

Names of BNL Risk Team Members: R. Chmiel; R. Sabatini; R. DiNardo; J. Peters; R. Gill; R. Selvey	Point Value → Parameter ↓	1	2	3	4	5
Names of Chemistry Department Risk Team Members: Diane Cabelli, Richard Hahn, Jan Hrbek	Frequency (B)	≤once/year	≤once/month	≤once/week	≤once/shift	>once/shift
Job Title: Cryogenic Work Job Number or Job Identifier: CO-FRA-6	Severity (C)	First Aid Only	Medical Treatment	Lost Time	Partial Disability	Death or Permanent Disability
Job Description: General work with non-combustible cryogenic fluids and systems. Does not include liquid hydrogen or liquid oxygen. Training and Procedure List (Optional):	Likelihood (D)	Extremely Unlikely	Unlikely	Possible	Probable	Multiple
Approved by: D. Cabelli Date: 6/18/12 Rev. #: 1/2/3						
Stressors (if applicable, please list all):		Reason for Revision: Triennial, reviewed by J. Taylor, changed severity on ODH in elevator to 5 Rev2: Added lessons learned about Dewars. Rev 3: Triennial removed O2 sensor control as CO has no O2 sensors and no need for O2 sensors.			Comments:	

Job Step / Task	Hazard	Control(s)	Before Additional Controls						Control(s) Added to Reduce Risk	After Additional Controls					% Risk Reduction	
			Stressors Y/N	# of People A	Frequency B	Severity C	Likelihood D	Risk* AxBxCxD		Stressors Y/N	# of People A	Frequency B	Severity C	Likelihood D		Risk* AxBxCxD
Moving large dewar to/from liquid nitrogen room	Overexertion injuries caused by excessive lifting, pushing, pulling	Wheeled dewars, training,	N	1	2	3	3	18								
	Tripping or having large dewar tip over.	Empty and full dewars separated. Room clear as monitored by Tier I inspections	N	1	2	3	2	12								

Job Step / Task	Hazard	Control(s)	Before Additional Controls						Control(s) Added to Reduce Risk	After Additional Controls					% Risk Reduction
			Stressors Y/N	# of People A	Frequency B	Severity C	Likelihood D	Risk* AxBxCxD		Stressors Y/N	# of People A	Frequency B	Severity C	Likelihood D	
	Being struck by object due to pressure release	Vessel design/certification, equipment inspection by BNL, Tier 1, training	N	1	2	4	2	16							
Transporting dewar in elevator	Oxygen deficiency	Training, no persons in elevator, signs posted in freight and personnel elevators.	N	1	2	5	1	10							
Connecting or disconnecting storage dewar to cryostat	Falls to lower level from ladders or other cryostat access	Ladder design, equipment inspection, Tier 1, training, procedures	N	1	3	3	3	27							
	Being struck by object due to pressure release	Vessel design/certification, equipment inspection, training, Tier 1	N	1	3	3	2	18							
	Contact with temperature extremes that result in such injuries as frost bite or burns	Training, procedures, gloves, eye protection, proper clothing	N	1	3	2	3	18							
	Oxygen deficiency	Training, posting, safety reviews, ventilation, ODH calculations (see ODH FRA)	N	1	3	5	1	15							
Transferring cryogenic liquid from storage dewar to cryostat	Being struck by object due to pressure release	Vessel design/certification, equipment inspection, training, Tier 1	N	1	3	3	1	9							
	Contact with temperature extremes that result in such injuries as frost bite or burns	Training, procedures, gloves, eye protection, proper clothing	N	1	3	2	3	18							

Job Step / Task	Hazard	Control(s)	Before Additional Controls						Control(s) Added to Reduce Risk	After Additional Controls					% Risk Reduction
			Stressors Y/N	# of People A	Frequency B	Severity C	Likelihood D	Risk* AxBxCxD		Stressors Y/N	# of People A	Frequency B	Severity C	Likelihood D	
	Oxygen deficiency	Training, posting, safety reviews, ventilation, ODH calculations (see ODH FRA)	N	1	3	5	1	15							
Transferring cryogenic fluid to portable dewar	Contact with temperature extremes that result in such injuries as frost bite or burns	Training, procedures, gloves, eye protection, proper clothing	N	1	3	2	3	18							
	Oxygen deficiency	Training, posting, safety reviews, ventilation, ODH calculations (see ODH FRA)	N	1	3	5	1	15							
Hand transfer of cryogenic fluid from portable dewar to system	Contact with temperature extremes that result in such injuries as frost bite or burns	Training, procedures, gloves, eye protection, proper clothing	N	1	3	2		24							
	Oxygen deficiency	Training, posting, safety reviews, ventilation, ODH calculations (see ODH FRA)	N	1	3	5	1	15							
	Cut by sharp object due to breakage of glass thermos dewar	Training, procedures, gloves, eye protection, proper clothing, wrapping dewar with tape or plastic netting	N	1	3	1	3	9							
Operation of auto fill system	Oxygen deficiency due to system failure	System design, operating procedures, work planning, training	N	1	3	5	2	30							

Job Step / Task	Hazard	Control(s)	Before Additional Controls						Control(s) Added to Reduce Risk	After Additional Controls					% Risk Reduction
			Stressors Y/N	# of People A	Frequency B	Severity C	Likelihood D	Risk* AxBxCxD		Stressors Y/N	# of People A	Frequency B	Severity C	Likelihood D	
	Contact with temperature extremes that result in such injuries as frost bite or burns	Training, procedures, gloves, eye protection, proper clothing	N	1	3	2	3	18							
Further Description of Controls Added to Reduce Risk:															
*Risk:	0 to 20 Negligible	21 to 40 Acceptable	41 to 60 Moderate					61 to 80 Substantial			81 or greater Intolerable				

Lessons Learned Statement:

- Even workers with years of lab experience who have satisfied all the training requirements can make poor choices in the absence of established protocol.
- Informal protocols that have been followed for years can have a small but significant failure rate leading to an accident.
- Equipment must be maintained in good working order. Get help if something needs to be repaired, rather than passing it over and possibly creating an unsafe condition.
- Every supervisor should be required to perform frequent laboratory walkarounds in which worker behavior, lab conditions and experimental protocols are evaluated with an eye to safe operation. Supervisors are responsible for correcting any adverse findings.
- Personal protective equipment must always be worn in the lab. This includes safety goggles, closed-toed shoes, and long pants. Special considerations apply to cryogenics (full face shield when working with a pressurized Dewar such as the 50 Liter in the accident, or standard 160& 220-Liter Dewars).

Discussion of Activities:

A guest scientist sustained a minor injury when a Dewar cap burst off and hit his forehead. The scientist needed to fill the 50-Liter liquid nitrogen Dewar, which hadn't been used for several months. He assumed it was depressurized because of its lack of use, and attempted to verify this assumption by pulling a pressure relief plug. His assumptions were incorrect, and the Dewar did contain residual pressure. When the scientist

removed a clamp holding the top valve assembly, it burst off and hit him. He suffered a slight laceration to the forehead between the eyes, was treated at a local hospital and returned to work the same day.

Analysis:

Several errors in safety planning occurred:

1. Instead of filling the Dewar through a safe fixed fill line, the worker elected to remove the entire top assembly. This was a poor choice of protocol, showing that the hazards hadn't been fully analyzed.
2. The worker erroneously assumed that the Dewar was empty, and this was "confirmed" by pulling the pressure relief plug without sensing any gas escape. However, the relief valve that he pulled was not designed to be manually operated (there was no pull ring) and it is probable that it never opened. The worker could have correctly relieved the internal Dewar pressure by opening a vent valve.
3. The worker did not wear safety goggles or face shield. The top assembly blew off, hitting his face, causing bleeding & requiring emergency medical response. Fortunately, the injury was not severe. It would have been more correct to make no assumption, instead wearing eye and face protection until the Dewar was proven to be empty.