HEAT AND COLD STRESS	Identifier: PRD-2107 Revision: 4 Page: **1** of 9

Subcontractors	Program Requirements Document	For Additional Info: http://EDMS	Effective Date: 03/23/05

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1. PURPOSE

This document provides requirements for addressing temperature conditions that may lead to heat stress or cold stress. This document highlights requirements referenced in the "Source Document" section, as well as CONTRACTOR requirements. Any applicable regulatory or CONTRACTOR requirements must be followed, with the most stringent requirement being met.

2. APPLICABILITY

This document applies to all subcontractors working at the INL as specified in their contract with CONTRACTOR. Stricter requirements may be imposed by subcontractors upon their employees or subtier contractors. The requirements of this document must be followed by subcontractors; however, the means of implementation may vary as determined by the subcontractor.

3. REQUIREMENTS

NOTE: *Throughout this document, the terms hot and cold are used to indicate temperature, rather than radioactive or electrical energy.*

3.1 All anticipated jobs shall be reviewed for potential heat and cold stress hazards by obtaining information regarding the temperature of the work area, expected work rate, and personal protective equipment required.

3.2 Workers shall be trained to:

3.2.1 recognize signs and symptoms of heat and cold stress

3.2.2 understand the concept of acclimatization

3.2.3 understand the importance of drinking plenty of water in heat stress environments

3.2.4 understand alternative methods for cooling in heat stress environments

3.2.5 understand alternative methods for warming in cold stress environments

3.2.6 the requirements of this document.

3.3 Workers shall inform their supervisor of any heat/cold stress restrictions or medical limitations.

3.4 Workers shall inform their supervisor of any physical conditions that may impact their work performance in a hot or cold environment, including illness, allergies, hangover, etc.

3.5 When informed of a physical condition or medical restriction, subcontractor management/supervision shall decide whether to refer the employee to the subcontractors contract physician for evaluation.

3.6 Work stay times shall be determined by supervision for jobs conducted under hot or cold conditions with the assistance of a safety and health officer, as appropriate, by:

3.6.1 determining cold stay times in accordance with Appendix A, Threshold Limit Values Work/Warm-up Schedule for four Hour Shift, and Appendix B, Equivalent Chill Temperatures.

3.6.2 determining the work rest stay times using Appendix C, Heat Stress Stay Time Worksheet. Note: Tables, 1-2-3 are to be used to establish clothing allowances and work/rest stay times. Apendix D provides a decision-making diagram for the use of WBGT values.

3.6.3 document the heat stress work/rest stay times, by the Supervisor/safety and Health Officer using Appendix C, on work control documents, associated pre-job briefing form, safe work permit, or on a confined space entry permit, as applicable.

3.7 Supervisors shall determine if there is a need to use a buddy system.

3.8 If the anticipated work time will exceed the heat stress stay time, then the heat stress stay time may, with Safety and Health Officer concurrence, be extended.

3.9 Extensions to the heat stress stay time shall be documented and agreed to by all workers involved with the particular task/job.

3.10 All heat/cold requirements, including stay times and extensions, shall be documented on the appropriate work control document.

3.11 Workers shall be directed by supervision to leave the work area when the heat stress or cold stress stay time is reached.

4. DEFINITIONS

None

5. REFERENCES

5.1 Source Documents

DOE Order 440.1A, Worker Protection Management for DOE Federal & Contractor Employees .

Occupational Safety and Health Act, AGeneral Duty Clause≅ section 5(a)1, 1970.

5.2 Related Requirements

The following documents may also contain requirements that apply to this activity:

PRD-2001, Personal Protective Equipment

6. APPENDICES

Appendix A, Threshold Limit Values Work/Warm-up Schedule for four-Hour Shift

Appendix B, Equivalent Chill Temperature

Appendix C, Heat Stress Stay Time Worksheet

Appendix D, Heat Stress Decision-Making Diagram

APPENDIX A

Threshold Limit Values[a] Work/Warm-up Schedule for Four-Hour Shift[b, c]

Air Temp – Sunny Sky	No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
(°F)	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks	Max. Work Period (min.)	No. of Breaks
-5 to -9	120	1	120	1	120	1	120	1	75	2
-10 to -14	120	1	120	1	120	1	75	2	55	3
-15 to -19	120	1	120	1	75	2	55	3	40	4
-20 to -24	120	1	75	2	55	3	40	4	30	5
-25 to -29	75	2	55	3	40	4	30	5	Non-emergency work should cease	
-30 to -34	55	3	40	4	30	5	Non-emergency work should cease		Non-emergency work should cease	
-35 to -39	40	4	30	5	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease	
-40 to -44	30	5	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease	
-45 & below	Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease		Non-emergency work should cease	

a. TLVs apply only for workers in dry clothing.

b. Schedule applies to any 4-hour work period with moderate-to-heavy work activity, with warm-up periods of 10 minutes in a warm location and with an extended break (i.e., lunch) at the end of the 4-hour work period in a warm location. For light-to-moderate work (limited physical movement): apply the schedule one step lower. For example, at -30°F with no noticeable wind, a worker at a job with little physical movement should have a maximum work period of 40 minutes with 4 breaks in a 4-hour period. This scenario would have 5 work periods of 40 minutes each, with each work period being followed by a 10-minute warm-up period. An extended break (i.e., lunch), would occur at the end of the 5th 40 minute work period.

APPENDIX B

Equivalent Chill Temperatures

Wind Chill Chart

Wind (mph)

Temperature (°F)	Calm	5	10	15	20	25	30	35	40	45	50	55	60
40	36	34	32	30	29	28	28	27	26	26	25	25	
35	31	27	25	24	23	22	21	20	19	19	18	17	
30	25	21	19	17	16	15	14	13	12	12	11	10	
25	19	15	13	11	9	8	7	6	5	4	4	3	
20	13	9	6	4	3	1	0	-1	-2	-3	-3	-4	
15	7	3	0	-2	-4	-5	-7	-8	-9	-10	-11	-11	
10	1	-4	-7	-9	-11	-12	-14	-15	-16	-17	-18	-19	
5	-5	-10	-13	-15	-17	-19	-21	-22	-23	-24	-25	-26	
0	-11	-16	-19	-22	-24	-26	-27	-29	-30	-31	-32	-33	
-5	-16	-22	-26	-29	-31	-33	-34	-36	-37	-38	-39	-40	
-10	-22	-28	-32	-35	-37	-39	-41	-43	-44	-45	-46	-48	
-15	-28	-35	-39	-42	-44	-46	-48	-50	-51	-52	-54	-55	
-20	-34	-41	-45	-48	-51	-53	-55	-57	-58	-60	-61	-62	
-25	-40	-47	-51	-55	-58	-60	-62	-64	-65	-67	-68	-69	
-30	-46	-53	-58	-61	-64	-67	-69	-71	-72	-74	-75	-76	
-35	-52	-59	-64	-68	-71	-73	-76	-78	-79	-81	-82	-84	
-40	-57	-66	-71	-74	-78	-80	-82	-84	-86	-88	-89	-91	
-45	-63	-72	-77	-81	-84	-87	-89	-91	-93	-95	-97	-98	

Frostbite occurs in 15 minutes or less

$$\text{Wind Chill } (^{\circ}\text{F}) = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T = Air Temperature (°F)
V = Wind Speed (mph)

APPENDIX C

Heat Stress Stay Time Worksheet

Work Description

_____

1. What is the WBGT temperature in the work area? ☐

☐ Measured ☐ Estimated

2. What is the WBGT clothing adjustment factor? (Table 1) ☐

3. Add the WBGT values from the above two steps. ☐

4. Identify the expected work demand category? (Table 2) Light Moderate Heavy Very Heavy

WORK REST DETERMINATION

5. Compare WBGT value from line 3 to Table 3 to obtain work/rest times.

Work Time
Rest Time

NOTE: *If WBGT value is greater than those given in Table 3, then physiological monitoring must be performed.*

Table 1. WBGT clothing adjustment factors (CAF) in ^{o}F.

Clothing Ensemble	CAF
Standard cotton work clothes (denim work clothes or cloth coveralls)	0.0
Tyvek 1422/1424 coveralls over scrubs (not taped and without hood)	3.0
Single set of Anti-Cs; one Protech 2000 (polyester) or Tyvek coverall 1422/1424 with hood over scrubs	5.5
Tyvek coveralls over scrubs (not taped and without hood)	6.0
Single set of Anti-Cs; one coverall taped (cotton, cotton/polyester, or Tyvek) with hood over scrubs	8.0
Double set of Anti-Cs; two coveralls taped (cotton, cotton/polyester, or Tyvek) with hood over scrubs	11.0
Double set of Anti-Cs; two Protech 2000 (polyester) or Tyvek 1422/1424 with hood over scrubs.	9.0
Acid Suit (vapor-barrier coveralls designed for limited use worn over cloth coveralls; typical fabrics might be a polyethylene coated spunbonded polyethylene or a polyvinylchloride)	15.5
Encapsulating suit or turn-out gear	20.0
Level 2 Arc Flash Protective Equipment (flame-retardant shirt and pants made from FR treated fabric)	2.0

APPENDIX C

Clothing Ensemble	CAF
Level 3 arc flash protective equipment (flame-retardant shirt and pants w/single-layer jacket or coveralls made from FR-treated fabric)	3.5
Level 4 arc flash protective equipment (flame-retardant shirt and pants w/double-layer jacket or coveralls made from FR-treated fabric)	5.5
All clothing ensembles include consideration for the use of undergarment. If not specified as part of the ensemble, subtract 1.0 from all ensembles if the use of hood is eliminated. Add 1.0 if a hood is added. Clothing ensembles not identified within this table should be discussed with the area industrial hygienist for a determination of heat stress controls. If mixing ensembles with different types of materials, use the most conservative CAF value.	

Table 2. Work category guidelines.

Category	Example Activities	Site-Specific Examples
Light Work sustainable with ease for 8 hours.	Sitting w/ moderate arm and leg movement Standing w/ light work at machine/bench, using mostly arms Using a table saw Standing w/ light to moderate work at machine/bench and some walking about	Inspections and surveys Rigging activities Electrical shop work Carpenter shop work
Moderate Work sustainable for 8 hours with nominal breaks.	Scrubbing in a standing position Walking about w/ moderate lifting or pushing Walking on level at 6 km/hr while carrying 3 kg weight load	Painting Mopping floors Using and automatic buffer Insulation removal/installation
Heavy Work where breaks are required at least every hour.	Carpenter sawing by hand Shoveling dry sand/soil Intermittent heavy lifting with pushing or pulling (e.g. pick-and-shovel work) Heavy assembly work on a noncontinuous basis	Moving furniture by hand Scaffold erection, manual handling
Very Heavy Work where frequent breaks are required.	Shoveling wet sand/soil	Shoveling out tank sludge

APPENDIX C

TABLE 3. SCREENING CRITERIA FOR HEAT STRESS EXPOSURE (WBGT VALUES IN °F) BASED ON 1 HOUR WORK PERIODS.

	Acclimatized[1]				Unacclimatized[1]			
Work Demands	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
100% Work	< 85.1	< 81.5	< 78.8		< 81.5	< 77.0	< 72.5	
45 Min. Work; 15 Min. Rest	85.1 86.9	81.5 83.3	78.8 81.5		81.5 84.2	77.0 79.7	72.5 76.1	
30 Min Work; 30 Min. Rest	87.0 88.7	83.4 85.1	81.6 83.3	< 81.5	84.3 86.0	79.8 82.4	76.2 79.7	< 77.0
15 Min. Work; 45 Min. Rest	88.8 90.5	85.2 87.8	83.4 86.0	81.5 85.1	86.1 87.8	82.5 84.2	79.8 82.4	77.0 79.7

NOTES:

For the purposes of establishing work/rest schedules, workers can be considered acclimated if they have a history of heat stress exposure 4 of the past 7 days.

Normal breaks should be followed per 4-hour shift (i.e., midshift break and longer lunch break) whenever possible for continuous work.

Rest breaks may be taken in the work environment under the following conditions:

- The work environment is cool (WBGT is at or below the 100% work category for light work)
- Consideration given to the worker's well being and the need for a more formal break.
- Rest breaks taken in the work environment shall be without PPE that affects the Clothing Adjustment Factor.

Consideration given to the worker's well being and the need for a more formal break.

Industrial Hygiene can evaluate and extend work rest times when using additional controls such as cooling ensembles (cooling vests, vortex tubes, etc.) or conducting physiological monitoring.

APPENDIX D

Heat Stress Decision-Making Diagram