Exhibit
Chemical Protective Gloves and Suit Selection Process

The table below provides guidance in the selection of Chemical Protective Equipment. Steps in selecting an appropriate glove or suit:

1	Choose PPE only after alternative controls have been explored: • Substitute a less hazardous chemical (if practical) • Use hoods, glove boxes, capture ventilation to control vapors, mists, liquids
2.	Evaluate the job and type of exposure: a. Chemical(s) involved (example: benzene) b. Duration of exposure (example: 20 minutes in constant contact with liquid) • How long will contact be in routine use and emergencies? Will the contact be immersion for long periods, splash, or incidental contact? • Chemical(s) attack on the glove (breakthrough time, permeation rate, degradation) must be shorter than the breakthrough time. Be sure to include cumulative time on re-used gloves. Refer to a Chemical-Resistant Table from the manufacturer or the attached <u>Recommended Glove Material for common BNL laboratory chemicals</u> • **Breakthrough Time:** The elapsed time between initial contact of the chemical on the glove surface and the analytical detection on the inside of the glove. When expressed with a greater than symbol (>), the test was run for "n" minutes and then stopped. • **Degradation:** A change in one or more of the physical properties of a glove due to contact with a chemical. Can appear as a swelling, softening, shrinkage or cracking of the material. A rating of "E" for excellent, means the glove has little or no signs of degradation when exposed to the challenge chemical. **A favorable degradation rating does not guarantee an acceptable breakthrough time.** • **Permeation Rate:** The rate at which a chemical passes through a glove material. This process involves absorption on the glove surface, the diffusion of the chemical through the material, and the desorption on the glove's inside surface. This measurement is given is $\mu g/cm^2$/minute, but is sometimes expressed as "E" to "P" for excellent to poor.
3	Evaluate the material handling aspects of the job: The nature of the job being performed will greatly influence the selection and features of protective clothing. For example, analyzing samples in a laboratory may require light-duty gloves (<10 mils in thickness) that are flexible and have good manual dexterity; while a maintenance project, such as repairing a pump line, may require thicker gloves that are rugged and durable. **Glove Dexterity** - Will a bulky glove cause drops, accidents or slips? Are small intricate parts handled? **Select the appropriate glove thickness** (example: single use disposable glove vs. reusable gloves) • Select a thinner, unsupported glove when you require extra dexterity and tactile sensitivity. When a high degree of manual dexterity is needed with a hazardous substance, use of thin glove with limited protection time may be acceptable *if the*

	gloves are changed with sufficient frequency. • Select a heavier-gauge unsupported glove for greater protection and wear. Consider a flock-lined, unsupported glove for extra comfort, insulation and wear. **Choose the finish** you need for the grip for your application: rough, smooth, wrinkle, embossed, bisque, etc.
4.	Evaluate the physical conditions the gloves will be subjected to and determine which types of resistance are important: abrasion, cut, puncture, temperature, etc. Physical conditions can influence chemical resistance. When possible, choose a supported or cut-and-sewn glove for added cut, snag, puncture or abrasion resistance.
5	Size the glove: • Select glove length by determining the depth to which your hand and arm will be immersed in a solution and the extent to which you need splash protection. • Select the hand size that gives you the right fit, dexterity and comfort. To determine your size, measure the circumference around the palm area. This is your glove size. For example, 7" is equal to a size 7 glove. (XS = 6-7, S = 7-8, M = 8-9, L = 9-10, XL = 10-11)
6	Factor in the following • Cost of the glove (example: Viton is very expensive). Does a cheaper glove have adequate properties? • Reuse of the glove (example: Can many cheaper disposable gloves be used in place of a more expensive reusable glove? • Storage and decontamination: Storing an exposed glove between uses can shorten the life of protection). Use of disposable gloves and clothing is often preferred, because proper decontamination of reusable items is often difficult.
7.	Document the selection via • Exhibit: PPE Selection Form • SOP • Work planning documentation • Other Department/Division-developed mechanism.

Recommended Glove Material for common BNL laboratory chemicals

Chemical Name	Splash Protection (disposable, exam style)			Immersion & Sustained Contact						
				Disposable Nitrile (N-Dex) (unflocked and unsupported)						Reusable (typically flocked or fabric support)
	Nitrile (N-Dex, Purple Knight)	Natural Rubber (Latex Exam)	PVC	DEGRADATION (MIN)				PERMEATION (MIN)		
				5	30	60	240	Break-thru time	Rate	
Acetonitrile	**p**	NR	NR	P	P	P	P	4		E= Butyl, Teflon, 4H
Acetic anhydride	NR	NR	NR	NR	NR	NR	NR	NR	NR	E= butyl, Teflon, 4H
ACIDS, dilute	E	F	F	E	E	E	E			Butyl, Nat Rubber, Neoprene, Nitrile, PVC, Teflon, Viton, 4H
Hydrochloric Acid 37%	E	F	F	E	E	E	E	ND	ND	E= Butyl, Nat Rubber, Neoprene, Nitrile, PVC, Teflon, Viton, 4H
Phosphoric Acid 85%	E	F	F	E	E	E	E	ND	ND	E= Butyl, Nat Rubber, Neoprene, Nitrile, PVC, Viton, 4H
Nitric Acid 30-70%	G	NR	F	G	P	NR	NR	NR	NR	E= Butyl, Neoprene, Viton, 4H
Nitric Red Fuming	NR	NR	NR							E= Teflon
Sulfuric Acid 97%	G	NR	F	G	P	NR	NR	NR	NR	E= Butyl, Teflon, 4H, Viton
Acetic Acid 84%	E	F 1-4 HR	F 1-4 HR	E	P	P	NR	NR	NR	E= Butyl, Neoprene, Viton, 4H
ALKALI, dilute	G	F	F	F	F	F	F			Butyl, Nat Rubber, Neoprene, Nitrile, PVC, Teflon, Viton, 4H
Ammonium Hydroxide 30-70%	G	NR	P							E= Butyl, Neoprene, Nitrile, Teflon
Potassium Hydroxide (KOH) 45%	E	F	F	E	E	E	E	ND	ND	E= Butyl, Nat Rubber, Neoprene, Nitrile, PVC, Teflon, Viton, 4H
Sodium Hydorxide (NaOH) 50%	E	F	F	E	E	E	E	ND	ND	E= Butyl, Nat Rubber, Neoprene, Nitrile, PVC, Teflon, Viton, 4H
ALCOHOLS	G	F	G							Butyl, Nat Rubber, Neoprene, Nitrile, PVC, Teflon, Viton, 4H
Ethanol	E	NR	NR	E	E	E	G	7	12	E= Butyl, Neoprene, Viton, 4H; F= Nitrile
Iso-propanol (2-propanol)	E	NR	F	E	E	E	E	15	29	E= Butyl, Neoprene, Nitrile, Teflon, Viton, 4H
Methanol	E	NR	NR	E	G	G	F	NR	NR	E = Butyl, Neoprene, Nitrile, Teflon, Viton, 4H
n-Propanol	G	NR	F	G	F	P	P	7	42	E = Butyl, Teflon, Viton, 4H
ALDEHYDES										
Acetaldehyde	NR	NR	NR	NR	NR	NR	NR	NR	NR	E= Butyl, 4H, Teflon
Benzaldehyde	NR	NR	NR	NR	NR	NR	NR	NR	NR	E= Butyl, PVA, Viton, 4H
Formaldehyde	E	NR	F	E	E	E	E	ND	ND	E= Butyl, Nitrile, Viton, 4H
Ammonia	NR	NT	NR	NR	NR	NR	NR	NR	NR	E= Butyl, Nitrile, Teflon, Viton
AROMATICS	F	NR	NR	NR	NR	NR	NR	NR	NR	PVA, Viton, 4H
Benzene	NR	NR	NR	NR	NR	NR	NR	NR	NR	E= PVA, Teflon, Viton, 4H
Toluene	F	NR	NR	NR	NR	NR	NR	NR	NR	E= PVA, Teflon, Viton, 4H
Xylene	F	NR	NR	NR	NR	NR	NR	NR	NR	E= PVA, Teflon, Viton, 4H
CHLORINATED HYDROCARBONS	P	NR	NR	NR	NR	NR	NR	NR	NR	Butyl, Nitrile, PVA, Teflon, Viton, 4H
Carbon tetrachloride	F	NR	NR	NR	NR	NR	NR	NR	NR	E= PVA, Viton, 4H
Chloroform	P	NR	NR	NR	NR	NR	NR	NR	NR	E= PVA, Viton, 4H, Teflon

Chemical Name	Splash Protection (disposable, exam style)			Immersion & Sustained Contact						
				Disposable Nitrile (N-Dex) (unflocked and unsupported)						**Reusable** (typically flocked or fabric support)
				DEGRADATION (MIN)				PERMEATION (MIN)		
	Nitrile (N-Dex, Purple Knight)	Natural Rubber (Latex Exam)	PVC	5	30	60	240	Break-thru time	Rate	
Methylene Chloride (dichloromethane)	F	NR	NR	NR	NR	NR	NR	NR	NR	E= PVA, Teflon, 4H
Trichloroethane, 1,1,1-	F	NR	NR	NR	NR	NR	NR	NR	NR	E= Butyl, PVA, Viton, 4H
Trichloroethylene	F	NR	NR	NR	NR	NR	NR	NR	NR	E = PVA, Viton, 4H
DMF	P	NR	NR	NR	NR	NR	NR	NR	NR	E= Butyl, Teflon, 4H
DMSO	E	NR	NR	E	G	F	P	23	84	E= Butyl, Neoprene, Teflon, 4H
EPOXY RESINS	G	P	F							Butyl, Neoprene, Nitrile, PVC, Teflon, Viton, 4H
Ethyl ether	G	NR	NR	G	G	G	G	2	495	E= PVA, 4H, Teflon
ESTERS	P	NR	NR	NR	NR	NR	NR			Butyl
Ethyl Acetate	P	NR	NR	NT	NT	NT	NT	NT	NT	E= PVA, Teflon, 4H; F= Butyl
Hydrazine	NT	F	G							E= Butyl, Neoprene, Nitrile, PVC
HYDROCARBONS/ PETROLEUM DISTILLATES	G	F	F							E= Butyl, Neoprene, Nitrile, PVC, PVA, Teflon, Viton, 4H
Hexane	E	NR	NR	E	E	E	E	11	8	E= Nitrile, PVA, Teflon, Viton, 4H
Hydrogen Peroxide 30-70%	G	G	G							Butyl, Nitrile, PVa, Viton, 4H
KETONES										Butyl, 4H
Acetone	NR	NR	NR	NR	NR	NR	NR	NR	NR	E= Butyl, Teflon, 4H
Methyl Ethyl ketone	F	NR	NR	NR	NR	NR	NR	NR	NR	E= Butyl, Viton, 4H
Mercury	G	G	G	NT	NT	NT	NT	NT	NT	E = 4H **Note:** most gloves afford good protection
OILS, GREASE	E	E	E							E= Butyl, Neoprene, Nitrile, PVC, PVA, Teflon, Viton, 4H
PCBs	F	NR	NR							E = Viton
Tetrahydrofuran	F	NR	NR	NR	NR	NR	NR	NR	NR	E= Teflon, 4H

NR= not recommended **ND**= none detectable (permeation) **NT** = not tested **NA** = not applicable	**E**= excellent **G** = good **F** = fair **P** =poor	Butyl = butylenes/isoprene copolymer 4H = Silvershield = (polyethylene/ethylene vinyl alcohol copolymer) Natural rubber = isoprene from *gutta percha* Neoprene = DuPont trademark for chloroprene	PVA= tradename of Ansell for polyvinyl alcohol PVC= polyvinyl chloride Teflon = DuPont trademark for polytetrafluoroethylene (PFTE) Viton = DuPont trademark for hexafluoropropylene/vinylidene fluoride copolymer

Source: Best Glove 4/98 Degradation/Permeation Table: Forsberg, Krister, & Mansdorf, S. Z. (1997). *Quick Selection Guide to Chemical Protective Clothing* (3rd ed.). New York: Van Nostrand Reinhold.