

State Technologies Advancement Collaborative (STAC)
Solicitation Number 03-STAC-1
Program Area B.1.: Industrial Technologies, Energy Systems
Cooperative Agreement No. DE-FC36-03G013026 USDOE/NASEO
Contract No. P01645 PH70 NASEO/Oregon Department of Energy

Western United States Food Processing Efficiency Initiative

Quarterly Progress Report
July 1, 2004 through September, 30 2004
Contract # P01645 PH70

Recipient Organization: Oregon Department of Energy

Participants:

Washington State University Energy Program (WSU)
Idaho Department of Water Resources Energy Division (Idaho)
California Energy Commission (CEC)
Lawrence Berkeley National Laboratories (LBNL)
Del Monte Foods
Northwest Food Processors Association (NWFPA)
California League of Food Processors (CLFP)

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Certifying Officer: Bruce Westerberg, Assistant Director

Quarterly Report Scope

This report covers the third quarter of 2004, or July 1, 2004 through September 30, 2004. The Oregon Department of Energy is reporting on all activities undertaken by all partners. Each of the tasks is underway and the project management plan is in place.

1. STAC Project Objective:

The primary objective of the State Technology Advancement Collaborative (“STAC”) is to support joint energy research, development, demonstration, and deployment (“RDD&D”) of technologies where common Federal and State objectives exist. Under STAC, an area of emphasis is the dissemination of results from projects and transfer of technology for broad application and impact. This project will develop technical resources for improving resource efficiency of the food processing industry and identify formats and methods to deliver that information.

2. Background and Project Description:

Create an effective network to improve the energy and water efficiency and productivity of the food processing industry (North American Industry Classification System category – NAICS 311) in Oregon, Washington, California, and Idaho. An active and effective network will bring together complementary activities and assist the states in broadening their food processing industry offerings while helping to avoid duplication of programs. This project will initiate the collection, analysis, and dissemination of information to Western state food processors about best energy efficiency practices, best available commercialized technologies, and leading-edge energy efficiency and environmental technologies applicable to food processing. The demonstration of a world class enterprise management system integrated with plant management controls will be used to illustrate resource efficiency potential.

3. Patents:

No patents have been applied for nor are any planned to be developed or applied for under this agreement.

4. Publications/Presentations:

This quarter presentations were made to both the California League of Food Processors, and the NW Food Processors Association Energy Committee and Executive Committees. The September 29th meetings reiterated in more detail the State Technology Advancement Collaborative objectives and asked for feedback on the first case study completed. A copy of the updated, more detailed PowerPoint Presentation is attached. A letterhead, with the team agreed upon acronym FIRE (Foodprocessing Industry Resource Efficiency), is now available for use by partners. It will be used for the case studies and communications. It is attached for reference.

5. Progress in Past Quarter and Current Status:

Final contract terms have been supplied to Lawrence Berkeley Laboratories with exceptional assistance from the NASEO attorney. The California Energy Commission recently approved the contract for their signature. These final sub-contracts are on track for signature in the first month of the fourth quarter of 2004. An overall project plan and task assignment is complete. Outlines and lists of the best practices and emerging technologies to be initially investigated are complete. A second level of detail has been developed for the emerging technologies. An information sharing structure is developed for web or catalog use. The extranet web site housed

by Washington State University is a location where e-mails and information can be shared by partners readily <http://forum.energywa.org/mbbs2/category-view.asp>.

The enterprise management system project plan is complete. The first food processor association demonstration project in Oregon is being completed. And a case study is being developed. Matching funds of over \$200,000 have been invested and are reported on in the accompanying financial report. The task descriptions are included below followed by descriptions of specific progress. Appendices supplement the progress descriptions.

Task 1: Form Network/Planning

Develop a collaborative network of stakeholders, including industry associations, universities, industry leaders, state and regional agencies, energy-efficiency organizations, and national laboratories through the following activities: (1) All participants will identify key food processing companies in the western states region, beyond the participants described in this proposal, and invite them to participate in on-going planning and implementation. (2) Industry associations will facilitate industry participation in the project. (3) NWFPA and CLFP will use their energy task forces of company executives to identify effective strategies to reach decision makers in industry for transfer of best practices and emerging technologies. (4) WSU Energy Program will schedule two face-to-face participant meetings at annual conventions and/or video conferencing broadcasts to provide opportunities for industry and partner participation. (5) The NWFPA and CLFP will convene member advisory groups to provide input on best practices, technology experiences, and needs. (6) WSU Energy Program will lead development of the strategic plan for the participants and facilitate the project Industry Advisory Group. (7) WSU Energy Program will lead recruitment of regional and national industry executives for policy development and long-range strategic planning. This will include site visits to seven key regional corporate offices or plants to identify and document priority needs, standards of practice, and new or emerging technologies in use. (8) LBNL will lead evaluation of the California Food Processing Road map for applicability to the western states research agenda and needs identified through association data gathering. All participants will detail outcomes of the projects to include energy savings, emissions reductions, products produced and value added for the industry.

The network of implementers meets monthly and three meetings were held this quarter. Minutes of those meetings are attached. Project and task Gantt charts detail more than 60 individual task and are updated on the extranet site. Both the NWFPA and CLFP has developed steering committees to advise the group as the develop products to assure the usefulness of the project. The NWFPA Energy Committee and Executive Committees met on September 29, 2004 and reviewed the program objectives by task, reviewed a case study and gave team representatives feedback on specific tasks and process.

Task 2: Best Practices Portfolio

All participants will assemble an initial portfolio of best practices already known to the organizations and share the information throughout the region. All participants will develop relationships with industry contacts, EERE, state energy offices, national laboratories, associations, suppliers, Industrial Assessment Centers, and universities to gather information, identify promotion leveraging opportunities, and collaborate on demonstrations or case studies. All participants will provide content input and Web links to the NWFPA's newly developing Web portal with the Best Practices Programs available to food processors. This is being planned under recent DOE funding. WSU Energy Program will coordinate this material. Resources will include solutions to key issues such as: applicable technologies, best practices, productivity,

financial incentive programs, and homeland security supply chain/regulatory issues. NWFPA and the CLFP will identify members with active best practice capability or programs and identify which have published findings or data to share.

The list of 16 target Best Practices specific to food processing is attached. Development has commenced on collecting the pertinent information and resources to best meet food processors needs. A draft motors, blanchers, and lift trucks information for a web page has been developed and is attached. The structure of the web portal as it relates to the Best Practices is updated and finalized. The map of the page interrelations is attached. The structure of the incentives and services element is generally outlined and will be a major focus in the upcoming quarter.

The NWFPA and CLFP steering committees review of the focus areas and web layout in the first part of the upcoming quarter. The Truitt Brothers, Incorporated are investing in a boiler best practice project. Working with them since April resulted in a commitment to invest \$115,812 in a flue gas economizer and flash steam economizer to reclaim the heat from blowdown on three boilers used for fruit food processing. Over \$100,000 of the matching demonstration project monies have been invested. An independent Certified Public Accountant will compile all the cost for this specific project once it is complete in the first part of the coming quarter. As members of NWFPA they are participants in the project and are willing to help with a case study.

Task 3: Emerging Technologies

A portfolio of emerging technologies that show promise for efficiency, productivity, or emissions improvement for the food processing industry will be created. WSU Energy Program will compile data and case studies on emerging technologies being applied in the food processing industry for productivity improvement, energy efficiency, quality enhancement, or waste minimization. CEC will develop six case studies of their Public Interest Energy Research (PIER) projects that demonstrate commercial application of emerging technologies that may benefit food processors. WSU Energy Program will identify specific services of WSU's Food Science Department and the Impacts Center with ties to the Manufacturing Extension Network for developing marketing or delivery strategies for emerging technologies. CEC will inventory emerging technology demonstration sites and identify which incorporate widespread best practices to identify case examples for write up. Idaho will lead development of best practice guidelines for specifying and protecting programmable logic controllers resistant to interruption from voltage drop. WSU and Oregon will research combined heat and power applications in food processing and identify barriers and opportunities. LBNL will compile an inventory for food processing of the best available commercial and emerging technologies and sort by end use (hot water, steam, motors), process (washing, cutting, freezing, refrigeration, canning, conveying...) or system type (boilers, chillers, refrigeration compressors...). The Alliance will target the fruit and vegetable (NAICS 3114) and dairy products (NAICS 3115) sub-segments with a combination of technology and business-related solutions.

The emerging technologies group has met once in this quarter to brainstorm the initial list of target technologies. The list of emerging technologies to investigate is complete and comprehensive. That inventory list is attached. Specific content or pointers to locations with the specific content for those technologies is being developed.

Task 4: Prepare and Deliver Content for use through the associations' web sites, e-newsletters, workshops, video-streaming, and other conferences and promotions.

NWFPA will facilitate a teleconference workshop for food processing maintenance personnel in energy efficiency training with assistance from all partners. The workshop will be available to interested parties in up to 15 other Western states. CEC will research their experience with video streaming and educate the partners on how to prepare materials for use in that context for satellite conferences, Web, or e-mail delivery. CEC, Oregon and WSU Energy Program will develop a format for compiling, crediting, publishing and delivering reports useful to the industry. NWFPA and CLFP will identify graphic content needs for presentations, case studies, and Web sites and will manage partners contribution to meet those needs. A case study format was agreed upon and the Motor Challenge two page, four-sided format was selected. A format guide and questionnaire was developed to assure that there is continuity of content in each of the sections of the case studies. Elements of the case study (tables, graphs, photos, headers) are included in the format guide (attached). CEC will develop and distribute streaming video training or promotion clips regarding thermal systems. CEC will provide training or guide other partners to develop similar capabilities.

The task group for dissemination and training has met three times in this quarter. The satellite conference is scheduled for June, 22 2005. The annual conferences of NWFPA and the CLFP are scheduled and the energy efficiency and emerging technology curriculums are being developed. The January 17th 2005 agenda for the industrial efficiency workshop is complete and speakers are committed. The agenda is attached. The workshop is co-located with the Northwest Food Processors Association annual convention. US Department of Energy will partner with the food processing associations to provide some Best Practices trainers at those events. A west coast training calendar for Best Practices and Emerging Technologies is being developed. A preview Web Ex conference for training on the EPRI-PIAC hardening standards for programable logic controllers is scheduled for Monday, November 8, 2004 at 9:45 am, Pacific Standard Time. This call is to finalize the training for widespread distribution for guidelines adoption. The agenda, planned in this quarter, includes the following.

AGENDA

Scope of Work

Review PQ Environment

Introduce Guideline Documents:

FPG-P1 – Defines voltage sag immunity levels

FPG-P2 – Defines voltage sag test methodology

Examples of How to Meet

FPG-P1 Requirements

Expected Benefit

Conclusion/Forward Path

<https://epri-peac.webex.com/epri-peac/j.php?ED=84199907&RG=1>

Task 5: Utility/Management Demonstration

Del Monte will demonstrate the best available technology and applications of Utility Management Systems (UMS) integrated with Enterprise Asset Management (EAM) technologies. Del Monte and LBNL will conduct research, literature search and

technology overview of the state-of-the-art of utility management and enterprise asset management tools. The multiple product features, integration capabilities, systems requirements and other characteristics of those tools will be identified so industry can readily conduct comparative analysis. LBNL will outline the scope necessary to study in detail the standards of production, water and energy efficiency practice for one of the largest food processing sectors.

The Enterprise asset management system project team has been assembled and two meetings held. The work plan is drawn out in detail and is attached. Progress on this task is on schedule and will complete as planned. Vertical integration of the Enterprise Management System with plant process controls will be developed node-by-node. The first plant process or node to be demonstrated is electric lift trucks. Charging systems energy performance, vehicle charges and charge cost per shift per vehicle and real time status for shift charge forecasting are just some of the features to be enabled at the plant and accessible by corporate through EAM. Progress on this task in this quarter includes completion of the RFP for contractor selection for the software. Also specifications for the lift truck monitoring capabilities are finished. Other systems such as boilers, chillers, refrigeration, lighting and conveyance will be added after this first node (electric lift trucks) is proven out.

6. Plans for Next Quarter:

The first priority is to finalize all the subcontracts with partners. On task 1 network, we plan to re-convene the advisory committees of the NWFPA and CLFP to evaluate the Best Practice list, case studies and Emerging Technology strategies. Three coordination meetings of all partners will occur. Each of the task group will meet to plan best practices, emerging technologies, information sharing and the enterprise management system demonstration. Collection of the best practices materials and resources will continue and template data for workbooks and web pages assembled. Several case studies are underway and will be either edited or completed to fit the needs of that portfolio. Finalization of the training calendar and final conference speaker schedules for the January NWFPA and CLFP will be complete to include best practices. An emerging technologies presentation will be considered and designed if indicated.

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INDUSTRIAL ENERGY BEST PRACTICES CONFERENCE (DRAFT)

Learn How to Save Money Now!

January 17, 2005

- | | |
|---------------------|--|
| 8:00 – 8:15:00 a.m. | Welcome & Introductions- Ken Canon (Industrial Customers of NW Utilities), Paula Pyron (NW Industrial Gas Users Association) - invited |
| 8:15- 8:45 a.m. | “Energy Prices.... Powerful Driving Forces”- David Hawk, Nate Carpenter/
- confirmed |
| 8:15 – 10:15 a.m. | Boise Cascade Best Practice Success Stories- David Tobin, Pat Lupin- invited |
| 10:15 – 11:15 a.m. | Weyerhaeuser Best Practice Success Stories- Tom Dunn- confirmed |
| 11:15- 12:00 noon | Frito-Lay Best Practice Success Stories- Rob Schasel or staff - invited |
| 12:00- 1:15 p.m. | Lunch, designated Exhibitor presentations/networking at NW Food Processing Association Annual Exposition |
| 1:15 – 2:15 p.m. | Successes/Lessons-Learned with Best Management Practices-Del Monte (Glen Lewis- confirmed), ConAgra- Mike Henderson or staff invited), NW Energy Efficiency Alliance (Bob Helm or designee-confirmed). |
| 2:15 – 3: 15 p.m. | Industry Panel Session to review Best Management Successes – Intel (Rick Kroon- invited), Micron (), Albertson’s (Scott Moore- invited) |
| 3:15 – 3:30 p.m. | Break |
| 3:30 – 4:30 p.m. | Facilitated plant solution sessions (seek attendees input, suggest solutions and follow-up actions commitments)-Chris Cockrill, USDOE to facilitate-confirmed. |
| 4:30 – 4:45 p.m. | Close and Thankyou’s |
| 4:45 – 6:00 p.m. | Wrap-up Session with Service Provider presentations |

Ball room set up with Table Exhibits by Utilities, State Programs, USDOE- ITP, NEEA, and key selected vendors.

**STAC TASK #4: CONTENT DELIVERY
TASK LIST**

Task List	Deliverable	Lead
A. Web Site		
1. Establish Web Content Work Group	Work Group	NWFPA
2. Identify Content Categories for Web Site	Logic Map for Web Site; List of Content Categories	NWFPA
3. Develop Format for Informational Materials to be posted to the Site.	Format for Materials	NWFPA
4. Identify graphic content needs for Informational Materials and work with partners to achieve.	Graphic Content	NWFPA, CLFP
5. Develop the Web Site.	Web Site at NWFPA, integrated with CLFP, that delivers STAC content	NWFPA, CLFP
6. Provide Content for the Site.	Content to NWFPA, CLFP, CEC	
7. Post materials to the Site and Manage Content.	Content on Web Site	NWFPA
8. Develop an integrated calendar for posting on the Web Site.	Integrated calendar on the web site.	NWFPA
B. Satellite Teleconference – June 16, 2005		
1. Develop curricula/program	Teleconference Program	NWFPA
2. Identify downlink sites and secure some on a tentative basis.	Downlink sites in 10-15 states.	NWFPA
3. Secure speakers.	Teleconference Speakers	NWFPA
4. Secure sponsors/partners.	Teleconference Sponsors/Partners contributing \$ _____.	NWFPA
5. Develop Marketing, Registration, and Program Materials.	Marketing Strategy and Materials, Registration and Program Materials	NWFPA
6. Market the Teleconference	Program Interest and ____ number of Participants	NWFPA
7. Distribute Registration and Program Materials.		NWFPA
8. Register Participants and receive money.	Secure Participants and fees	NWFPA
9. Coordinate Downlink and Catering Arrangements	Broadcast-ready sites	NWFPA
10. Select and Train Downlink Coordinators	Trained Coordinators	NWFPA
11. Conduct Dress Rehearsal	Broadcast-ready Program	NWFPA
12. Conduct Teleconference	Broadcasted Teleconference	NWFPA
13. Coordinate post event follow-up, thank you's, accounting, videos	Certificates, Analysis of Evaluations, Thank you letters	NWFPA
C. Video Streaming Information Sharing		
1. Research experience with video streaming.	Assessment of Video Streaming experience	CEC
2. Provide guidelines for the STAC Partners on how to prepare	Guidelines for video streaming	CEC

Task List	Deliverable	Lead
materials and develop similar capabilities.		
D. Reporting Format for Information Sharing		
1. Develop a format for compiling, crediting, publishing and delivering reports useful to the industry.	Information Sharing Format	John Ryan
E. Four Plant Success Reports		
1. Prepare reports summarizing the implementation of emerging technologies and best practices tools at four plants.	Four Implementation Reports to post to the Web Site	John Ryan
F. Compilation of Energy Savings Tools		
1. Compile energy, other resource and productivity savings estimating tools for easily determining the benefits of best practices and emerging technologies.	Compilation of Savings Tools	Mark Kendall
G. NWFPA Convention Energy Efficiency and Productivity workshops – January 17-19, 2005		
1. Develop curricula/program	Workshops Program	NWFPA
2. Secure speakers.	Workshop Speakers	NWFPA
3. Develop Marketing, Registration, and Program Materials.	Marketing Strategy and Materials, Registration, and Program Materials	NWFPA
4. Market the Workshops	Workshop Interest and ____ number of Participants	NWFPA
5. Register Participants	Secured Participants	NWFPA
6. Conduct Workshops	Workshops	NWFPA
7. Post event follow-up, certificates, evaluations	Certificates, Analysis of Evaluations, Thank you letters	NWFPA
H. CLFP Energy Efficiency and Productivity Workshops – February 2, 2005		
1. Develop curricula/program	Workshops Program	CLFP
2. Secure speakers.	Workshop Speakers	CLFP
3. Develop Marketing, Registration, and Program Materials.	Marketing Strategy and Materials, Registration, and Program Materials	CLFP
4. Market the Workshops		CLFP
5. Register Participants		CLFP
6. Conduct Workshops	Workshops	CLFP
7. Post event follow-up		CLFP
I. Thermal Efficiency Courses		
1. Conduct training courses targeting thermal energy systems – Steam Tools and Resources, Process Heating System Tools and Resources, Process Heating Assessment and Survey Tool (PHAST) Qualification.	Training Courses	CEC
J. Workshops		
1. Voltage Regulation Workshop		Ken Ecklund
2. Open House at Del Monte, Modesto		Glen Lewis

FoodProcessing Industry Resource Efficiency (FIRE) Conference Call – September 15, 2004

**The next team meeting is on Wednesday, October 20th from 9:30am until 11:30 noon Pacific Time, Call-in number: 360 956-2226.
Sample Agenda/Minutes**

PARTICIPANTS

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Glen Lewis, *Del Monte Foods*

Ricardo Amon, *California Energy Commission*

Ann Grim, *Oregon Office of Energy*

Jan Simmons, *Oregon Office of Energy*

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Ed Yates, *California League of Food Processors*

John Ryan, *WSU Energy Program*

Christine Love, *WSU Energy Program*

AGENDA

- **Agenda Review**
- **Review of actions taken since August 3rd conference call**
- **Updates GANTT chart task/leads/ milestone schedules**
- **Group Leads status reports – Group task work underway, deliverables, resource constraints**

- **October WebX Industry Advisory Council kickoff meeting**
- **Contract status report**

NEXT STEPS

- Mark will email the Task 2 one-pager documents to group, and post on FIRE Forum. Will also schedule Task 2 Group conference call sometime during week of Sept 20-24.
- Mark has completed latest changes on project web structure and Best Practices list; will email to group and get posted on Forum.
- Mark will follow up with Pam, Ed, John, AND Ricardo by next week on content for NWFPA/CLFT Industry Advisory Council WebX kickoff meeting.
- Cris Love will email group list of dates that Chris Cockrill has suggested for MSE2000 WEBX conference call.
- Task Group leaders will schedule conference calls with their groups sometime before September ends.
- Jan will check with Mark on copyright status of CEC video work. Ricardo asked if it made sense that the copyright was for the FIRE group, rather than any one entity.

Agenda:

Action Items Review

1. Mark handed over FIRE stationary ideas to Ann Grim, who will come up with some options for our group. Tag Line: "Resource Efficiency through Collaboration" Will email suggestions to group w/in next 10 days. Glen has relationship with Office Dept and offered to use them for printing stationary. All principal partners (i.e. LBL, WSU, Del Monte, CLFP, NWFPA, IDWR, OOE, CEC) authorized to use stationary when representing FIRE efforts.
2. Mark has completed latest changes on project web structure and Best Practices list, and will email to group and get posted on FIRE Forum.
3. Mark drafted an outline of presentation material for NWFPA and CLFP Energy IAC kickoff meeting. Needs some refining. Will f/u with Pam, Ed, John, AND Ricardo by next week.
4. Pam has not yet set a date for the WebX kickoff meeting; likely sometime during third week of October.
5. Acacia has completed one-pagers for Task 2 Group; did a good job on content. Mark still trying to distinguish between fact sheet and website data. The web page will probably just be parts of the fact sheet. Mark will email the documents to group, and post on forum. Will also schedule Task 2 Group conference call sometime next week.
6. Mark also has draft content for business industry practices. Includes current business practice standards (e.g. MSE2000, SIXSIGMA, etc.) – summary of what they are and related web links. Mark will ask Glen to help him flesh out software category. Aimee doing a fair amount of work on this, offered to assist.
7. Pam still trying to schedule the EPRI/PEAC Programmable Logic session at Jan conference. Currently set for Sept 30th; she will keep us informed.
8. John waiting for email from Chris Cockrill suggesting dates for WEBX conference call on MSE2000.
9. John has scheduled a meeting with various NW players to discuss each groups' BestPractices training efforts. Want to make sure trainings compliment each other, rather than overlap.
10. No Task Group conference calls were scheduled during August. Group Leaders have committed to meeting sometime during September.

Gantt Chart Updates

No updates to report this month. Please make sure to send future updates to Cris Love so she can update the master Gantt Chart.

Status Reports

Task 1:

- John has scheduled a NW Training Summit meeting with players from NEEA, USDOE, OR, ID and WA to discuss and coordinate individual BestPractices training efforts.

Task 2:

- Kettle Chips Case Study in final phase. Five other case studies in various production phase: Four are basically done, need technical accuracy review. Fifth one still in beginning stage, has not received pre and post commissioning reports. Waiting on that.
- Current Case Study structure 8 sections as follows:
 1. Executive study/summary (pulled from rest of case study)
 2. Body – background: history of project, how mgmt made decisions on project, who were decision makers, etc.
 3. Project features: focuses on physical characteristics and design
 4. Project benefits
 5. Transferability/replicability: info for reader to decide if technology is good fit for their plant operations.
 6. What a company would want to know if they've decided to use technology – how can they make it work for them. Lessons learned, etc.
 7. Financial details (incentive, tax credit, simple payback, total project costs, equipment, labor, supplies, etc.)
 8. Contacts, resources, etc. to help reader implement their own project.

Originally were considering a separate sidebar section that would cover technology basics. Since potential for this information to be lengthy, maybe a better fit for this material could be content for initial page on web site. Can provide a link in the case study, rather than the sidebar.

Task 3:

- Preliminary work on Emerging Technologies topics done. Aimee will send to group for input.
- Will also schedule a task group meeting during September.

Task 4:

- Pam had first meeting with web guy last week for work on energy portal. Trying to move everything along as rapidly as possible; wants to go live in a couple of months. Web people need a definitive outline of architecture from us. Jeff Goby emailed a copy of the work they did, Pam will forward to web group. As web site design moves forward, Pam will see that FIRE group gets copies of draft screen captures.
- Will set up task group meeting w/in next 2 weeks.

Task 5:

- Glen scheduled task group conference call with Aimee; still moving forward. Work on task.

Contract Status Report

- Five of seven contracts complete: contracts in place, signed, sent everyone copies.
- CEC paperwork still in process, moving along.
- LBNL, new draft looks good on first reading. ODOE will f/u with them to get finalized.

Northwest Food Processors Association

ENERGY COMMITTEE

September 30, 2004

Portland Airport Sheraton 8:00 a.m. – 2:30 p.m.

AGENDA

- 8:00** Call to Order and Welcome – David Hawk, Chair
- 8:10** Energy Costs and Supplies – David Hawk and industry and/or utility representatives
- 9:15** Visit with the NWFPA Board Chairman and President – Rick Fisch, Chairman, Dave Zeponi, President, Brian Brown, Competitiveness Task Force
- 9:30** Report and Discussion of NWFPA Energy Program Activities
- 10:15** **Break**
- 10:30** Northwest Energy Efficiency Alliance Industrial Sector Initiative
- 11:00** Committee Business
Identification and discussion of priority issues
Development of 2005 Priorities for presentation to NWFPA Board on October 1, 2004
- Noon** **Joint Lunch and Program**
- 1:30** Guidelines for Protection of Programmable Logic Controller (PLC) Based Systems –
Web cast presentation by EPRI/PEAC Corporation
- 2:30** Adjourn

Action by NWFPA on
Western States Food Processing Industry Resource Efficiency Initiative
Protection of Programmable Logic Control Systems from
Unplanned Shut Down

The Food Processing Industry Resource Efficiency Initiative includes a joint project of the Idaho Energy Division, Del Monte Foods, and NWFPA to assist the food processing industry in adopting guidelines for protecting PLC systems and to provide training in this technology at the 2005 NWFPA Exposition. The following briefly describes the issue and outlines the steps needed for implementation.

Issue

Programmable Logic Controller (PLC) based control systems are the hubs for a wide variety of automated systems and processes. Common voltage dips on the electrical system can cause Programmable Logic Controller based control systems elements to shut down. Because of system complexity, the task of locating the component that shuts down may take hours or even days, resulting in extensive down-time, lost product and revenue. Repeated events can significantly affect productivity as well as increase labor, energy, and raw materials costs.

Solution

1. Adopt a guideline for improving PLC based control system equipment resistance to voltage drop.
2. Create a database of voltage response for PLC equipment.
3. Train plant staff to:
 - a. Use the data base to choose equipment that meets the guidelines; and
 - b. Audit plant equipment to identify potential shut down triggers.
4. Provide a resource for troubleshooting complex systems with severe problems.

A guideline has already been developed by the EPRI PEAC Corporation for the semi conductor industry that can be imported directly into the food processing industry. EPRI PEAC has also developed and maintains a database for PLC equipment voltage response. EPRI PEAC has a training program and also provides system audits using specially developed voltage simulators.

The Food Industry Initiative is providing EPRI PEAC to NWFPA members through the Idaho Energy Division for consultative assistance in applying the Guidelines and for training at the 2005 NWFPA Exposition.

Process

1. The Guideline is presented to the NWFPA Energy Committee via a web cast meeting this summer (August or September) and provides feedback and recommendations.
2. The NWFPA Energy Committee decides whether to recommend Guideline adoption to the NWFPA Board (September).
3. The NWFPA Board considers adoption of the Guideline at its October 1, 2004 meeting.
4. The Guideline and Training are marketed by NWFPA, working with the Idaho Energy Division (October – January).
5. Training on the Guideline and how to implement it is provided by EPRI PEAC at the 2005 NWFPA Exposition on January 18, 2005.

Emerging Technologies Index Document

Cross-Cutting Technologies

Motors

Motor diagnostics (BAT)

“Emerging Energy Efficient Industrial Technologies report (2000)”

Motor system optimization (BAT)

“Emerging Energy Efficient Industrial Technologies report (2000)”

Lubricants

“Emerging Energy Efficient Industrial Technologies report (2000)”

<http://www.foodproductiondaily.com/news/news-NG.asp?id=2949>

Written-pole motors

“Emerging Energy Efficient Industrial Technologies report (2000)”

http://www.alliantenergy.com/stellent/groups/public/documents/pub/ag_il_ec_blaze_000330.hcsp

Switched reluctance motors

“Emerging Energy Efficient Industrial Technologies report (2000)”

Advanced ASD motors

“Emerging Energy Efficient Industrial Technologies report (2000)”

Bacteria resistant drum motor drives

<http://www.manufacturingtalk.com/news/bdl/bdl100.html>

http://www.foodmanufacture.co.uk/news/fullstory.php/aid/203/Sshhh..._quiet_and_clean_moves.html

Process Heating/Cooling

High-efficiency, high-capacity cooling and refrigeration (BAT)

<http://www.eere.energy.gov/inventions/pdfs/envteched.pdf>

Thermosyphon oil cooling

<http://postharvest.tfrec.wsu.edu/pgDisplay.php?article=PC97P>

Finned tube evaporators

Evaporator fan controller for small applications

<http://www.eere.energy.gov/inventions/pdfs/advrefrig.pdf>

Chiller tube coatings

http://www.eci-ndt.com/tb_m_08.htm

Integrated heating and cooling (BAT)

http://www.caddet.org/public/uploads/pdfs/newsletter/002_09.pdf

Innovative computer control (BAT)

<http://www.caddet.org/infostore/display.php?id=4121>

<http://www.arti-21cr.org/documents/roadmap.pdf>

Ammonia refrigeration systems

<http://www.caddet.org/infostore/display.php?section=1&id=4124>

Insulation of cooling lines

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Improved operation of ammonia cooling system (BAT)

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Improved heat exchanger surfaces

http://www.energy.ca.gov/pier/indust/presentations/2004_02_11_Heat_Exchange.PDF

Low temperature heat recovery

“Emerging Energy Efficient Industrial Technologies report (2000)”

Use of gas engines to power refrigeration compressors instead of electric motors

“Emerging Energy Efficient Industrial Technologies report (2000)”

Thermal storage system: Use of off-peak electricity to generate ice that is stored for later use

“Emerging Energy Efficient Industrial Technologies report (2000)”

Development of new working fluids for compression heat pumps

“Emerging Energy Efficient Industrial Technologies report (2000)”

Waste heat driven chilling technology

http://www.energy.ca.gov/pier/indust/presentations/2004_02_11_Chilling_Tech.PDF

Electrocaloric cooling for refrigeration near room temperature

<http://www.eere.energy.gov/inventions/pdfs/ceramphys.pdf>

New refrigerant

<http://www.etc-nm.com/library/iec98.htm>

Refrigerant additives

<http://www.molecular-solutions.com/JCChanges/PROAProdSum.html>

Evaporator fan variable frequency drives

<http://www.nwalliance.org/resources/documents/VFDSummaryCaseStudyCS.pdf>

Vapor absorption refrigeration

<http://www.engr.sjsu.edu/mae/faculty/homepages/dejong/me182/Absorption%20Refrigeration.pdf>

<http://pib.nic.in/feature/feyr2000/ffeb2000/f080220001.html>

Compressed Air

Improved compressed air technologies/practices (BAT)

<http://www.ecw.org/ecw/infopackagedetail.jsp?infoPackageId=8>

Advanced compressor controls (BAT)

“Emerging Energy Efficient Industrial Technologies report (2000)”

Compressed air system management (BAT)

“Emerging Energy Efficient Industrial Technologies report (2000)”

Pumping Systems

Pump efficiency improvement (BAT)

“Emerging Energy Efficient Industrial Technologies report (2000)”

Steam Generation

Combined heat and power systems

http://www.eere.energy.gov/de/program_areas/euid_combo_prgm.shtml

Cogeneration

<http://www.cogeneration.net/CogenerationExplained.htm>
<http://www.iclei.org/EFACTS/COGEN.HTM>
http://www.jxj.com/magsandj/cospp/2003_02/chp_industry.html

Biomass

<http://www.state.co.us/oemc/biomass/tech.html>
<http://www.calbiomass.org/>
<http://www.eere.energy.gov/biomass/>

Advanced CHP systems

“Emerging Energy Efficient Industrial Technologies report (2000)”

High-efficiency, low NOx burners

“Emerging Energy Efficient Industrial Technologies report (2000)”

Boiler maintenance (BAT)

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Flue gas recovery (BAT)

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Blowdown steam recovery (BAT)

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Steam trap maintenance (BAT)

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Leak repair

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Condensate return

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Improved insulation of steam pipes (BAT)

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Process integration (BAT)

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Innovative combustion systems: Forced internal recirculation boiler, fired process heater system, reboiler

http://www.oit.doe.gov/combustion/pdfs/combustion_brch.pdf
<http://www.oit.doe.gov/combustion/factsheets/superboiler.pdf>

Ultra-low NOx burners

<http://www.oit.doe.gov/combustion/factsheets/nox.pdf>

Fuel cells

“Emerging Energy Efficient Industrial Technologies report (2000)”
<http://www.fuelcells.org>

Microturbines

“Emerging Energy Efficient Industrial Technologies report (2000)”

Advanced reciprocating engines

“Emerging Energy Efficient Industrial Technologies report (2000)”

High-tech electro-chemistry

<http://www.etek-inc.com/inside.html>

Waste water management

Ozone

<http://www.ec.gc.ca/pp/en/storyoutput.cfm?storyid=39>

UV

http://www.energy.ca.gov/process/pubs/photocatalysis_an_ps112464.pdf

Anaerobic Digestion

<http://www.nwalliance.org/projects/projectdetail.asp?PID=43>

http://www.ecovillagefindhorn.com/living_machine/

Membrane

<http://foodsci.unl.edu/fmc/need-06.htm>

<http://www.dow.com/webapps/lit/litorder.asp?filepath=liquidseps/pdfs/noreg/609-00132.pdf&pdf=true>

Product Recovery

<http://foodsci.unl.edu/fmc/7/wastewa.htm>

General

Best practices software tools to improve efficiencies (BAT)

http://www.oit.doe.gov/bestpractices/software_tools.shtml

Power quality improvements (BAT)

<http://www.epriweb.com/public/00000000001009167.pdf>

Advanced lighting technologies (BAT)

“Emerging Energy Efficient Industrial Technologies report (2000)”

Advanced lighting design (BAT)

“Emerging Energy Efficient Industrial Technologies report (2000)”

Process integration (BAT)

“Emerging Energy Efficient Industrial Technologies report (2000)”

Sensor technologies

“Emerging Energy Efficient Industrial Technologies report (2000)”

<http://www.oit.doe.gov/cfm/fullarticle.cfm/id=812>

HVAC

Cogeneration/CHP systems

<http://www.cogeneration.net/CogenerationExplained.htm>

Energy recovery ventilation (BAT)

<http://www.ari.org/pr/2004/04-04-ERVWhite.html>

Geothermal heat pumps (currently applicable for residential purposes)

<http://www.geoexchange.org/>

Dessicant dehumidifiers

<http://www.nrel.gov/desiccantcool/tech.html>

Dual source heat pump

<http://www.pnl.gov/TechReview/heatpump/heatpump.html>

Ultra-high efficiency equipment, smart system integration, indoor environmental quality, new environmentally friendly working fluids

<http://www.arti-21cr.org/documents/roadmap.pdf>

Hi-tech facilities HVAC improvements

“Emerging Energy Efficient Industrial Technologies report (2000)”

Sector and Process Specific Technologies

Fruits and Vegetables

Sorting

Image processing techniques: MRI, ultrasound, computed tomography, electronic tomography

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VHY-4BNVWPP-1&_user=137179&_handle=B-WA-A-A-AU-MsSAYVA-UUW-AUYDVCUBBA-AUYCUBAABA-VAEZYWDDU-AU-U&_fmt=summary&_coverDate=05%2F31%2F2004&_rdoc=3&_orig=browse&_srch=%23toc%236079%232004%23999849994%2

Washing

Washing sanitizer

Ozone

http://www.ift.org/publications/docshop/ft_shop/09-03/09_03_pdfs/09-03-post-processing.pdf

http://www.ift.org/publications/docshop/ft_shop/04-04/04_04_pdfs/04-04-processing.pdf

Fluming

Trimming/peeling

Three stage Versapeel

http://www.foodengineeringmag.com/CDA/ArticleInformation/features/BNP_Features_Item/0.6330.94936.00.html

<http://www.heatandcontrol.com/news/articles/versapeel.htm>

Coring

Blanching

Turbo-Flo

<http://www.oit.doe.gov/nice3/factsheets/key.pdf>

Steam seals, insulation, heat-and-hold techniques, forced convection

<http://foodsci.unl.edu/fmc/10blanch.htm>

Steam recirculation

<http://www.caddet.org/infostore/display.php?id=3588>

Microwave, pulsed-electric field, UV radiation, ultra-high pressure

<http://foodsci.unl.edu/fmc/10blanch.htm>

High-pressure

http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VHY-49S7YBX-2&_user=137179&_handle=B-WA-A-A-AA-MsSAYWA-UUW-AUYDVCUBCBZ-AUYCUBAACZ-VAEZYBUVD-AA-

[U&_fmt=summary&_coverDate=02%2F29%2F2004&_rdoc=5&_orig=browse&_srch=%23toc%236079%232004%23999849997%2](http://www.usda.gov/oc/foia/summary/coverDate=02%2F29%2F2004&_rdoc=5&_orig=browse&_srch=%23toc%236079%232004%23999849997%2)

Ohmic and inductive heating, high voltage arc discharge, pulsed light technology, oscillating magnetic field, X-Rays

USFDA Center for Food Safety and Applied Nutrition, 6/2/2000

Ionizing radiation

<http://www.icfi.org/safetyofirrfod.php>

Electrolyzed water

http://www.enn.com/news/enn-stories/2000/08/08312000/electolyzed_31024.asp?P=2

Mixing

High-pressure homogenizers

http://www.foodengineeringmag.com/CDA/ArticleInformation/features/BNP_Features_Item/0,6330,120389,00.html

High-shear mixers

<http://www.silverson.com>

Heating

Enzymatic additives

http://www.ift.org/publications/docshop/ft_shop/04-04/04_04_pdfs/04-04-willrett.pdf

Evaporation/drying

Heat pump dryer

“Emerging Energy Efficient Industrial Technologies report (2000)”

http://www.caddet.org/public/uploads/pdfs/newsletter/974_01.pdf

Mechanical steam compression dryer

http://www.cenerg.ensmp.fr/francais/innov/pdf/ICR0143SLV%20_IIR_IIF%20Conf.pdf

Refractive window technology

<http://www.mcdtechnologiesinc.com/WSU - Final Report 1st grant.doc>

Pervaporation

<http://www.cheresources.com/pervaporation.shtml>

Infrared dryers (flameless and catalytic)

http://www.energy.ca.gov/pier/indust/presentations/2004_02_11_Infra_Red_Drying.PDF

Supercritical Fluid Extraction

http://www.ift.org/publications/docshop/ft_shop/09-03/09_03_pdfs/09-03-post-processing.pdf

http://www.chemicalprocessing.com/Web_First/cp.nsf/ArticleID/DPIC-4LKLWX/

Membrane technology: reverse osmosis, electrodialysis, microfiltration, ultrafiltration

“Emerging Energy Efficient Industrial Technologies report (2000)”

Freezing

“Emerging Energy Efficient Industrial Technologies report (2000)”

Osmotic dehydration

<http://www.uoguelph.ca/~odmlm/>

Extraction

Concentration

Canning

Preservation Additives

Biopreservatives

http://www.ift.org/publications/docshop/ft_shop/02-04/02_04_pdfs/02-04-draughon.pdf

Nanotechnology

http://www.ift.org/publications/docshop/ft_shop/01-04/01_04_pdfs/01-04-rudolph.pdf

Exhausting (reducing pressure in can)

Storage preservatives

Ozone

http://www.energy.ca.gov/process/pubs/OZONE_AQUEOUS.PDF

Quarantine pre-heating

<http://www.goodfruit.com/link/Nov-98/feature6.html>

Labeling

Packing

Airliner packaging

<http://www.lbl.gov/Science-Articles/Archive/airliner-packaging.html>

Advanced Modified Atmospheric Packaging (MAP)

<http://postharvest.tfrec.wsu.edu/pgDisplay.php?article=PC2000X>

http://www.foodengineeringmag.com/CDA/ArticleInformation/features/BNP_Features_Item/0,6330,94839,00.html

Freezing

Cryogenic impingement in freezers

http://www.foodengineeringmag.com/CDA/ArticleInformation/features/BNP_Features_Item/0,6330,95001,00.html

Dairy

Receiving

Directed infrared heating for receiving bay

Canadian Dairy Report (1997)

Filtration/fractionation

Membrane system for preconcentration of milk products

Canadian Dairy Report (1997)

Bactofuge

http://www.ust.is/media/skyrslur2002/BAT_mjolkuridn_2001-586.pdf

Membrane technology: reverse osmosis, electro dialysis, microfiltration, ultrafiltration

“Emerging Energy Efficient Industrial Technologies report (2000)”

Freeze Concentration

“Emerging Energy Efficient Industrial Technologies report (2000)”

Supercritical Extraction

“Emerging Energy Efficient Industrial Technologies report (2000)”

Refrigeration

Expert computer control systems

Canadian Dairy Report (1997)

Separation

Standardization

Ultrafiltration

http://www.ust.is/media/skyrslur2002/BAT_mjolkuridn_2001-586.pdf

Additivation

Homogenization/churning

Fluid handling technologies

<http://www.foodproductiondaily.com/news/news-NG.asp?id=52382>

Thermal treatment

Non-thermal pasteurization methods: Microfiltration, High-Hydrostatic Pressure, Electrical Field Effects
Canadian Dairy Report (1997)

Electron beam sterilization

“Emerging Energy Efficient Industrial Technologies report (2000)”

Ohmic and inductive heating

USFDA Center for Food Safety and Applied Nutrition, 6/2/2000

Microwave pasteurization or sterilization

USFDA Center for Food Safety and Applied Nutrition, 6/2/2000

High-voltage arc discharge

USFDA Center for Food Safety and Applied Nutrition, 6/2/2000

Oscillating magnetic fields

USFDA Center for Food Safety and Applied Nutrition, 6/2/2000

Ultrasound

USFDA Center for Food Safety and Applied Nutrition, 6/2/2000

Ionizing radiation

<http://www.icfi.org/safetyofirrfood.php>

Freezing

Cryogenic impingement in freezers

http://www.foodengineeringmag.com/CDA/ArticleInformation/features/BNP_Features_Item/0,6330,95001,00.html

Fermentation

Cooling

Efficient cooling systems

“Emerging Energy Efficient Industrial Technologies report (2000)”

Packaging

Advanced Modified Atmospheric Packaging (MAP)

<http://postharvest.tfrec.wsu.edu/pgDisplay.php?article=PC2000X>

http://www.foodengineeringmag.com/CDA/ArticleInformation/features/BNP_Features_Item/0,6330,94839,00.html

Cutting

Salting

Salt infusion system

Storage

Air-conditioned, temperature controlled environment (BAT)

http://www.ust.is/media/skyrslur2002/BAT_mjolkuridn_2001-586.pdf

Just-in-Time (JIT) Dairy Manufacturing Concept

“Canadian Dairy Report (1997)”

Use of edible whey protein as barrier films in storage and transportation

http://www.extraordinarydairy.com/archive/fs_edible_film.pdf

Cheese processing

Automated filling control to eliminate over-filling (BAT)

“Canadian Dairy Report (1997)”

Automated temperature controls to ensure no excess cooking (BAT)

“Canadian Dairy Report (1997)”

Making cheese from buttermilk via ultrafiltration

<http://www.ausingred.com.au/article.asp?articleID=163>
http://www.ust.is/media/skyrslur2002/BAT_mjolkuridn_2001-586.pdf
Antimicrobial Preservative Improves Shredded Cheese Quality and Shelf Life
http://www.extraordinarydairy.com/c_1_kfeaturearticle_20031018.asp
Producing Mozzarella-Style Cheese the Vatless Way
http://www.extraordinarydairy.com/c_1_kfeaturearticle_20031021.asp

Fruit/Flavor Addition

Gene enhancement technologies for better flavor
<http://www.tomorrowsbounty.org/library/dairy.htm>
Lactose free antioxidants, enzymes to reduce cholesterol or enhance flavor
http://www.extraordinarydairy.com/archive/innov_018_july_03.pdf

Evaporation/Drying

Vacuum Superheated Steam Drying (VSSD)
“Canadian Dairy Report (1997)”
Pulsed Drying Systems
“Canadian Dairy Report (1997)”
Condi-cyclone dryers
“Emerging Energy Efficient Industrial Technologies report (2000)”
4 or more effect evaporator
“Emerging Energy Efficient Industrial Technologies report (2000)”

Molding

Encapsulation

Whey protein-based microencapsulating agents
http://www.extraordinarydairy.com/archive/fs_whey_microagents.pdf

General

Product/Water/Chemical Interfaces- optical interface detection unit to prevent losses (BAT)
“Canadian Dairy Report (1997)”
Expert computer control systems
“Canadian Dairy Report (1997)”
Exploring the Relationship between Dairy and Probiotics
http://www.extraordinarydairy.com/c_1_kfeaturearticle_20031017.asp
Chromatographic whey treatment
http://www.ust.is/media/skyrslur2002/BAT_mjolkuridn_2001-586.pdf
Use of sensory technologies to determine off-flavor causes
http://www.extraordinarydairy.com/archive/innov_018_july_03.pdf

Culturing

Active bacterial control in starter culture area to reduce potential contamination and losses
“Canadian Dairy Report (1997)”
Phage-resistant cultures
<http://www.tomorrowsbounty.org/library/dairy.htm>

CIP

Recycle system on chemical washing solution to reduce heating requirements (BAT)
“Canadian Dairy Report (1997)”
Enzyme-based cleaners to improve CIP operations
“Canadian Dairy Report (1997)”

Beverage – Breweries

Water pre-treatment

Milling

Mashing

Wort separation

- Capture of waste heat energy (BAT)

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

- Use of compression filter (mashing)

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Wort boiling

- Heat recovery using vapor condensers (BAT)

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

- Steinecker Merlin system

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

- Wort stripping systems

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

- Continuous wort boiling

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Hop straining (filter)

Wort filter and recovery

Wort cooling

- Additional heat recovery from wort cooling (BAT)

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Fermentation

- Heat recovery (BAT)

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

- Immobilized yeast fermenter for accelerating fermentation

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

- New CO2 recovery systems

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

First Storage Tank

Yeast Removal

Carbonation

Second storage tank

Beer filtration

- Crossflow filtration system

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

- <http://www.alfalaval.com/ecoreJava/WebObjects/ecoreJava.woa/wa/showNode?siteNodeID=3301&contentID=31152&languageID=1>

- Hydroclones

- “Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Chill proofing

Ultrasonic separation

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Bottle washing

Heat recovery in bottle and keg washing (BAT)

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Cleaning efficiency improvements (BAT)

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Filling

Pasteurization

Heat recovery in pasteurization (BAT)

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Sterile filtration

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

<http://www.alfalaval.com/ecoreJava/WebObjects/ecoreJava.woa/wa/showNode?siteNodeID=3301&contentID=31152&languageID=1>

Ultra-high pressure sterilization

“Energy Efficiency Improvement and Cost Savings Opportunities for Breweries”

Labeling and Packing

Beverage – soft drink

Filtration

Membrane technologies

http://www.gewater.com/library/tp/718_Using_Nanofiltration.jsp

http://www.foodprocessing.com/Web_First/fp.nsf/ArticleID/LKIE-4LYM98?OpenDocument&Click=

Beverage – wineries

Sterilization

Electrodialysis

http://www.energy.ca.gov/process/pubs/MEMBRANE_APP_GRAPE.PDF

<http://winebusiness.com/html/SiteFrameSet.cfm?fn=../Archives/Monthly/1996/9605/bm059612.htm>

http://www.energy.ca.gov/pier/indust/descriptions/500_02_001.html