Fermilab

November 15, 1984

MEMO TO: Distribution

FROM: C. Bonham

SUBJECT: Hand and Face Protection While Working With Cryogens
A Review of a Recent Accident - November 1, 1984

The rare cook who doesn't suffer an occasional burn. When I pulled K.P. Duty in the army and a cook burned himself and swore, I quietly thought that it was a manifestation of God punishing the wicked. It is also the rare cryogenic worker who doesn't suffer an occasional cryogenic burn, but it is probably not God's wrath in this case, for our technicians are kind and good.

A thermal burn damages by "cooking" and killing the tissue thru coagulation of the proteins. Cryogenic burns also damage tissue but by the formation of ice crystals within the cells, which in some cases rupture the cell wall. This is why it is recommended never to rub frozen tissue in an effort to warm it. The subsequent manipulation causes additional damage by the movement of the ice crystals within the cells which might have otherwise made it thru the initial trauma of being frozen. It is interesting to note that under controlled laboratory conditions of freezing and thawing, some cells can actually survive freezing. Such is the case with artificial insemination (AI) as practiced in modern animal husbandry. Of course, a cryogenic spill on your skin is not a controlled situation. It is dangerous!

Remember that is is not just the liquid phase of a cryogen that can freeze tissue. Cold evolved gas and/or contact with cold materials (i.e. valve handles, tools etc.) can also extract heat from tissue. Leather gloves will provide protection for a few seconds, then they too will freeze. Some of our cryogenic groups have experimented with special thermal gloves (Fig.1) that combine leather with superinsulation sub-layers. These gloves are expensive ($25/pr.), and provide a few extra seconds of protection. These can be ordered thru your supervisor. Cotton gloves are, at least, no protection and may be worse than not wearing them at all. Take the following recent accident case (which is the reason for this memo).

Date & Time of Injury: October 24, 1984 1120 Hrs.

Diagnosis: 2^{o} Liquid Nitrogen burn-right hand. Employee states that liquid nitrogen boiled over top of reservoir onto right hand.

Employee Statement: "I was carrying an open mouthed LN_2 reservoir over to a supply of dewar when LN_2 boiled over top onto hand."

Employee Statement on Accident Prevention: "Place sharp metal object on bottom of reservoir to break up bubbles in LN_2."

Fig. 1 Tempo Thermo Gloves Used for Cryogenic Work.

A review of the accident revealed that the individual was wearing lightweight cotton gloves. These not only retained the cold liquid/gas next to the skin, but the gloves were difficult to remove quickly. This accounted for much of the burn. He would have been better off without cotton gloves. Only leather gloves which are easily removeable should be used when working with cryogens.

The second lesson to be learned from this accident is that a full open-mouthed dewar should never be moved. Move the supply dewar to it rather than visa-versa. If that is not practical, slowly pour off the contents of the open-mouthed dewar if it can be done without creating a local ODH problem. Figure 2 shows both the typical open-mouthed dewar and a supply dewar.

The employee's prevention statement was also interesting in that he recommended the use of a "boiling chip". A similar idea is used in the organic chemistry lab where a small stone chip is included with boiling solutions that are known to "bump" or boil-over with a sudden surge. LN_2 is also in this phase change state (boiling) where any added energy (such as sloshing about when carrying) may be just enough to cause it to "bump" or boil-over. This happens when the super-heated fluid on the bottom rolls-over to the top, or "bumps". Such a situation could occur, according to Stan Stoy, in a large dewar that has sat quiescent for a long time. He rather doubts that that situation would occur here at NAL because of our usage style.

And the hand bone is connected to the arm bone, so what about protection of your arms? Figure 3 shows Jerilyn (CHL) wearing a "TYVEC" shop coat (stock item-safety section of stores catalog). This is a plastic impregnated material that provides good initial protection

Fig.2 Open Mouthed Dewar and Supply Dewar (Jerilyn-CHL)

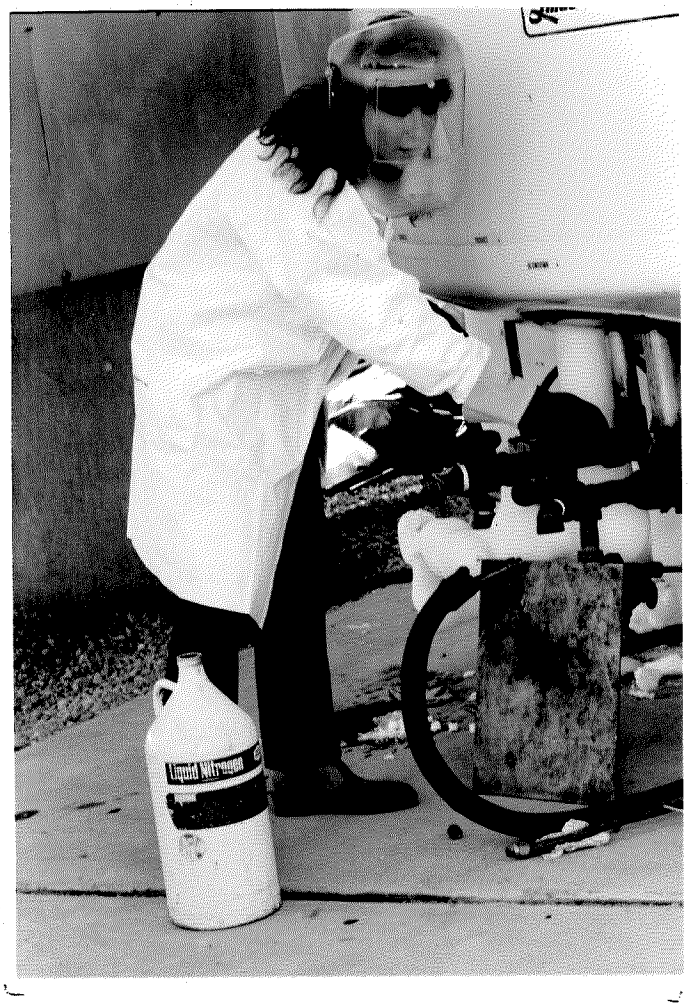

Fig.3 TYVEC Shop Coat. Provide Arm and Body Protection.

against cryogen splashes and cold gas. Figure 3 shows that long sleeves can offer minimal protection over that of unprotected skin.

The neck and head bone need protection as well. Note in Figure 4 that Jerilyn is wearing the "Tiger" brand face shield that provides protection to both the neck and face (NAL stock no. 2650-2620). It is shaped somewhat like a welder's face shield; note how the lateral curvature protects the sides of the face as well. This added protection is not afforded by the inexpensive GSA face shield.

Please see that your employees, who may work with cryogenic materials, understand the content of this memorandum. If you wish, Linda Beddingfield can provide short orientation training to your employees at your work area. You may contact Linda at X-4437.

Fig.4 "Tiger Face Shield" Provide Protection to Both Head and Neck, an NAL Stock Item.

ADDENDUM: Another Cryo Burn

We incurred another cryogenic burn on November 13th which we can include with this memorandum. The primary cause for this incident was a communications failure-a fairly common sort of thing. Lets see what happened; I'll use fake names in the story-line.

Horatius was apparently asked to "sting" a gauge in a valve box which was supposed to be warm. It wasn't; the gauge was actually intended to be put in a "Cold Box" which was actually warm, not cold. Are you following the story so far? A "Cold Box" is a generic name for a piece of cryogenic equipment. To "sting" a gauge (etc.) refers to opening a ball valve while simultaneously pushing a hollow shaft (pipe) past its throat area. In this case a gauge was attached to the other end of the pipe.

This is the same basic process used for connecting up transfer lines etc. Of course when the ball valve is holding back cryogens, the cryogenic technicians will wear all of the protective equipment discussed earlier in this memorandum. Since Horatius believed only warm gas was behind the valve, he did not bother wearing it. Then when he "stung" the gauge, SURPRISE-LN_2.

Several recommendations may be worth considering. Since all of our valves are tagged with brass I.D. tags, it might be better practice to refer to a specific valve by number, rather than less precise generic words, or use the two in combination. This would also require positive identification of the valve in question from an up-to-date print.

In those situations where a bayonet-type assembly may be holding back high pressure LN_2, they should only be "stung" by written procedure. LN_2 under pressure obviously represents a serious potential hazard which would warrant additional inquiry to the MCR cryogenic operator that any "warm" bayonet-type assembly, capable of containing LN_2 under pressure, is indeed "warm" - that is, it does not contain LN_2.

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