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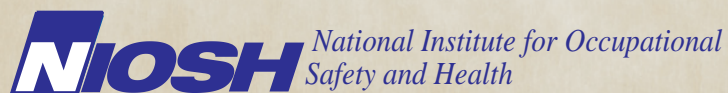
# Confined Space Program Recommendations for Dairy Plant Inspectors – Nationwide

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Health Hazard Evaluation Report  
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DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention



**The employer shall post a copy of this report for a period of 30 calendar days at or near the workplace(s) of affected employees. The employer shall take steps to insure that the posted determinations are not altered, defaced, or covered by other material during such period. [37 FR 23640, November 7, 1972, as amended at 45 FR 2653, January 14, 1980].**

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## ABBREVIATIONS

CFR	Code of Federal Regulations
HHE	Health hazard evaluation
IDLH	Immediately dangerous to life and health
MSDS	Material safety data sheet
NAICS	North American Industry Classification System
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PPE	Personal protective equipment

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# HIGHLIGHTS OF THE NIOSH HEALTH HAZARD EVALUATION

**The National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from a manager of a federal agency to assess potential hazards encountered by the federal agency's dairy equipment inspectors during entry into confined spaces. The requestor was concerned about the potential risk of oxygen deficiency and off-gassing of cleaning and disinfection products during equipment sanitation surveys in dairy plants.**

## ***What NIOSH Did***

- We visited two dairy plants in March 2011.
- We learned about typical dairy plant processes and equipment.
- We observed equipment sanitation surveys and reviewed survey forms.
- We reviewed a draft confined space program provided by the federal agency.
- We reviewed the confined space entry program at one of the dairies.
- We interviewed seven of 13 equipment inspectors about confined space entries. We asked them about their entry procedure, how often they entered confined spaces, confined space training, and if they had any work-related health or safety concerns.

## ***What NIOSH Found***

- Partial and whole body entries into permit-required confined spaces are common.
- Equipment inspectors rely solely on the dairy plant's confined space entry program for their safety.
- Equipment inspectors may not wear the proper personal protective equipment even when it is required by the dairy plant.
- Dairy plants do not always inform equipment inspectors of their confined space program or rescue procedures.
- Some dairy plants do not perform air monitoring before or during entry into confined spaces.
- Equipment inspectors do not undergo annual training for confined space entry. When training is provided, it is not always relevant to the hazards of the dairy industry.
- The draft confined space entry program provided by the federal agency was not complete. The program did not give specific information about confined space hazards or how to protect oneself when entering confined spaces in the dairy industry.
- Equipment inspectors reported no injuries or health concerns related to entry into confined spaces.

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# HIGHLIGHTS OF THE NIOSH HEALTH HAZARD EVALUATION (CONTINUED)

## ***What Managers Can Do***

- Treat all confined spaces as permit required.
- Create specific confined space training for equipment inspectors in dairy plants.
- Require all equipment inspectors to take annual confined space training.
- Provide equipment inspectors with full body harnesses, lockout/tagout locks, confined space air monitors, and intrinsically safe flashlights.

## ***What Employees Can Do***

- Take annual confined space training.
- Review information about the plant's permit-required confined spaces before your visit.
- Use appropriate safety equipment during equipment sanitation surveys. This should be done regardless of the dairy plant's requirements.
- Review rescue procedures before making a full body entry into a confined space.
- Ask dairy plants to follow proper procedures for confined space entry.
- Monitor the air before making a confined space entry.

**NIOSH was asked by a federal agency to evaluate potential hazards encountered by its equipment inspectors during confined space entry in dairy plants. Confined space programs were also reviewed. We found potential exposures to oxygen-deficient atmospheres, chemical disinfectants, and mechanical hazards. We determined that the agency's draft confined space program was insufficient and should be tailored to equipment inspectors in the dairy industry. Recommendations were made to minimize confined space hazards.**

NIOSH investigators evaluated a federal agency's confined space program for equipment inspectors in dairy plants on March 1–2, 2011, after receiving a request from the agency's health and safety manager. The requestor was concerned with potential exposures to oxygen-deficient atmospheres and off-gassing of cleaning and disinfection products during equipment sanitation surveys in dairy plants. No health concerns were specifically reported. We toured one dairy plant on March 1, 2011, to learn about dairy plant processes and equipment. We evaluated typical procedures during an equipment sanitation survey on March 2, 2011, at a second dairy plant. We also reviewed the agency's draft written confined space program and interviewed equipment inspectors about their confined space practices and work-related health and safety concerns.

We learned that dairy plants within the United States are increasing in size, which usually means more confined spaces in a plant. We observed six partial permit-required confined space entries (head and arm/hand into a vessel manhole for less than a minute) by an equipment inspector. We also observed several inspected pieces of equipment that were not confined spaces. The equipment inspector was accompanied at all times by plant personnel and usually wore a lab coat, safety glasses, hearing protection, bump cap, and a hair net, and used a high-intensity portable flashlight.

We found the agency's draft confined space program hard to understand because much of it was written using legal jargon. Also, the program was not specific to the dairy industry and did not include rescue procedures in case of an emergency during an equipment sanitation survey.

Our interviews with equipment inspectors revealed that they routinely entered permit-required confined spaces during equipment sanitation surveys but were not always familiar with the permit-required confined space and rescue procedures of the dairy plants. Although equipment inspectors usually wore the PPE required by the dairy plant they were inspecting, we observed instances where equipment inspectors did not follow all of the plant's requirements (for example, not wearing safety glasses or a bump cap when entering a confined space).

We recommend that the equipment inspectors obtain information about the plant's permit-required confined spaces before visiting a

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## SUMMARY

### (CONTINUED)

dairy plant. This may include, but is not limited to, a copy of the plant's written confined space entry program, recent calibration of the plant's confined space air monitoring equipment, and information on confined space emergency and rescue plans.

We recommend that the agency tailor its confined space program to the equipment and hazards found in the dairy industry, including rescue procedures. The agency should provide equipment inspectors with adequate PPE, calibrated air monitors, and yearly training in confined space entry specific to the dairy industry. Equipment inspectors should follow plant PPE requirements and permit-required confined space procedures during equipment sanitation surveys. We recommend that equipment inspectors use a bump cap with a chin strap, safety glasses, and intrinsically safe flashlights. Inspectors should also have lockout/tagout locks and full-body harnesses.

Keywords: NAICS 926140 (Regulation of Agricultural Marketing and Commodities), confined space, chlorine, survey, dairy products, oxygen deficiency, cleaning products, disinfection products, mechanical hazards



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## INTRODUCTION

On March 1-2, 2011, we responded to a request for an HHE from the health and safety manager of a federal agency. The requestor was concerned about partial and full entries into confined spaces during equipment sanitation surveys in dairy plants and about potential hazards including oxygen deficiency and off-gassing of cleaners and disinfectants. No specific health concerns were reported. The agency had 13 equipment inspectors nationwide who visited different dairy plants throughout the year; each equipment sanitation survey lasted 1-3 days.

We visited two dairy plants to learn about typical processes and equipment and to observe activities during a typical equipment sanitation survey. We also interviewed six equipment inspectors by phone to ask about confined space entry practices, confined space training, and health and safety concerns during surveys. On March 21, 2011, we sent an interim letter to the agency manager and an employee representative.

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## ASSESSMENT

We toured two dairy plants under normal operating conditions to better understand production processes, types of equipment used in the industry, and typical activities performed by an equipment inspector during an equipment sanitation survey. At both plants we met with employer and employee representatives to discuss the HHE request. On March 1, 2011, we toured a cheese and whey plant that had 225 employees. We asked employees and managers about typical confined space procedures for contractors/inspectors including entry permit, air monitoring, PPE use, training, and emergency rescue procedures.

On March 2, 2011, we visited a dry milk plant that had 125 employees. We observed work processes, work practices, and workplace conditions and spoke with employees, including one equipment inspector. We observed the dry milk plant equipment sanitation survey performed by the equipment inspector and procedures for entry into confined spaces. We asked dairy plant employees about typical confined space procedures for visitors/contractors including entry permit, air monitoring, PPE use, training, and emergency rescue procedures. We reviewed the plant's written confined space program, copies of the confined space entry permits issued the day of our visit, written procedures for entry to specific equipment, and MSDSs of the chemicals used to clean the confined spaces inspected. We also reviewed a draft

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## ASSESSMENT (CONTINUED)

written confined space program provided by the federal agency along with the forms that equipment inspectors used while doing the equipment sanitation survey. Finally, because we had the opportunity to only talk to one equipment inspector during our site visits, we also randomly contacted six equipment inspectors or supervisors by phone. We interviewed them about confined space hazards encountered when they performed equipment sanitation surveys and asked about their training and work-related health and safety concerns.

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## RESULTS

We learned in our visit on March 1, 2011, that cheese producers use either open or closed cheese vats and that equipment inspectors in large-scale production facilities encounter many confined spaces. During our visit on March 2, 2011, entry into confined spaces was only necessary when the equipment inspector was unable to see all of the processing equipment from outside the space. The equipment was inspected during the plant's first shift. We learned that equipment sanitation surveys were usually performed after the equipment had been sanitized; therefore surveys were often performed during the night shift when sanitation was likely scheduled. The equipment inspector was always accompanied by one to three plant personnel.

According to the equipment inspector, only partial entry into a confined space was usually necessary. However, complete entry into a confined space was sometimes required for the equipment inspector to be able to see all of the internal processing components.

On March 2, 2011, we observed the equipment inspector entering six permit-required confined spaces. Several pieces of inspected equipment were not considered confined spaces. During this equipment sanitation survey the equipment inspector wore a full-body harness and lifeline provided by the plant for fall protection on a catwalk during a partial permit-required entry survey of a milk tanker (Figure 1); the other five permit-required entries during this survey did not require fall protection or retrieval equipment. During these confined space entries the equipment inspector placed his head and one arm and shoulder inside the space (Figure 2). The equipment inspector did not wear safety glasses during the survey of the vessels. However, the dry milk plant's safety policy was for all employees and visitors to wear safety glasses. We noted

## RESULTS (CONTINUED)



Figure 1. Equipment inspector partially enters a milk tanker while wearing a full-body harness provided by the plant.



Figure 2. Equipment inspector makes a partial entry into a cream tank.

that the equipment inspector usually removed his bump cap when looking into a confined space so that the bump cap would not fall off his head.

In some instances there was inadequate communication of entry procedures between the plant employees and the equipment inspector before confined space entry. In one instance, the equipment inspector began entering a confined space, but the plant safety manager stopped him because the space was not yet ready for entry as the permit had not been issued yet.

All the permit-required confined spaces where the inspector performed partial entry had been sanitized prior to entry using clean-in-place procedures, which are procedures used to avoid disassembly or partial disassembly of dairy production vessels [Schmidt 2011]. The clean-in-place supply line usually included thermal and chemical sanitation. Thermal sanitation involves flushing with hot water or steam at a specified temperature and contact time, while chemical sanitation involves the use of an approved chemical sanitizer at a specified concentration and contact time [Schmidt 2011].

The two plants we visited had different confined space emergency rescue procedures. One plant relied on the local fire department, while the other plant used an onsite emergency response team. Because procedures can differ between dairy plants, equipment inspectors must be familiar with the emergency rescue procedures at each facility.

### Review of Written Confined Space Programs

#### *Dairy Plant Written Confined Space Program*

The written confined space program for the dairy plant was detailed, easy to read, and customized to the needs of the plant. All confined spaces in this plant were treated as permit-required confined spaces, as recommended by NIOSH [NIOSH 2011]. The written plan included a list of all the confined spaces and the hazards within each space. The following is an example of the hazard listing for a milk silo:

- (1) Product supply line: suffocation if product enters the silo while an employee is inside
- (2) Clean-in-place supply line: chemical or hot water burns or suffocation

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## RESULTS

### (CONTINUED)

- (3) Mechanical agitator: pinch points, amputations, lacerations, and death
- (4) Slips and falls: slippery surface on the tank's floor from the fat in milk
- (5) Hazardous atmospheres: various kinds of hazardous atmospheres that may exist in a confined space
- (6) Conductivity: electrical tools
- (7) Chemicals: incompatibility and reactivity

The written program contained general entry procedures for typical hazards common to most equipment (e.g., oxygen-deficient or enriched, flammable atmosphere, and contaminated atmospheres) and specific procedures for processing equipment. We reviewed specific confined space entry procedures for a vapor separator, evaporator, milk tankers, and silo. All the procedures contained detailed entry descriptions, including photos. Equipment was rinsed with cold water after cleaning and before entry to minimize chemical hazards from cleaners and reduce slippery surfaces. Equipment was de-energized using lockout/tagout procedures and the atmosphere was tested for oxygen, carbon monoxide, hydrogen sulfide, and flammability levels with a 4-gas meter before entry. The dairy plant program included guidance for in-house and contract rescue procedures.

The confined space permit form used by the plant met the basic requirements of OSHA 1910.146. The permit included basic but essential information such as date and time, purpose of entry, personnel, emergency phone numbers, hazards expected, isolation checklist, safety precautions (PPE and communication), atmospheric testing (calibration date and air monitor result), and authorization. The plant was also in the process of updating this to a more detailed permit format. Permits in partial entries were properly completed. Because no whole body entries were conducted during our visit, we were not able to compare with partial entries.

Five MSDSs for equipment cleaning products used in the plant listed sodium hydroxide, sodium hypochlorite, nitric acid, phosphoric acid, sulfuric acid, and propionic acid. These are typical chemicals used in food processing [Schmidt 2011]. Sodium hydroxide (caustic soda) is a highly alkaline detergent used in many clean-in-place systems [Schmidt 2011]. In the dairy plant cleaning products, sodium hydroxide comes mixed with a solution of sodium hypochlorite (bleach). Chlorine compounds (like bleach)

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## RESULTS

### (CONTINUED)

are the most commonly used sanitizers in food processing and handling applications because of their broad germicidal spectrum [Schmidt 2011]. When bleach is mixed with detergents (known as chlorinated detergents), the bleach acts like an oxidizing agent to clean protein residues. The inorganic and organic acids listed in the MSDSs account for common acid detergents that are often used in a two-step sequential cleaning regime with alkaline detergents for the prevention or removal of stone films like milk stone [Schmidt 2011].

The health and safety disadvantages to the use of alkaline and acid solutions are that they are corrosive, can cause burns, and are very reactive. Chlorine compounds can also initiate corrosion of many metal surfaces (especially at higher temperatures) [Schmidt 2011]. Health and safety concerns with bleach are skin irritation and mucous membrane damage in confined areas [Schmidt 2011]. At low pH (below 4.0), possibly caused by the use of acids, chlorine gas in lethal concentrations can form [Schmidt 2011].

### ***Federal Agency Draft Written Confined Space Program***

We found that the draft written confined space program for the agency was generalized to any industry or equipment and not specific to the hazards that may be encountered in the dairy industry. The draft program also contained legal jargon, making it difficult to understand. In addition, rescue procedures for equipment inspectors working in confined spaces in a dairy plant were missing from the program.

### **Employee Interviews**

We interviewed seven of 13 equipment inspectors; six were interviewed by phone and one in a personal interview during our March 2, 2011, field visit. Equipment inspectors had worked an average of 21 years (range 9 to 30 years) and most performed one to three equipment sanitation surveys per week. Some supervisory equipment inspectors only did a few equipment sanitation surveys a year. All equipment inspectors visited a wide range of dairy facilities. All equipment inspectors reported that throughout the whole equipment sanitation survey process they were accompanied by one or three company personnel to answer questions about food safety, production, and equipment entry.

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## RESULTS

### (CONTINUED)

Equipment inspectors indicated that more confined space entries had been performed in the past, especially full body entries. Some equipment inspectors commented that more stringent safety regulations in dairy plants had discouraged confined space entries during sanitary surveys. Most equipment inspectors said they still regularly performed full body entries, with some stating they always had one or more full entries during an equipment sanitation survey. Some equipment inspectors said that full entries were performed sporadically when there was a need (e.g., need to further check internal structural integrity or cleanliness of the equipment). Equipment inspectors stated that they would more likely consider fully entering a confined space if the dairy plant equipment had cooled down after cleaning. Equipment inspectors reported remaining in a confined space from 1 to 10 minutes. Equipment inspectors reported full entries into the following confined spaces: milk tankers, cream tanks, evaporators, silos, driers, double enclosed cheese vats, and storage tanks.

All equipment inspectors reported performing partial confined space entries (usually head and sometimes hand, arm, and shoulder). One equipment inspector estimated that 80% of the equipment inspected could be categorized as a confined space and that a small plant could have up to nine vessels requiring partial entries; large plants would have more. Equipment inspectors reported from two to ten partial confined space entries per day during an equipment sanitation survey. Estimates of the duration for partial confined space entries ranged from 30 seconds to a few minutes and included entries into milk tankers, evaporators, and silos.

Equipment inspectors reported that they entered into a confined space to further assess cleanliness and construction of the equipment and look for potential cracks, films, or product build up. All inspectors used a flashlight during entry to help them properly see inside the space. Inspectors reported that their flashlights were not intrinsically safe and were bought by the equipment inspectors and compensated by the agency. Most used small but high powered emitting diode flashlights. Some described their flashlight as a “pen light” or “3 cell Maglite®.”

Equipment inspectors reported compliance with the dairy plant’s PPE requirements. Inspectors reported occasionally wearing a body harness when conducting a full confined space entry. Body harnesses were typically provided by the dairy plant. Partial entries

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## RESULTS

### (CONTINUED)

usually required a bump cap, hair net, lab coat, safety glasses, ear plugs, and occasionally shoe covers. Some equipment inspectors reported removing the bump cap before entering the confined space to avoid losing it inside the equipment. Some equipment inspectors had their own lock for lockout/tagout of equipment.

Some but not all equipment inspectors were familiar with procedures for entry into confined spaces. However, some equipment inspectors were not sure if dairy plants performed air monitoring before entering a confined space and were not familiar with procedures or equipment used during air monitoring for entry into confined spaces. Most were familiar with lockout/tagout procedures before entering into a confined space. Further, several equipment inspectors believed that air monitoring and permit issuing were needed only for full body entries and not for partial entries.

Many equipment inspectors believed that safety awareness in the dairy industry had increased over the years, and they felt safe at their jobs. One inspector suggested that supervisors encouraged them to make decisions on safety, so equipment inspectors felt empowered. Some suggested that safety is learned primarily through experience on the job. All equipment inspectors agreed that training was last given during the national meeting 2 to 3 years ago. Most equipment inspectors supported annual confined space refresher training, especially because national meetings are no longer held annually. Some specified that it would be ideal to provide online training on confined space so that it was more convenient. Many suggested that training should be tailored to the needs of the dairy industry, with specific examples of the hazards and procedures for the typical equipment that they inspect. One suggested creating a video that shows proper entry into confined spaces commonly encountered in the dairy industry.

Equipment inspectors reported no health concerns related to work. Some described concerns not related to confined space like “bad air” at one facility and a pump that was not locked. An equipment inspector described an incident many years ago in which he fully entered an enclosed cheese vat and had difficulty breathing. The inspector promptly and safely exited the vat, and continued the equipment sanitation survey.

U.S. domestic dairy consumption has grown over the last 20 years, with increases in population and per capita consumption of dairy products [Cessna 2011]. The increase in production usually translates into larger production plants with an increased number of confined spaces.

OSHA's confined space regulations can be found at 29 CFR 1910.146 [OSHA 2011a]. OSHA defines a confined space as a space large enough to physically enter, has limited entry and exit, and is not designed for continuous human occupancy. OSHA classifies confined spaces as permit required when one or more of the following conditions are met:

- (1) The space contains or has the potential to contain a hazardous atmosphere.
- (2) The space contains material that could engulf someone in the space.
- (3) Internal configuration is such that the entrant could be trapped or asphyxiated.
- (4) The space contains any other recognized serious safety or health hazard.

Under the OSHA confined space regulation, requirements for dairy plant equipment inspectors would be similar to those for contractors. When a plant arranges to have a contractor perform work that involves confined space entry, the following requirements apply: informing the contractor of the facility's permit spaces and their hazards, advising the contractor on confined space precautions and procedures, coordinating entry operations, and debriefing the contractor regarding any hazards created or confronted during and at the end of the entry. The contractor's responsibilities are to obtain any available information about the permit space hazards and entry operations of the plant, coordinate operations with them, and inform the plant of any hazards created or confronted during or at the end of the entry. The OSHA confined space standard does not specify a frequency of training, only that adequate training is provided prior to assignment to confined space entry operations.

NIOSH defines a confined space as a space that by design has limited openings for entry and exit, unfavorable natural ventilation that could contain or produce dangerous air contaminants, and that is not intended for continuous employee occupancy [NIOSH 2011]. In the NIOSH confined space criteria document, confined spaces are classified on the hazard potential or existing hazard.



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## DISCUSSION

### (CONTINUED)

Confined spaces are divided into three classes: class A (IDLH), class B (dangerous but not IDLH), and class C (a potential hazard). All three classes require atmospheric testing [NIOSH 2011]. Continuous monitoring of the confined space is required for class A and optional for class B and C. Unlike OSHA, NIOSH recommends an entry permit system and the use of rescue procedures for all three confined space classifications. Classes A and B require a standby person equipped with a self-contained breathing apparatus. For class C spaces, rescue personnel must use supplied air or self-contained breathing apparatus to remove victims. NIOSH recommends training at least annually for any confined space entry [NIOSH 2011].

Considering that most confined spaces inspected by equipment inspectors in the dairy industry are permit-required confined spaces defined by OSHA and NIOSH [OSHA 2011a, NIOSH 2011], the agency could manage entry into confined spaces for equipment inspectors by following the OSHA standard for permit-required confined spaces (29 CFR 1910.146) [OSHA 2011a]. The OSHA standard does allow a permit-required space to be reclassified as a non-permit-required space [OSHA 2011a, OSHA 2011c]. However, to make this determination, the employer must document the basis for determining that all hazards in a permit space have been eliminated [OSHA 2011a, OSHA 2011c]. On the basis of our observations of the dairy processing equipment in this evaluation, we assume that an equipment inspector, at a minimum, would need to document proper lockout/tagout procedures and air monitoring before entry.

Alternatively, the agency could follow NIOSH guidance and recommend that equipment inspectors treat all confined space entries (both full and partial) as permit required [NIOSH 2011]. The advantages of this approach are reduced confusion in distinguishing between permit-required and non-permit-required confined spaces and documentation of each entry.

Because the quality of confined space programs differs throughout the industry, equipment inspectors should have the option of using an agency provided and calibrated air monitor before confined space entries. It can be used when the plant does not conduct its own air monitoring or to verify that the plant's air monitoring results are accurate. The former procedure is used by OSHA compliance officers before entering a confined space [OSHA 2011b]. Additionally, having equipment inspectors involved

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## DISCUSSION (CONTINUED)

in the confined space permit issuing procedure may improve communication with the plant's safety personnel in determining when it is safe to enter. The agency would need to obtain air monitors and provide specific training in their use.

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## CONCLUSIONS

On the basis of our site visits and the interviews with equipment inspectors, we conclude that equipment inspectors in dairy plants routinely enter into OSHA permit-required confined spaces when performing equipment sanitation surveys. These entries involve partial or whole body entries to assess the cleanliness and maintenance of dairy processing equipment. Some entries were performed without having had a permit-required confined space entry permit completed. Additionally, not all equipment inspectors are sufficiently trained in confined space hazards and procedures, may not have the necessary entry equipment and PPE, and are not always familiar with confined space entry and rescue procedures of the dairy plant. Our review of the federal agency confined space program suggests that the written draft was too general and lacked information regarding specific hazards faced by equipment inspectors in the dairy industry and proper rescue procedures.

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## RECOMMENDATIONS

On the basis of our findings, we recommend the actions listed below to create a more healthful workplace. We encourage the agency to use a labor-management health and safety committee or working group to discuss the recommendations in this report and develop an action plan. Those involved in the work can best set priorities and assess the feasibility of our recommendations for the specific situation at the agency. Our recommendations are based on the hierarchy of controls approach. Some of these recommendations were provided to management and employee representatives in an interim letter dated March 22, 2011.

### **Engineering Controls**

Engineering controls reduce exposures to employees by removing the hazard from the process or placing a barrier between the hazard and the employee. Engineering controls are very effective at protecting employees without placing primary responsibility of implementation on the employee.

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## RECOMMENDATIONS (CONTINUED)

1. The agency should continue to provide locks to equipment inspectors and promote their use to make sure that lockout/tagout procedures are enforced during their visits.

### **Administrative Controls**

Administrative controls are management-dictated work practices and policies to reduce or prevent exposures to workplace hazards. The effectiveness of administrative changes in work practices for controlling workplace hazards is dependent on management commitment and employee acceptance. Regular monitoring and reinforcement are necessary to ensure that control policies and procedures are not circumvented in the name of convenience or production.

1. Obtain information about a dairy plant's confined spaces prior to the survey. This may include, but is not limited to, a copy of the plant's written confined space entry program, documentation of recent calibration of the plant's confined space air monitoring equipment, and information on confined space rescue and emergency plans.
2. Request that the plant always perform a water rinse after chemically cleaning equipment and before a confined space entry is conducted.
3. Treat all confined spaces as permit-required confined spaces.
4. Update the agency's written confined space program to include detailed descriptions of the specific hazards that equipment inspectors may encounter in dairy plants and procedures to mitigate these hazards. The program should also have specific information about PPE, air monitoring, rescue procedures, and training pertaining to confined space entry in a dairy plant.
5. Make calibrated air monitors available for use by inspectors, and train equipment inspectors in their use.
6. Provide yearly training in confined spaces, tailored to the specific hazards typical in dairy plants. Using online resources may be an option considering that equipment inspectors are located across the country. Bannen [2009] provides guidelines and suggestions for developing an effective confined space training program.

## Personal Protective Equipment

PPE is the least effective means for controlling employee exposures. Proper use of PPE requires a comprehensive program and calls for a high level of employee involvement and commitment to be effective. The use of PPE requires the choice of the appropriate equipment to reduce the hazard and the development of supporting programs such as training, change-out schedules, and medical assessment if needed. PPE should not be relied upon as the sole method for limiting employee exposures. Rather, PPE should be used until engineering and administrative controls can be demonstrated to be effective in limiting exposures to acceptable levels.

1. Instruct equipment inspectors to always wear adequate PPE including safety glasses, bump cap, safety boots, and ear protection (if in a noisy environment). Inspectors must follow any other plant PPE requirements during site visits. A bump cap may be used with a chin strap so that it does not fall off the inspector's head into the confined space.
2. Use a full-body harness (where required) provided by the federal agency when possible. Always inspect the harness before each entry. NIOSH recommends always wearing a full body harness in any full body entry typical to this industry, which would be considered confined space classes B and C [NIOSH 2011].

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## ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

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