

# Caution Bulletin

Fluor Hanford

## Mobile Office Trailer Fire

March 24, 2008

2008-RL-HNF-0003

Tracking No: 924

**Summary:** A fire occurred in a vacated mobile office (MO-384) on the Hanford Site. The apparent direct cause of the event was radiant ignition of the building's wood framing, which supported the HVAC supply ducting, due to operation of the HVAC heater coils without airflow. Electrical component failures could have created heat sufficient to cause ignition of the wood framing directly or indirectly. A factor in the ignition of the wood framing was an improper clearance between the unit supply ducting and the unit's wood structural framing members.

**Discussion of Activities:** On the afternoon of February 15, 2008, a Hanford Patrol unit radioed the Hanford Fire Department (HFD) that the MO-384 trailer had smoke and flames coming from it.

On arrival, the HFD crew witnessed fire in the double-wide office trailer and confirmed that the fire had burned through the roof on the south end. The fire was burning in rooms on the south end and had traveled throughout much of the enclosed space above the ceiling towards the north end of the structure.



The fire was extinguished and HFD remained at the scene overnight to watch the building for rekindling. No injuries to personnel or damage to fire fighting equipment were reported.

**Analysis:** The MO-384 facility was vacated in early October 2007 and all useable equipment was removed. A final turnover walkthrough with the former occupant and Facilities personnel occurred on October 23, 2007. The facility was planned for turnover to the D&D organization for demolition. Negotiations between the involved parties over the state of the water connection and other criteria as a precondition for turnover delayed the turnover process. Due to funding issues concerning, in part, the expense of permanently isolating the water supply at the underground connection, the underground isolation did not occur and the potential for water pipe freezing remained. As a result, the HVAC units were left operational to alleviate this concern.

The High Limit Safety Cutout device and associated wiring were inspected for damage. It was determined during the investigation that one of the two devices had failed electrically before the fire started as evidenced by a fused contact. This failure eliminated the capability of the device to deenergize two of the three HVAC unit heating elements. The failure of the Cutout to operate is considered an indirect cause of the fire.

Failure of the of the Cutout initiated a sequence of events that culminated with ignition of the wooden HVAC supply duct framing due to radiant heat from the heating elements. Insufficient clearance between the wooden frame and the HVAC ducting as required by NFPA 90B (and specified on the UL listed of the HVAC unit itself) and the close proximity of the wooden frame to the heater elements is a contributing factor. A recommendation of this report is to have the owners/occupants of MO's develop an inspection plan to evaluate HVAC duct for compliance with combustible material clearances.

During normal operation in the heating cycle, when the thermostat calls for heat, the fan will start and the heating elements will energize to circulate the hot air. The sequencers on the unit are arranged to properly format this process. When the room set temperature is reached the thermostat will send a signal to deenergize the heating elements through the sequencer. The heating elements are deenergized with the fan continuing to operate until the discharge air temperature cools after a predetermined time. The fan will then be deenergized. This cycle is continuously repeated as heat is needed. The High Limit Safety Cutout does not operate during the normal operating scenario. Therefore, a failure of the Cutout could have occurred long before the fire event but the failure not significant until this safety function was needed due to the failure or temporary malfunction of another component.

Per discussions with HVAC technicians and the manufacturer, the Cutouts are designed to operate at an air temperature of approximately 140 degrees Fahrenheit just outside the area of the heater elements. A fan failure while the heaters are energized will result in Cutout operation. Scenarios where this could occur are possible and could occur from a sticking controller relay or fan sequencer, or a failed fan capacitor. The exact sequence of events that created the condition of fan off, heater coils on, and then fan on until final fan and unit failure, could not be determined. But is it known that the heater coils were energized for a period of time with no air flow.

The three heating elements, which are located no more than 8 inches from the ductwork over the wooden duct framing at the closest point, are capable of producing 15 Kw of heat. The radiant heat flux required for spontaneous combustion of wood is approximately 29 Kw/m<sup>2</sup>. The spontaneous combustion temperature of wood is approximately 600 degrees Celsius. Under normal operation, HVAC safety features will prevent the wood framing members from being exposed to temperatures that would result in spontaneous ignition. However, metallic heating elements can achieve a maximum temperature of approximately 1400 degrees Celsius. A failed Cutout in combination with a failed HVAC fan would produce the condition for spontaneous combustion of the wood in a very short period of time.

A review of the maintenance work conducted on the southeast HVAC unit over the past several years reveals routine maintenance work. However, in August of 2004 one failed high temperature Cutout was replaced. This is not the same Cutout that was found to have failed in the investigation, but could have been an indicator that failure of the second cutout was forthcoming. Emphasis on the inspection of the high temperature cutouts for signs of damage or overheating and verification of tight electrical connections to these devices by the maintenance organization is recommended.

### **Recommended Actions:**

Projects owning or occupying MO's with wall mounted HVAC units should develop an inspection plan to inspect for proper clearance to combustible materials (i.e., wood framing, etc.) as required by the UL listing for the HVAC unit.

HVAC maintenance procedures should emphasize the need to perform a complete visual inspection of the high temperature cutout switches for any sign of damage or indications of overheating. Routine maintenance should also include a check of the wiring connections on these devices to ensure they are tight.

When buildings are being transitioned to D&D for demolition, ensure the prompt elimination of utilities and other related items is conducted. Although a fire of this nature cannot be predicted, isolation of the electrical power to these designated facilities would eliminate an ignition source which could potentially lead to a future similar event.

**Work Function:** Fire Protection

**Hazard:** Fire

**ISM Core Function:** Implement Controls

**Keywords:** Fire, HVAC, Mobile office

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**References:** Hanford Fire Department, Mo-384 Trailer Fire Report, February 15, 2008