STRICTLY PRIVATE INFORMATION DELETED

OCCURRENCE REPORT

Energy Research (PNNL)

(Name of Facility)

Balance-of-Plant

(Facility Function Involved)

HANFORD SITE

(Name of Laboratory, Site or Organization)

Name: [redacted]
Title: Manager, Facilities Operations Management
Telephone No.: [redacted]

(Facility Manager/Designee)

Name: [redacted]
Title: Deputy Operations, Facilities ESH&Q
Telephone No.: [redacted]

(Originator)

Name: [redacted]. **Date:** 07 / 16 / 99 **Time:** 0450 **hrs. [ ] Classified [X] Unclassified**

(Authorized Classifier (AC))

1. OCCURRENCE REPORT NUMBER: RL--PNNL-PNNLBOPER-1999-0017

2. STATUS AND REPORT DATE:

	Date Due	Date Submitted
[ ] **Notification Report**	06/03/99	06/03/99
[X] **Final**	07/16/99	07/16/99

3. OCCURRENCE CATEGORY:

[ ] **Emergency**
[ ] **Unusual**
[X] **Off-Normal**

4. NUMBER OF OCCURRENCES:

1 **Original Occurrence Report:** N/A

5. DIVISION OR PROJECT:

Facilities & Operations

6. DOE SECRETARIAL OFFICE:

SC – Office of Science

7. SYSTEM, BLDG. OR EQUIPMENT: **8. UCNI?:** **9. PLANT AREA:**

Marine Sciences Laboratory (MSL) No Sequim, WA

10. DATE & TIME DISCOVERED: **11. DATE AND TIME CATEGORIZED:**

06/02/99 1610 hrs. 06/02/99 1655 hrs.

12. DATE & TIME OF DOE/HQ-EOC NOTIFICATION:

13. DATE & TIME OF OTHER NOTIFICATIONS:

06/02/99 1705 hrs. Trevino, J. E. RL/STO

14. SUBJECT OR TITLE OF OCCURRENCE:

Two Staff Member Locked in Walk-in Freezer at Marine Sciences Laboratory

15. NATURE OF OCCURRENCE:

10) Cross Category Items
B. Near Miss Occurrence

16. DESCRIPTION OF OCCURRENCE:

On Wednesday, June 2, 1999, a PNNL waste management specialist from Richland, WA traveled to the Marine Science Laboratory (MSL) located in Sequim, WA, to assist with waste management activities. An hourly MSL scientist was assigned to assist the waste management specialist locate samples that met the definition of hazardous waste. The purpose of locating the samples was to remove them from storage, label them as hazardous waste, and move them to the less than 90-day accumulation area.

Many of the samples were being stored in a stand-alone cooler/freezer unit located approximately 75 feet north of the “upland” facility loading dock. At approximately 1400 hours, the two workers went out to the cooler/freezer to search for samples listed on a printout of the sample inventory. They entered the cooler compartment (1° C) to look for specific sample numbers. The door to the freezer compartment was not opened. After a short time (about 10 minutes) the workers left the cooler, having decided to get a coat and lab coat respectively, since they were cold and anticipated

needing to spend additional time in the freezer (between –26° C and –29° C) to locate the samples.

After returning to the cooler, the workers verified the sample numbers that they needed to locate, opened the freezer door, went into the freezer unit and pulled the door closed without latching it. A short time later, the waste management specialist returned to the cooler to verify a sample number on the print out. When he re-entered the freezer, he pulled the door closed. This time the door fully closed and latched. The workers were aware that if the freezer door was left open the internal temperature increases and a local alarm at the recorder on the outside of the freezer/cooler beeps. After searching for about 10 minutes with the freezer door closed, the workers decided to leave the freezer, because they were getting cold and wanted to warm up.

As they attempted to exit they pressed the push-rod safety-latch knob and found that it would not budge. One worker kicked at the latch to break it free, but only succeeded in breaking off the plastic glow-in-the-dark knob. An ice chest was then used to hammer on the end of the exposed push-rod, but the push-rod just punched holes in the ice chest. At this point the workers realized that they were in trouble. An attempt was made to beat on the walls and yell for help, but they quickly decided that was fruitless. One of the workers produced a multiple-purpose pocket knife that he used to remove the four screws and white plastic cowling from around the push-rod safety latch revealing the Styrofoam insulation. He found ice-covering the insulation around the push-rod. He removed as much of the insulation (about ¼inch) and ice from around the push-rod as he could by chipping at it with the knife. They then looked for means to reduce the cooling in the freezer by resetting a thermostat, but found it only controlled the defrost cycle for the cooling unit inside the freezer. They then thought that they could possibly turn off the cooler by disconnecting the wires in a 4” square junction box just above the door. They used the knife to remove the cover plate from the junction box with the idea of disconnecting power to the cooler, but realized that these wires only provided power to the light (the workers were unaware that these wires also provided power to the heat trace circuits).

One of the workers wedged the junction box cover plate between the metal door skin and the insulation just in front of the push-rod to provide a larger surface area to strike against. After several attempts of striking the cover plate with the ice chest, the door latch released and allowed the workers to exit the freezer.

After exiting the cooler/freezer, the workers informed MSL management of the incident. They immediately inspected the freezer door latching mechanism and removed the striker plate to ensure nobody else would get locked in. The lock on the cooler door (outer door) was subsequently changed to a unique lock and a danger tag was attached.

17. OPERATING CONDITIONS OF FACILITY AT TIME OF OCCURRENCE:

N/A

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18. ACTIVITY CATEGORY:

03 - Normal Operations

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19. IMMEDIATE ACTIONS TAKEN AND RESULTS:

The stationary latch was removed from the Freezer Door to prevent it from being locked.

The Freezer was Locked and Tagged with a Danger Tag by the Controlling Organization.

A critique was conducted via conference call.

A multidisciplinary team from Facilities, Safety and Research was appointed by the Environmental Technology Division manager to investigate the incident. The FM was the chair.

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20. DIRECT CAUSE:

1) Equipment/Material Problem
   f. Contaminant

21. CONTRIBUTING CAUSE(S):

4. Design Problem,
   a. Inadequate Work Environment

6. Management Problem
   b. Work Organization/Planning Deficiency

6. Management Problem
   d. Improper Resource Allocation

6. Management Problem
   e. Policy Not Adequately Defined, Disseminated, or Enforced

22. ROOT CAUSE:

4) Design Problem
   b. Inadequate or Defective Design

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23. DESCRIPTION OF CAUSE:

Methodology: Events and Causal Factors Chart, and Barrier/Control Analysis.

Direct Cause:

1) Equipment/Material Problem, f. Contaminant: The design of the freezer door allows introduction of moisture into the safety release mechanism:

- No seal around push-rod
- No seal around latch mechanism
- No sleeve for push-rod.

Contributing Causes:

4) Design Problem, a. Inadequate Work Environment: There are no alarms or communications for trapped or disabled staff to alert other staff for assistance.

6) Management Problem, b. Work Organization/Planning Deficiency: A modification to the freezer door was made at some time after installation to add approximately 6 millimeters of foam rubber insulation to the outer surface of the door, likely to prevent condensation formation. Documentation of the change could not be found and vendor contact was not possible as the installer/manufacturer is no longer in business. Furthermore, it cannot be established that analysis of the impact of the change on other design features was considered. The installation of the foam rubber on the door is important to this incident since the foam rubber insulated the door from the warmer environment in the cooler section. The foam rubber reduced the average temperature in the door and could have been a significant contribution to the build up of ice around the push-rod.

Also, functional checks of the design features were not performed on the door/doorframe heat trace, equalizing vent, or emergency release mechanism. Manufacturer information on recommended maintenance is not available.

6) Management Problem, d. Improper Resource Allocation: Adequate protective clothing was not provided to mitigate staff exposure to the freezing conditions.

6) Management Problem, e. Policy Not Adequately Defined, Disseminated, or Enforced: The requirements of the “Working Alone” Standards Based Management System (SBMS) subject area were not implemented. The title and the applicability of the Working Alone SBMS Subject area infer that the subject area only applies to an individual working alone and not individuals or groups working remotely. None of the staff interviewed believed that the Working Alone subject area was applicable, however, they did believe that it was a good idea.

Root Cause:

4) Design Problem, b. Inadequate or Defective Design: The manufacturer design is inadequate to insure that the freezer door can be opened from the inside. The freezer door's emergency release mechanism had inadequate features to prevent moisture that was present in the mechanism penetration from freezing and immobilizing the push-rod:

- Little insulation around the push-rod (about ¼inch)
- No heat trace

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24. EVALUATION (By Facility Manager/Designee)

On Wednesday, June 2, 1999, two PNNL staff members entered a walk-in cooler/freezer unit at the Marine Science Laboratory (MSL) located in Sequim, WA, to process legacy waste samples. When they attempted to leave the freezer portion of the unit, they found that the release mechanism was inoperable, trapping them inside. Using makeshift tools, they were able to free the mechanism and exit the unit.

The investigation of the incident concluded that the direct cause of this event was that the door design did not prevent moisture from collecting in the space where the safety release mechanism push-rod penetrated the door. Due to the subfreezing conditions, the moisture froze and immobilized the push-rod on the inside, although the latch mechanism itself, located on the outside of the door, remained operational. The root cause is that the manufacturer's design of the freezer door did not employ features like heat trace or adequate insulation to prevent moisture in the push-rod penetration from freezing and immobilizing the push-rod.

The investigation determined that there were also several causal factors that contributed to this event:

A thin layer of insulation was affixed to the outside surface of the door. This modification was apparently not properly analyzed and may have significantly contributed to the event by allowing the safety release mechanism push-rod to thermally equalize with the freezer side temperature.

No periodic functional testing was conducted on the latch and safety release mechanism nor the heat trace to ensure continued operation.

There are no means to alert staff outside of the freezer/cooler in the event that staff inside require assistance.

The requirements of Working Alone Standards Based Management System (SBMS) subject area were not implemented. The title and applicability of the subject area infer that requirements only apply to one person working alone.

Following the incident, steps were immediately taken to disable the door hardware to preclude recurrence, and administrative controls were put in place to allow staff to

safely work in the unit. Additional recommendations under evaluation are permanently modifying the closing mechanism to preclude recurrence, installation of alarm or other communication device for use by staff within the cooler/freezer unit and storage of adequate protective clothing within the unit. All PNNL building managers were instructed to conduct an immediate self-assessment of similar walk-in spaces, including coolers, freezers, atmospheric or other chambers and incubators, to ensure that a similar incident was prevented. No similar conditions were found.

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25. IS FURTHER EVALUATION REQUIRED?: Yes[ ] No[X]

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26. CORRECTIVE ACTIONS:

1) Conduct a self-assessment of PNNL facilities to identify walk-in freezers, coolers and other similar equipment to ensure similar conditions do not exist where staff can become entrapped and establish additional controls where necessary.

ACTION OWNER: Deputy Operations, Facilities ESH&Q ([redacted])
TARGET COMPLETION DATE: 06/25/99 **COMPLETION DATE:** 06/22/99

2) Prepare a service request to:
   - Evaluate alternative modifications to the MSL freezer/cooler design and controls (alarms, communications, removal of the latch, change seal to magnetic type, install a mechanical interlock that prevents the door from closing except by someone on the outside, etc.). Implement the changes.
   - Establish appropriate functional checks for design features (to detect failure or degradation of function).

ACTION OWNER: Building Manager, MSL ([redacted])
TARGET COMPLETION DATE: 06/30/99 **COMPLETION DATE:** 06/24/99

3) Review administrative controls to ensure: 1) that new systems, structures and components (SSC) will include owner/operating manuals that include engineered features and recommended service; 2) that modifications to systems, structures and equipment (SSC) similar to the freezer/cooler are reviewed for impact to the function of the engineered features.

ACTION OWNER: Manager, Plant Engineering ([redacted])
TARGET COMPLETION DATE: 11/1/99 **COMPLETION DATE:** //

4) Ensure full implementation of the Working Alone subject area with staff at MSL.

ACTION OWNER: Operations Manager, ETD ([redacted])
TARGET COMPLETION DATE: 07/30/99 **COMPLETION DATE:** //

5) Revise the title and applicability of Working Alone SBMS Subject Area to insure that it clearly includes groups who are working alone and not just an individual.

ACTION OWNER: Manager, Safety & Health ([redacted])
TARGET COMPLETION DATE: 12/13/99 **COMPLETION DATE:** //

6) Provide protective clothing for use by staff to enter the freezer/cooler compartments.

ACTION OWNER: Building Manager, MSL ([redacted])
TARGET COMPLETION DATE: 08/06/99 **COMPLETION DATE:** //

7) Issue Lessons Learned Bulletin.

ACTION OWNER: PNNL Lessons Learned Coordinator ([redacted])
TARGET COMPLETION DATE: 08/27/99 **COMPLETION DATE:** //

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27. IMPACT ON ENVIRONMENT, SAFETY, AND HEALTH:

Entry into the MSL walk-in freezer exposes staff to a frigid environment and potentially to toxic chemical vapors or an oxygen deficient environment. Exposure to cold cannot be eliminated and is normally controlled with appropriate clothing or short stay times.

The potential for encountering toxic vapors in the MSL freezer is considered extremely remote based on the inventory of material that is stored inside. The inventory consists of sealed sediment and tissue samples. The samples are frozen to prevent spoilage, they are not placed in any preserving solution. There isn't a significant source of chemicals in the freezer that could reach a level of concern in a "zero ventilation, saturation model."

It is difficult to estimate how long an individual could remain in the freezer with sufficient oxygen for life due to the variables in estimated oxygen consumption rate, individual metabolism, heat loss, etc…. However, calculations based on conservative assumptions show that two staff members can perform very heavy work for greater than five hours. Normal working stay times in the freezer are typically less than 30 minutes; therefore, the potential for encountering an oxygen deficient atmosphere is considered remote.

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28. PROGRAMMATIC IMPACT:

None

29. IMPACT UPON CODES AND STANDARDS:

None

30. LESSONS LEARNED:

Industry available equipment like a walk-in freezer or cooler is often treated as inherently safe. However, this equipment should have controls in place that treats entries by the staff as "working alone," regardless of the number who enter the equipment, in order to mitigate entrapment or impairment conditions. Information should be obtained from the manufacturers/suppliers of industry available equipment like walk-in freezers and should include as a minimum the design features and recommended service. Any manufacturer recommended service should be implemented as preventive maintenance or other methods to ensure proper function of design features. Modifications to the design of the equipment should be reviewed for the effect of the changes on the design features. Prolonged exposure to anticipated hazards should be planned for and adequate protective equipment should be provided and employed.

31. SIMILAR OCCURRENCE REPORT NUMBERS:

None

36. APPROVAL SIGNATURES:

Originator _____ Date _____
[redacted] Deputy Operations
Facilities ESH&Q

Facility Operations _____ Date _____
[redacted] Deputy Operations
Facilities ESH&Q

Facility Manager _____ Date _____
[redacted] Manager
Facility Operations Management