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Subject: **Red Alert: Update of Type A Investigation of Carbon Dioxide Discharge**

This lessons learned is provided by Lockheed Martin Idaho Technologies Company (LMITCO) to communicate the results of recent tests on an AFP-200 fire control panel. Individuals responsible for the operation of fire protection systems should review this material and take the appropriate action. Proactive use and implementation of this information is advised to preclude similar events.

Title: **RED - Lessons Learned from the Type A Investigation of a Carbon Dioxide Discharge Resulting in a Fatality and Injuries - Update**

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LMITCO is currently developing a comprehensive report detailing all lessons learned from the July 28, 1998, accident; a digest of the lessons learned, and a video tape. This information will be provided as it becomes available.

Lessons Learned Statement: Testing has shown that the AFP-200 panel sometimes activates its notification appliance circuits on terminal block 2 when AC power to the panel is interrupted. Therefore, precautions should be taken to mitigate the possibility of injury, death, and property damage which could occur due to unwanted discharge of fire suppression systems controlled by the AFP-200 panel.

Discussion: On Tuesday, July 28, 1998, a CO₂ fire suppression system, controlled by an AFP-200 analog fire panel, unexpectedly discharged without an evacuation warning alarm, when it was disconnected from normal AC power during routine electrical maintenance. The fire suppression system was installed in Building TRA-648 at the Idaho National Engineering and Environmental Laboratory. During the DOE Type A Investigation of the event, Notifier Corporation, the manufacturer of the AFP-200 panel, provided the following information to DOE: "Our testing has shown the AFP-200, when used with the separate NR45 charger, can be perturbed momentarily by an AC power loss or an AC voltage transient. When this perturbation occurs, it is possible that the output circuits could momentarily activate." (Page 41 of Type A Accident Investigation Board Report of the July 28, 1998, Fatality and Multiple Injuries Resulting from Release of Carbon Dioxide at Building 648, Test Reactor Area, Idaho National Engineering and Environmental Laboratory, September 9, 1998.)

Analysis: Lockheed Martin Idaho Technologies Company commissioned circuit analysis and testing of the AFP-200 panel. These tests showed that the control panel sometimes activates its notification appliance circuits upon loss of AC power. These output circuits on terminal block 2, whether configured for control of notification appliances or releasing devices, activated upon loss of AC power under the following conditions:

Condition 1: When Jumper JP2 has been cut. This condition was tested.

Notifier AFP-200 Instruction Manual Document 1511 Rev: D dated 9/14/94 instructs the installer to cut this jumper when using an external battery charger, such as the NR45, with the AFP-200 panel.

Condition 2: If Jumper JP2 is left intact (not cut) and no standby batteries are connected to the AFP-200 panel. This condition was tested.

Condition 3: If Jumper JP2 is left intact (not cut) and "weak" or faulty standby batteries are connected to the AFP-200 panel. This condition was not tested.

The circuit analysis results indicate that interruption of AC power to the AFP-200 panel can also cause activation of the output circuits if Jumper JP2 has not been cut and "weak" or faulty standby batteries are connected to the control panel. This analytical result has not been confirmed by testing. However, the activation mechanism determined from measurements made during testing under Conditions 1 and 2 above would be expected to create the possibility of output activation upon interruption of AC power to the AFP-200 if a "weak" or faulty battery were connected to the control panel.

During the testing, one or more notification appliance circuits activated in approximately 1.5% of the instances when AC power to the AFP-200 panel was interrupted and either Condition 1 or Condition 2 existed.

CAUTION: There may be other conditions under which removal of electrical power from the AFP-200 could cause activation of the panel output circuits. For example, complete power down of the panel for any reason (e.g., servicing or maintenance) could result in momentary transfer of the output circuits. All possible conditions have not been tested.

NOTE: The activation of the notification appliance circuits observed during testing was "momentary." Some releasing devices require only "momentary" (a few milliseconds) input of power to operate while other releasing devices require input of power for significantly longer times. Testing was done with Kidde-Fenwal Electric Control Heads. These heads were connected to notification appliance circuits configured for releasing service on terminal block 2 of the AFP-200. The Kidde-Fenwal Electric Control Heads did respond to the momentary pulses. No determination was made as to which other releasing devices might respond to pulses produced by the AFP-200 panel.

In some installations, releasing devices are connected to CMX modules on the AFP-200 signaling line circuits (SLC) rather than to the notification appliance circuits on terminal block 2. The possibility of activation of releasing devices connected to CMX modules on the SLC upon interruption of AC power to the AFP-200 theoretically should be remote. No testing has been done to date, however, to determine a risk factor for unwanted activation of releasing devices connected to CMX modules on the SLC.

Notifier Document 15378 lists releasing devices compatible with AFP-200 panels. Among the

compatible releasing devices, there is equipment that is used to discharge high-pressure carbon dioxide as well as other types of fire suppression agents (for example, Halon 1301, FE-13, FM200, Inergen, dry chemical).

Recommended Actions: Testing has shown that the AFP-200 panel sometimes activates its notification appliance circuits on terminal block 2 when AC power to the panel is interrupted. Notifier, in the statement quoted above, acknowledges the possibility of momentary activation of output circuits due to "AC power loss or an AC voltage transient" under certain conditions. THEREFORE, PRECAUTIONS SHOULD BE TAKEN TO MITIGATE THE POSSIBILITY OF INJURY, DEATH, AND PROPERTY DAMAGE WHICH COULD OCCUR DUE TO UNWANTED DISCHARGE OF FIRE SUPPRESSION SYSTEMS CONTROLLED BY THE AFP-200 PANEL. ALTHOUGH THE SPECIFIC REQUIRED ACTIONS MAY VARY FROM INSTALLATION TO INSTALLATION, THE FOLLOWING GENERAL RECOMMENDATIONS ARE OFFERED FOR CONSIDERATION:

For any fire suppression system controlled by an AFP-200 panel: If the fire suppression system depends upon operation of the AFP-200 panel notification appliance circuits to control pre-discharge alarms, interlocks, shutdowns, remote notifications of discharge, etc., and a discharge in the absence of any of the aforementioned functions could result in injury or death to persons or unacceptable property damage:

- Take immediate action to establish compensatory measures. Disable releasing devices controlled by the AFP-200 panel in a manner that will prevent discharge of agent if the AFP-200 should activate those releasing devices.

- Do not remove any source of electric power, that is disconnect batteries or disconnect AC power, from the AFP-200 control until the releasing devices controlled by the panel are physically disabled.

- Until releasing devices are physically disabled, persons who must enter spaces that could be made unsafe by a discharge of a fire-extinguishing agent must use suitable personal protective equipment to protect them from injury or death in case of a discharge of the fire suppression agent.

Unless the potential consequences and costs of an unwanted discharge of agent are acceptable, replace AFP-200 control panels which control release of fire suppression systems with control panels that are designed such that, in case of failure, they will not release fire extinguishing agents without required pre-discharge alarms and auxiliary functions. As an alternative, if the manufacturer of the AFP-200 panel provides instructions for a modification of the panel which would preclude unwanted activation of the output circuits, modify all AFP-200 panels in accordance with such instructions.

In some cases the AFP-200 panel is used solely for alarm and signaling purposes with no releasing devices connected. Since the AFP-200 has been observed to produce momentary, undesired activation of its output circuits, review the functions associated with such systems. If momentary, unwanted activation of outputs could adversely affect life-safety or cause property

damage, replace the AFP-200 panel with a suitable, reliable substitute or as an alternative, if the manufacturer of the AFP-200 panel provides instructions for a modification of the panel which would preclude unwanted activation of the output circuits, modify all AFP-200 panels in accordance with such instructions.

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(Follow-up 1); Type A Accident Investigation Board Report