation room should be minimized to reduce installation cost and pumping energy.

Press

Presses will be mobile and may be used both inside the Fermentation Room and outside in the Winery Receiving Area. Reearch fermenters will be dumped directly into the press by forklift. Must from the teaching fermenter will be moved into MacroBins and dumped by forklift into the press.

Settling

The current compliment of tanks can be used for settling as winery operations allow. In the future, development of a solid removal system is desired. The system would be in-line and carried out during transfer of juice to the fermenter from the press.

Barrel Aging and Barrel Fermentation

Three Winery Cellars provide flexible space for barrel aging, barrel fermentation, bottling and other research and teaching activities. Standard 225 to 240 liter barrels of all different shapes will be used. The cellars will be designed to accommodate up to 24 barrels without stacking, although two high stacking may occur in the future. The cellars do not need to be publicly visible but must connect directly to the Fermentation Room. The cellars will be used 9 months of the year for barrel storage and used at other times for other procedures including bottling.

The Long Term Barrel Storage Room provides space for the storage of up to 40 barrels, 1 high on Western Square racks. This room should be publicly visible and will be used 12 months of the year.

All cellars shall be designed as analytical laboratories that are sanitary, well lit and precisely controlled for a variety of temperature and humidity protocols. No wood or unprotected steel will be allowed in the construction. The structure would ideally be massive and well insulated in order to encourage stable climatic conditions. Each cellar must have smooth walls and enough air movement to prevent mold growth. The cellars should be grouped for efficiency of construction and climate control.

CO2 control and recovery is required for both white and red wines. White wine generates 60 liters of CO2 for each liter of wine going through primary fermentation over a six week period. Red wine generates 5 liters of CO2 for each liter of wine going through malo-latic fermentation. Negligible CO2 should be generated in the long-term barrel cellar.

The barrels will be cleaned two at a time on a barrel cleaner in the adjacent Fermentation Room using water heated to 100 degrees F, with the ability to add treatment chemicals if needed.

Blending and Bottling

Blending and storage can be achieved within the fermentation tanks.

About 500 cases were bottled last year and it is projected that 2,000 cases will be bottled in the future facility. Bottling will be done in the Fermentation Room or one of the cellars. Bottling will be done with a portable mono block. The bottles are then taken to the Research Bottle Storage room.

Long-term Research Bottle Aging

There are currently 30,000 bottles or 2,500 cases of research wines in storage in the existing winery but it is not anticipated that many, if any, will be relocated to the new facility. The new facility will provide about 1,000 square feet for the storage of future individual bottles, cases and other containers of varying sizes. Storage will initially occur on adjustable height metal shelving fixed in place on the perimeter walls. It is anticipated that high density mobile shelving units will be installed in the center of the space in the future as storage demands grow. Precise and reliable control of temperature and humidity is essential. No wood, paper, cardboard or other organics will be permitted in this room.

Special Collections Bottle Storage

A tax-paid Special Collections Bottle Storage room is required to house a small collection of donated wine and special collections. Precise and reliable control of temperature and humidity is essential. There will be occasional small group tastings and the room should be accessible and viewable by the public. Finishes and lighting in this room should reflect its special character.

Sustainability

The goal of the project is to incorporate, to the maximum extent possible within budget constraints, a variety of innovative sustainability measures specifically relevant to the unique environmental challenges and opportunities in the California wine industry.

The new winery is to be designed to lead by example, to demonstrate and teach students current sustainable practices, to inform the public and industry and to provide a flexible platform for research and future innovation in this area.

Systems and utilities should be designed so that energy and water use can be measured, monitored and displayed at the process level. Extensive signage, exhibits and live information displays are a critical element in successfully using the facility as a platform to teach and inform.

In addition, the project is to achieve a LEED Silver rating as a minimum within the scope of the base bid and a LEED Platinum rating within the scope of an alternate bid.

The Sustainability section of this program describes potential sustainable design features in more detail.

Future Winery Expansion Requirements

It is anticipated that the winery will be expanded in the future by at least 12,000 gross square feet. The site plan and the floor plan of the initial phase must provide sufficient space in logical locations to accommodate the following functions as a minimum:

- 4,000 gsf for additional fermentation room area
- 1,000 gsf for two additional cellars
- 500 gsf for three additional offices
- 1,000 gsf for additional research bottle storage
- 4,000 gsf for two new teaching labs and support space
- 1,500 gsf for a new distillery

FOOD PILOT FACILITY

Introduction

The UC Davis Department of Food Science and Technology is the only food science program in the University of California system and the only food science Ph.D. program in the state. The Department evolved from origins at the Berkeley campus in the early 20th century to become a center for teaching and research that supports the agricultural economy of California. California is the third largest agricultural economy in the world, with an annual farm gate of $32 billion and $100 billion in related economic activity.

The Department's teaching and research programs help the state's food industry produce competitive, value-added products. Food Science and Technology currently instructs about 2,300 students each year and issues approximately 50 undergraduate and 15 graduate degrees, respectively. Research topics range from production of food ingredients (e.g., growing tomatoes and grains, producing milk and meat) to harvesting and processing food commodities into safe, transportable, diverse products for consumption. The department is multidisciplinary, including faculty with training in the disciplines of chemistry, biochemistry, engineering, microbiology, and sensory science. Key research areas include:

- Lipid metabolism and the associated design of foods to improve individual health and well being.
- Food safety, in particular bacterial and microbial poisoning.
- Food packaging that protects and communicates food quality while protecting the environment, including:

    - Edible coatings for foods that provide protection from oxidation, moisture change, aroma loss and microbes.
    - Edible film pouches for dry food ingredients that become part of the food product.
    - Biodegradable oxygen-barrier and oil-barrier coatings to replace synthetic coatings for paper.

- Water management of effluent streams within food processing facilities. The Department's research has assisted California food processors in increasing plant capacity by in-plant water reuse, recovery of chemicals, reduction in energy use, and overall cost savings.

The Davis campus produces the largest number of food science graduates of any academic institution in the United States. The Department instructs over 200 students each year and issues approximately 50 undergraduate and graduate degrees annually. Alumni now work in key positions within the food industry. Department graduates also work in the malting and brewing industry.

General Food Processing

General Food Processing will provide a flexible facility for a wide range of pilot-scale food processing activities for research and teaching. The facility includes both fixed equipment and mobile equipment used on an infrequent or seasonal schedule. Commodities and activities to initially include tomato analysis, pear processing, raw milk processing, cheesemaking and olive oil production.

Primary objectives to include:

Hygienic environment for food-grade facility: The design of the facility, including finishes, drains, HVAC system and layout shall facilitate maintaining a safe and clean environment and demonstrate best practices. Codes applying to this room include, but are not limited to, the Code of Federal Regulations, Title 21, Chapter 1, Part 110 "Current Good Manufacturing Practice in Manufacturing, Packing, or Hold Human Food" and the State of California Health & Safety Code, Part 6, Article 1 Food Processing Establishments, Section 111950-112055 "The California Food Sanitation Act".

Flexibility: The main general food processing space shall be a large high bay space that provides maximum flexibility for a wide range of equipment that will constantly change with the season and academic and research directions. An extensive and generic utility distribution

system is a key element in providing flexibility. A wide range of utilities for present and future equipment must be available from pre-fixed ceiling drops, fed from an above-ceiling catwalk and pipe rack system that separates utilities from the food preparation area below but provides for easy access to distribution mains for future changes.

Product Analysis: Provide a small analytical laboratory for use by General Food Processing, Milk Processing Research & Teaching Laboratory and the Brewery.

Public viewing: The main spaces shall be visible from public corridors for tours and viewing without disruption to classes or compromising safety and hygienic standards.

Support spaces: Provide support spaces including cooler rooms, freezer rooms, equipment storage, tool storage and chemical cleaning storage as required.

Milk Processing Teaching & Research Laboratory

The Milk Processing Teaching & Research Laboratory provides a controlled facility for benchtop dairy and cheese making pilot equipment for teaching, demonstration, research and human tasting and consumption. New equipment planned for this laboratory is intended to demonstrate basic principles, food engineering techniques and provide for small-scale process tests.

Flexibility of utility distribution systems and utilization of moveable and adjustable lab tables and casework in lieu of fixed casework are necessary to provide an adaptable space to evolving academic and research directions.

Hygienic standards with respect to finishes, dedicated drains, dedicated HVAC systems and other design features are critical to the functionality of this facility and its intended use for tasting as well as research and demonstration of process. Codes applying to this room include, but are not limited to, the Code of Federal Regulations, Title 21, Chapter 1, Part 110 "Current Good Manufacturing Practice in Manufacturing, Packing, or Hold Human Food", the Federal Pasteurized Milk Ordinance (PMO), the State of California Health & Safety Code, Part 6, Article 1 Food Processing Establishments, Section 111950-112055 "The California Food Sanitation Act" and all California state requlations pertaining to raw milk processing and the production of dairy products for human consumption.