



ENGINEERING, AUTOMATION
and DESIGN, Inc.



Food Processing without Contamination during Construction

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Executive Summary

This white paper is addressed to the managers and operators of food processing plants that may be considering additions or modifications to their plant. To show the importance of contamination control in food plants the contamination control measures in a hospital's Operating Room (OR) are compared to those in a food processing plant. The special measures required to avoid contamination of the food product while the plant is operating during construction are described. Training, the use of sign-off checklists and monitoring protective enclosure integrity are emphasized to assure compliance with Food current Good Manufacturing Practice (GMP) and HACCP plans. Guidance is provided on what to look for when hiring an engineer/constructor team to assure that the construction will proceed without food contamination.

Introduction

Operating a food processing plant is very challenging under perfect conditions. Levels of cleanliness, sanitization and contamination control must be maintained that rival or exceed those required in a hospital (OR).

In an OR a failure of process standards for contamination control could result in complications for the patient or possibly even death. This would be an unfortunate and unacceptable outcome.

In a food processing plant a failure in the contamination control processes could result in sickness for hundreds or thousands of people or even death for tens or hundreds of people. It's an order of magnitude more serious issue than in the OR. And unlike the OR issue, the food processing plant failure will become headline news for all media and will result in the withdrawal of the product from the market, law suits, citations and fines by the FDA, USDA, possible congressional investigations and significant financial consequences for the parent company.

If this is the case under normal conditions, imagine how more challenging the plant operation becomes when food processing continues during construction. It would be like adding an extension to the OR while the OR continues to operate on patients. Something the public can't imagine but a situation that food processing plants must face unless production can be halted for the duration of the construction. This is rarely possible for both economic and supply and demand reasons.

Contamination control requirements in a food processing plant equal or exceed those in a Hospital Operating Room

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So, what are the steps that must be taken by the plant in conjunction with its selected engineering/construction partner to ensure continued operation without contamination?

Engineering/Construction Requirements for Food Processing without Contamination during Construction

Completing a construction project at an operating food processing plant is a complicated and detailed task. It involves activities above and beyond those normally associated with construction projects at non-food industrial plants. To ensure success without contamination, both the plant operator and the selected engineer/constructor must understand and implement Food Current Good Manufacturing Practices (21 CFR Part 110) (GMP). The key factors that ensure successful completion of a construction project at an operating food processing plant are described in this white paper.

Key factors for successful completion of construction at a food processing plant

Engineering/Construction of additions or modifications including lessons learned

As with any industrial construction project at an operating plant, the engineering for an addition or modification to a food processing plant starts with a conceptual design followed by:

Standard engineering steps

- Physical layout of the mechanical and electrical systems
- Equipment selection and sizing
- Structure and foundation design
- Creation of construction drawings
- Planning of construction activities so that the plant operation is not disrupted.

But in the food industry there is an additional layer of activities dictated by the food process itself. This is required to ensure that the construction does not contaminate the food and involves the preparation and implementation of food safety training, safety checklists, specialized construction procedures and audit procedures. These steps go far beyond the customary OSHA and journeyman training.

Additional steps required in food industry

1. Training – Contractors

Ideally contractors and maintenance personnel with prior food industry experience should be selected for the project, preferably with SQFI training. However, this not always possible. Therefore, workers new to the food industry must be given general food industry orientation training. Both experienced and new workers must be given training that is specific to the site because no two food processing plants even in the

Training of contractors key

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same industry working with the same product are identical. If the plant has its own written contractor work rules they should be included in the site specific training.

A HACCP program specific to each project site must be developed and personnel trained in it. The food plant must validate the HACCP plan and all project personnel must be trained in what HACCP means and how it will be implemented at the site.

This training should be conducted by personnel from the food plant or the engineering firm that are SQF certified practitioners and written training materials should be provided to all trainees. Documented competency testing should be administered. A SQFI certified third party training body should be considered.

This training is not a onetime effort but should be reinforced with weekly toolbox and safety talks. Disciplinary methods must be implemented for deliberate violation of safety rules.

Fundamental to all food safety plans is the Food Current Good Manufacturing Practices (CGMP) as laid out in 21 CFR 110. While this is intended primarily for operators of food processing plants, the principles apply to construction activities in operating plants. Contractors should be trained in the pertinent sections of 21 CFR 110 that deal with food contamination from the following sources

- Physical
 - Grinding/Welding debris
 - Foot traffic
 - General construction debris
- Chemical
 - Painting/Odors
 - Solvents
 - cutting oils
- Microbiological
 - Debris shaken loose from construction activities
 - Drain Backups
- Other from lessons learned at this site and others

*Training not one
time effort but
ongoing*

*Food current Good
Manufacturing
Practices*

2. Safety checklists

With the best intentions in the world construction workers will not remember all of the steps required to work safely in an operating food

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*Safety checklist key
to contamination
control*

processing plant no more than the pilot of a 747 can remember all of the steps required to take-off or land safely. The pilot uses a checklist not because he's incompetent but to guarantee the safety of his passengers. Likewise, the construction crews in an operating food processing plant use checklists to ensure the safety of the consumers of the food produced in the plant. Some of the checklists used are:

- Pre-Construction Checklist/Walk-thru
- Audit Checklist during construction
- Start Up Safety Checklist/Walk-thru

3. Pre-Planning of Work

*Work pre-planning
with contamination
control in mind
essential*

In a typical non-food industrial plant pre-planning the work for a modification or addition involves ensuring that the construction does not interfere with the operation of the plant and that materials and equipment can be brought into the plant and stored until needed. All of these steps are required for a food processing plant but in addition food safety measures must be added. The following additional steps are needed in an operating food processing plant

- Setting up a HACCP team including members of the plant's staff
- Develop Safe Plans of Action to avoid food contamination
- Using Lessons Learned from previous work experience to plan work

To effectively perform these work pre-planning activities protection levels throughout the plant must be identified.

4. Identification of Levels of Protection by Plant Area

*Contamination
control measures
keyed to plant area
protection
requirements*

Each area of the operating food processing plant in which construction is planned has unique protection requirements. These must be identified and included in the construction plan and included as Critical Control Points in the HACCP plan.

The first step is to identify, in conjunction with the plant operator, the areas in the plant by activity and the protection required. The plant Owners/Operators may perform this step themselves or in conjunction with the engineer/constructor. The following areas need to be addressed:

- Raw Goods and Ingredients – Grains
- Raw Goods and Ingredients – Meats
- Raw Goods and Ingredients – Fats, Oils and Other Liquids
- Wet Processing

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- Dry Processing
- Cooking/Drying
- Coating
- Packaging
- Warehouse
- Utilities
- Building Exterior and Grounds

Within each of the food processing areas the following sub-areas or zones need to be identified. The following is an example of how these zones could be designated:

- Zone I – Food Contact Surfaces
- Zone II – Within 3' of Food Contact Surfaces
- Zone III – Outside 3' of Food Contact Surfaces

Once these steps have been completed, a plan of the plant should be prepared that identifies for each area and zone within that area what level of protection is required for personnel, equipment and machinery. A set of mutually agreed upon codes should be used to uniquely identify each area and zone. Then provisions for enclosures and hygienic segregation must be developed to implement the required protection levels.

5. Enclosures and Hygienic Segregation

*Enclosures integrity
control important.
Breaches serious –
must be reported*

Enclosures are used to keep things out and to keep things in. Keep construction contamination out of the food processing areas and keep food processing materials out of the construction area; keep contractors, material and equipment in the construction area and to control traffic between the two areas. The following types of enclosures may be used depending on the area and level of protection required:

- Tarps
- Stud Walls w/plastic sheeting 1 side
- Stud Walls w/plastic sheeting both sides
- Stud Walls w/Masonite sheeting & plastic
- Sloped roofs (if required) on containment area to allow water, food debris and dust particles to run off the containment

Consideration must be given to how to protect the areas when contractors are not present. One method is the provision of field constructed windows in the containment tarps or walls to allow plant personnel to look into construction areas without entering the construction area.

There may be plant personnel, equipment and material movement

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around the protected areas and there may be contractor personnel, equipment and material movement into and out of the protected areas. Critical Control Points need to be established for these movements. Transition zones, such as airlocks, may be needed to provide isolation between the construction area and the protected area to permit these movements and to accommodate contractor check in areas.. Swabbing and testing locations must be established.

There are usually some waste materials associated with construction projects from demolition work or construction activities. Provisions must be in place for handling such materials and moving them from and possibly through the protected area. All such waste should be considered contaminated and tested to determine how they should be handled.

The integrity of the enclosure/containment must be monitored on a daily basis and any damage or breaches repaired. Any breaches should be documented and reported both to plant supervision and to the engineer/contractor project manager. The cause for the breach must be established and eliminated where possible. It could be that a plant operator needs to get into the segregation every day in order to operate equipment or valves. If that is the case, the enclosure/segregation should be modified if possible to prevent such breaches.

A checklist with signature locations for the plant owner/operator and engineer/constructor should be used for documenting these integrity inspections.

Continuous sanitizing of personnel, equipment and materials intrinsic part of working in food industry

6. Sanitizing Personnel, Equipment and Materials

When contractors must enter or pass through a food protected area to access the construction area they must take the following precautions:

- All personal equipment (tools) must be sanitized prior to entering plant and prior to removal from work area
- Bring in only tools needed for the job. Don't bring in tool boxes.
- Sanitize the tools....tool wash sinks, sanitizing wipes, captive tool program
- Document tool cleaning
- Swab and test tools as needed

Procedures must be established for sanitizing heavy equipment.

Fumes and odors from vehicles and material must be controlled to protect food and personnel

7. Associated fumes and odors from traffic, tools and materials

Vehicles, tools and materials used in construction can produce fumes and odors that can contaminate food and cause illness in workers. The

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following measures must be taken to prevent such fumes and odors from contaminating food or causing worker illness

- Ventilation to the outside air away from any plant air intakes for vehicles going to/from construction areas
- Consider using only propane fired vehicles inside the building
- With vehicles inside containment, need to monitor CO to prevent worker illness
- Adequate ventilation is required for paints, caulks, solvents, epoxies and other coatings can produce odors that can overwhelm workers and can taint food on nearby production lines.
- Welding smoke can also produce odors that can overwhelm workers and can taint food – smoke-eaters can help filter particulates and carbon filters can help remove odors. Adequate ventilation should be provided
- Ensure the HVAC is designed to prevent pockets of fumes or gases from collecting in spaces that could overcome workers
- Vent or control exhausts and any vaporized operating oil from air tools that can carry contaminants

Designated route for material flow into, out of and through plant must be laid out

8. Material Flow

During construction materials and equipment will be moving constantly in and out of the plant. In order to control contamination a designated route(s) must be developed from the plant entry point to the construction area(s). This route must be reviewed and approved by plant operations and maintained and sanitized by the plant or tradesmen. Any open food streams along the route must be protected. This may require additional hand/foot/equipment/material sanitizing requirements and sanitizing locations.

If soils must be transported through the plant covers must be used on buggies and the wheels must be sanitized when leaving the construction area. Material spotters who move in front of the loads should be used to guide the loads through the plant.

Critical Control Points should be established along the designated materials path.

The planned designated route for materials through the plant must be assessed on an ongoing basis because conditions in the plant may change. The plan should be documented and be posted in the contractor area. Assessments of the plan should also be documented. And finally the route should be marked throughout the plant and this marking must be updated depending on the results of the ongoing plant assessments.

CCP points must be established

*Use JIT for
fabrication materials*

a. Fabrication & Laydown

Fabrication materials constantly arrive at the plant and need to be stored prior to being used. To minimize on site storage requirements, Just in Time (JIT) methods should be used when possible. Materials may be stored outside or inside depending on the nature and size of the items.

Outside storage of fabrication materials should be limited to large items only and items should be handled as follows:

- Items should be clean of all food debris
- Stored equipment should be contained/covered
- Equipment should be placed on cribbing/pallets
- Equipment should be monitored for rodent/pest activity

Smaller fabrication items should be stored inside unless there is no laydown area available. In this case they could be stored in tractor trailers outside. Inside storage areas should be:

- Tarped or designated w/ temporary barricades
- Monitored for accumulation of food dusts/debris
- Cleaned and sanitized as necessary
- Scheduled for inspection by sanitation
- Lit by temp lighting as required
- Provided with plastic cribbing to store items for sanitation purposes

In the fabrication area the following procedures should be followed and the responsibility established for who is conducting the inspections to maintain a food personnel safe environment.

- Fabrication Areas
 - Area tarped to contain debris generated by fabrication activities
 - Area monitored for accumulation of food dusts/debris
 - Area cleaned and sanitized as necessary
 - Area scheduled for inspection by sanitation
 - Temp lighting installed as req'd
 - Items staged on plastic cribbing for sanitation purposes
 - Welding barricades/shades usage.
 - Temporary ventilation and/or smoke eaters as required to eliminate fumes from welding or painting
- Inspect arriving equipment for possible infestation
- Sanitize new equipment coming into the plant
- Plan for an equipment sanitizing and drying area

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- Remove wood cribbing prior to bringing new equipment into the plant
- Document sanitizing

Clean up in food plant far more extensive than in typical industrial plant

9. Clean-up prior to start-up

When the construction has been completed the contractor's job is not done. There is still much to be done to render the new facility section fit for food processing. This goes far beyond the normal post construction industrial project clean-up. It starts with the normal contractor broom, brush and mop clean up of the construction area.

All equipment that was worked on during the construction must be tagged and the tagging must be documented. The tagged equipment must be sanitized, swabbed, tested and, if necessary, re-sanitized.

The segregation enclosure walls must be sanitized prior to removal and decisions made as to whether the components such as metal studs and other non-porous materials can be re-used.

Special sanitizing methods must be used for non-wash down equipment such as electrical devices and switchgear. Alcohol based sanitary wipes can be used for the electrical equipment. Sanitizing of other equipment may require superheated steam, CO₂ blasting or dry ice.

10. Testing in Production Areas – Swabs, Number of tests

Testing production areas for contamination after clean up essential

After the cleanup has been completed the production areas must be tested to ensure that they are ready for production. A 3-D grid for the production area should be established and testing locations specified. Swab locations should include the traffic paths and the main entrances and exits from the construction area. The number of swabs to be taken from an area should have been defined prior to the start of the project. Food samples and air samples must be taken and non-food contact surfaces must be tested.

If during this testing process an area is judged to be contaminated and is re-sanitized It must be re-tested. It is critical that the number of tests required before an area is deemed suitable for production be established by the plant food safety department.

What to Look for in an Engineer/Constructor for Food Processing Plant Construction/Modification Projects

What to look for

The key factor to consider when selecting an engineer/constructor is previous

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*when selecting
engineer/constructor
for food plant*

experience in the food industry ideally in the type of plant under consideration.

The other factors which should be considered are:

- Principals or top management with food industry backgrounds
- Long-term clients in food industry
- Testimonials from satisfied clients
- Integrated team consisting of engineers and constructors under the same management to minimize handoffs and communication problems
- Team qualifications – food industry background preferred
- HACCP certification – what percentage of team is HACCP certified
- SQF practitioners on staff in sufficient number to cover all projects
- How Engineer/constructor works with plant. Is it an us and them relationship or we?
- Contractor Hiring criteria – food industry experience more important than training
- Project managers to monitor FDA, USDA requirements to ensure compliance
- Training of contractors in Food cGMP

*EAD has what it
takes to serve the
food industry*

About EAD

The company was founded in 2001 on food plant work at local plants. Both the president and vice-president come from engineering backgrounds directly tied into food processing. Initially they each provided engineering services to food processing facilities on a full time basis. When the construction arm was added, the Project Managers worked directly for them. As the firm grew in size, engineers with vast knowledge and backgrounds in food processing were brought on board. Currently 90% of the staff are HACCP certified and there are 2 GMP practitioners in house.

EAD consists of four arms - EAD Engineering LLC, EAD Constructors Inc., EAD Control Systems LLC, and EAD Management Services Inc. They work together to provide the client with a turnkey solution. This allows efficient communications between EAD Engineering and Constructors which minimizes handoffs, and eliminates constructability issues.

*EAD views itself as
an extension of
client's staff and acts
accordingly*

EAD regards itself as an extension of the client's staff rather than an outside

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entity – not us and them but we. Accordingly, EAD requires that all client phone calls be returned within one hour even if it is to say that the call has been received and is being acted on.

Contact information

Many of our clients have been with the firm since its inception. Due to the confidentiality of our business, a client list can be provided on request.

To learn more about EAD food industry construction experience call Ryan C. Amys, Industrial Pre-Construction Project Manager, EAD Construction or Bradley A. Weckerlin, EAD Engineering at 402-884-8650.