REPORT OF FIRE IN LABORATORY HOOD, WING I, BUILDING 4500

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SUMMARY

Nature of Incident: Approximately 16-18 liters of isopropyl alcohol in a 20-liter glass carboy in a floor-type hood were ignited by infrared heat lamps used to heat the carboy and contents.

Injury to Personnel: [REDACTED] Technician in the Chemical Development Department, Section A, Chemical Technology Division. Extent of injuries: Several minor lacerations on left hand. After treatment at the dispensary, he returned to regular work.

Property Damage: Damage to building: \$1,036
Damage to building contents: \$3,214
Total damage: \$4,250

Time of Incident: May 22, 1959 - 11:32 AM

Location of Incident: Building 4500, Wing 1, Laboratory B-1, Union Carbide Nuclear Company, Oak Ridge National Laboratory, Oak Ridge, Tennessee

DESCRIPTION OF INCIDENT

This fire involved approximately 30 liters of isopropyl alcohol as a result of the ignition of about 16-18 liters of isopropyl alcohol and a slurry of thoria and ammonium nitrate in a 20-liter glass carboy. This material was undergoing a volume reduction by boiling in a floor-type metal hood with Plexiglas sides and 3 sliding doors on the front of ordinary glass. The alcohol vapor was vented directly into the hood (Fig. 1). Three, 375-w, infrared heat lamps surrounding the carboy were used to heat the contents.

An employee working in the laboratory heard a noise behind him as if something were breaking. He turned and saw the entire floor of the hood involved in fire of sufficient magnitude to indicate leaving the laboratory at once. He left the laboratory and telephoned the Fire Department at 11:32 AM. Simultaneously with the telephone call, a Fenwal heat detector in the ceiling actuated fire alarm box No. 312 (Fig. 2). At approximately the same time, another employee actuated an auxiliary fire alarm box which tripped fire alarm box No. 315. The fire spread to involve 10 liters of alcohol in a polyethylene bottle on a stand and three liters in a glass filtering

flask nearby and thence to involve the room and paper-covered fiberglass insulation in the metal pan ceiling (Figs. 3 and 4). Heat was sufficient to melt a portion of the aluminum ceiling air intake ventilator and cause the safety plug on a small CO₂ extinguisher to fuse (Fig. 2).

A large portion of the heat and flames was pulled through the hood exhaust system in the attic and discharged above the roof. The neoprene connector between the filter and blower was destroyed and paint on the hood exhaust was burned off (Fig. 5). The two noncombustible filters (Protexol treated, wood frame, 24 x 24 in., 1000 cfm, ultra filters) maintained their integrity (Fig. 6). The entire attic was charged with heavy smoke due to the destruction of this connector, smoke seepage through the ceiling from the hood fire, and the burning paper covering the ceiling insulation, making ventilation extremely difficult (see Figs. 7 and 8, photos for general attic layout).

During the first few minutes of the fire, while waiting for the arrival of the Fire Department, three employees discharged two 15-lb CO₂ extinguishers into the room through the louvers located in the bottom of the door and a portion of a 100-lb CO₂ extinguisher was discharged through the broken glass panel of the door (Fig. 3). This knocked down the fire to some extent, but extinguishment was not possible due to the amount of heat which precluded direct discharge into the hood. Upon arrival, fire fighters discharged several short bursts of water fog from a 1 1/2-in. standpipe system through the door thereby effecting immediate control and extinguishment. A 15-lb, CO₂ fire extinguisher was used to extinguish the neoprene connector fire in the attic and the area was ventilated as quickly as possible. Several sections of the metal pan ceiling were pulled and a small wall section explored to seek out hidden traces of fire. The search proved negative. There were no radiation effects from the fire and no water damage resulted.

INCIDENTS INVOLVED

This process had been in intermittent operation on the day shift, 8:00 AM to 4:30 PM, since May 20 without incident. On the day of the fire, the process was started at approximately 8:05 AM, and was being routinely

checked by the laboratory technician, who was present when the fire occurred. There has been no previous history of hood fires involving flammable liquids in these amounts at ORNL. Hood fires experienced in the past involved only small amounts of such liquids and were extinguished in their incipency with small fire extinguishers and resulted in little or no damage.

CAUSE

The cause is attributed to ignition of the isopropyl alcohol vapors collecting in the bottom of the hood by heat from three 375-w infrared heat lamps or a lamp may have broken and exposed the vapor to the hot filament.

CONCLUSIONS

Fires from this type of process are to be expected and should be conducted in equipment specifically designed to contain any fire which may occur. In this case an excessive amount of flammable liquid was being processed in a hood of improper design and no automatic fire extinguishing equipment was provided. Sprinkler protection for the laboratory rooms in Building 4500 and in other buildings had been approved prior to the fire and will be installed in the near future.

Building employees are to be commended for their fire fighting efforts before arrival of the Fire Department. However, they would have been in a better position to effect immediate control of the fire if they had been trained more extensively in the location and application of fire fighting equipment available at the scene.

The fire emphasized the fact that employees not concerned with the emergency almost invariably gather at the scene, thereby impeding control of the emergency and exposing themselves needlessly to injury.

As will be noted in Fig. 3, one of the exit doors nearest the fire was blocked by a desk and hydrogen cylinder. This condition presents a danger of employees becoming trapped at the time of fire and presents an additional problem to fire fighting activities. At the time of the fire, the laboratory technician was standing to the left of the hood. Had he

been standing near this blocked door, or sitting at the desk, his chances of safely exiting the room without injury would have been considerably reduced.

Evident hazards to life and property were the presence of flammable gases, not in immediate use and exposed by the fire, that is, hydrogen, acetylene, and oxygen.

The fire alarm (evacuation signals) cannot be heard in all parts of the building. Where they can be heard, some employees are either not familiar with the signals or have not been instructed, in every case, as to the correct procedure to follow when the signals sound.

The Health Physics aspects of the fire were handled extremely well by Health Physics personnel at the scene, who continuously advised Fire Department personnel of activity conditions.

RECOMMENDATIONS

In order to prevent recurrence of fires of this type, the following recommendations should be incorporated in the conduct of chemical laboratories:

1. The quantity of flammable liquids and gases contained in individual laboratories should be limited to a minimum.
2. Approved flammable liquid storage cabinets and insulated metal bottle carriers should be procured by the Stores Department and made available as a stores stock issue.
3. Building Emergency Squads should be organized for Building 4500 to control local emergencies and provide the mechanics for an orderly evacuation of all personnel not immediately concerned with the emergency.
4. Hoods should be designed to contain any fire that could be reasonably expected and when it is necessary to process appreciable quantities of flammable liquids, a safe method of heating should be utilized and a fixed fire protection system should be incorporated.

5. The hood exhaust systems throughout the building should have:
 - A. Combustible filters replaced with the fire resistive type.
 - B. Neoprene connectors to the blowers replaced with a noncombustible material.
 - C. Low air flow alarm systems should be checked and placed in working order.

Fig. 1. Hood and Origin of Fire.

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HEAD DETECTOR
(FENWALL 140°F)
WHICH ACTIVATED
BOX 312

MELTED PORTION
OF ALUMINUM
VENTILATOR (AIR INTAKE)

HOOD LOCATED ABOUT
6 ft AWAY

SMALL CO₂ EXTINGUISHER
(SAFETY PLUG FUSED)

Fig. 2. General View of Ceiling.

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Fig. 3. General Room Damage.

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PHOTO 46758A

EXHAUST DUCT FROM
LABORATORY HOOD BELOW.
LOCATED ABOUT HERE

GENERAL VIEW OF PAPER
COVERED INSULATION INVOLVED.
LABORATORY IS DIRECTLY UNDERNEATH

PAPER EITHER CHARRED OR COMPLETELY BURNED OFF

PIPE CHASE IS
DIRECTLY BEYOND
THIS AREA (SEE FIG. 8)

Fig. 4. Space Between the Suspended Ceiling of the Laboratory and the Partial Concrete Floor in the Attic.

Fig. 5. Exhaust Duct from Laboratory Hood.

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PHOTO 46800A

Fig. 6. Cutaway Section of Ultra Filter.

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CLASS 2 ROOF

THIS AREA HEAVILY CHARGED WITH SMOKE
(VISIBILITY LIMITED TO 10-FT AT ENTRANCE
TO ATTIC)

CONCRETE FLOOR COVERS AREA OF LABS
IN CENTER OF WING ONLY, AND IS OPEN AT
EACH SIDE, AND HAS CONTINUOUS PIPE CHASE
OPENINGS IN THE CENTER. SEE FIG. 8. THIS
ACCOUNTS FOR SOME OF THE SMOKE PENETRATION.

Fig. 7. General Attic Layout.

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Fig. 8. General Attic Layout Showing Pipe Chase.

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