Winter Survey Plan

Appendix R

Revision 01, March 2009

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STANDARD OPERATING PROCEDURE FOR WINTER OPERATIONS

1.0 INTRODUCTION

0.0 This document describes the Standard Operating Procedures (SOP), as required by the USEPA Great Lake National Program Office (GLNPO) Maritime Safety Program, for winter sampling activities. This SOP has been developed with the objective of minimizing the hazards associated with winter sampling operations.

This SOP applies to all EPA personnel, EPA contractors or federal, state, or local government agencies, and persons who operate or are passengers on board USEPA -GLNPO vessels during winter work activities.

0.0 Objectives

0.0.0 Operate during meteorological conditions such that little or no icing occurs.

0.0.0 Operate in proximity to a port of refuge such that is icing occurs, ice build up can be controlled by returning to port.

0.0.0 Operate when air temperatures are above 28º Fahrenheit. (Figures 1 - 25).

0.0.0 Operate to avoid relative wind speed about 20 knots. (Figure 1 -24).

0.0.0 Maintain contact on a four hour shift basis with weather forecasting to determine the prediction of the passage of weather fronts, air temperatures, wind speeds, and lake water temperatures. Determine appropriate scenario to avoid icing conditions.

0.0.0 Incorporate the instructions by reference to USEPA GLNPO SOP for Winter Operations December 1994 booklet for PPE and Lifesaving and safety equipment.

2.0 LIFESAVING AND SAFETY EQUIPMENT

2.0 Rescue Boats

2.0.0 At all times during winter sampling activities, a rescue boat must be out rigged into a deployable position. Members of the crew responsible for man overboard rescue procedures must be well trained and readied for response activities. A response time of three minutes must be demonstrated by response team personnel.

2.0.0 All lifesaving equipment, such as lifelines, ring buoys, rescue boats and associated equipment, must remain un-obstructed at all times.

3.0 PERSONAL PROTECTIVE EQUIPMENT

3.0 Harnesses/Lifelines

3.0.0 When working on deck, specifically on the fantail or around the perimeter of the vessel, persons must wear safety harnesses and a lifeline should be rigged and used.

3.0 Personal Flotation Devices (PFDs)

3.0.0 All persons working on deck must wear, at a minimum, a type III PFD.

3.0 Hard Hats

3.0.0 Persons working an the bow of the vessel, or in any area where over head hazards may be present, must wear hard hats. (Refer to Protective Clothing, Head Covering section for additional information).

3.0 Protective Clothing

3.0.0 Humans are thermally sensitive creatures, and as such, must pay close attention to the temperatures in which they work. The most common types of cold injuries include hypothermia, a dangerous lowering of the body's temperature, and frostbite. To prevent hypothermia and frostbite, persons must be aware of the body as a heat source and the importance of clothing and insulation. A critical element in regulating heat loss is the type of fabric one chooses to wear. The insulating and ventilating properties of a given fabric or fill will determine how well one can moderate body temperature under certain conditions. The fibers provide good insulating values in a maritime environment. Polypropylene reduces heat stress and increases comfort and warmth by wicking moisture away from the body.

3.0 Socks

3.0.0 Warm socks made of polypropylene or wool are recommended. Make sure to have sufficient supply in the event they become wet.

4.0 OPERATION LIMITATIONS

4.2 Icing

5.0.0 The effects of icing on a vessel are a reduction in stability due to an increase in displacement and a rise in vertical center of gravity. In addition, a heeling movement may also develop due to an off-center accumulation of ice. Ship operators must be aware of the dependency of ice accumulation on the vessel heading. The need for the ship operator to make good a specific course can greatly influence the symmetry or asymmetry of ice accumulation.

When a vessel operates in areas where icing conditions are present, the operator must be aware that icing increases with the amount of time spent in icing conditions. Generally, any time the air

temperature is below 28º F, icing can occur. Wind speed, vessel heading and air temperature must all be considered when calculating expected icing conditions.

Safe operations as well as personal safety can be greatly increased by establishing operational limitations based on weather conditions. Staying abreast of current conditions and developing conditions is the responsibility of the Shipmaster. Maximum operating conditions are discretionary and final determinations should be made with consultation of the USEPA Chief Scientist and the Shipmaster, with the Shipmaster having final authority.

4.0 DECK EQUIPMENT

4.0 During icing conditions, all deck equipment should be covered and secured. Derricks, booms and like item should be stowed in the lowered position.

5.0 HEALTH AND SAFETY

5.0 Restricted Areas

5.0.0 There are a multitude of hazards which can occur in heavy weather. Persons involved in winter work who are exposed to weather must be aware of the potential hazards and safety requirements associated with work activities. To minimize the potential hazards associated with winter work activities, several areas on board the vessel have been designated as restricted areas. Weather decks subjected to seas are off limits unless permission has been granted from the Captain, and when applicable, in conjunction with the Health and Safety Officer. Such areas include, but are not limited to, the following:

0.) Top of Pilot House
0.) Mast
0.) Rosette Work Platform
0.) The 02 Deck
0.) The 01 Deck
0.) Starboard & Port Weather Decks
0.) Stern

5.0 Movement throughout the vessel should be limited to the interior whenever possible.

5.0 Buddy System

5.0.0 When involved in activities on deck, all persons will comply with the buddy system. The buddy should be capable of providing his or her partner with assistance, observe his or her partner for signs and symptoms of exposure, periodically check the integrity of his or her partners protective clothing, notify the bridge or others in the event of an emergency or need of assistance. The Buddy System alone may not be sufficient to ensure that help will be provided in an emergency. Therefore, persons on deck must be in line-sight or establish radio communication (or equivalent) with the Bridge at all times.

5.0 Hypothermia

5.0.0 As mentioned earlier in this document, hypothermia and frostbite are the most common cold injuries to humans. There are great individual differences in the body's ability to produce and conserve heat. When a body's loss of heat exceeds the ability to produce it, and the conditions persist over time, hypothermia results. To prevent hypothermia, it is important that the body be provided with the energy needed to produce heat. Energy is provided by food and drink. If you are cold, eat. Drink when you need to drink. Fatigue is a real danger. If cold, take steps to correct the problem. However, if a person has failed to prevent hypothermia, it is important that everyone involved in sampling activities be capable of recognizing the signs and symptoms of exposure. Early recognition is extremely important. The victim will often not realize nor admit they are experiencing the signs and symptoms of hypothermia.

Some of the symptoms include slurred or slowed speech, incoherence, failing memory, stumbling, and drowsiness. All individuals involved in winter work activities must receive training in regards to hypothermia (and frostbite). Attachment 2, which can be used as a training guideline, contains information which includes: the definition of hypothermia (and frostbite) and associated risk factors, signs and symptoms of exposure, and pre-hospital treatment procedures for exposed victims.

5.0 Communication

5.0.0 Persons working on deck must remain in constant communication with the Bridge. Communication can be established by means of a two way radio or, when applicable, the ship's PA system maybe utilized.

When operating in icing conditions, a regular radio watch with shore and other vessels must be established and maintained by the ship's operator throughout the icing event.

5.0 Water Tight Doors

5.0.0 During an icing event, all watertight doors, manholes and hatch covers must be battened down.

ATTACHMENT 2

A.1 HYPOTHERMIA

A.1.1 Hypothermia is defined as a spontaneous drop in core body temperature below 95 of (35°C). Hypothermia can occur at air temperatures up to 18.3 °C (65 OF) or in water up to 22.2 °C (72 OF). All people, including those in excellent physical condition, can become hypothermic given the necessary environmental conditions and exposure duration. Heat loss is increased greatly by low environmental temperatures, low relative humidity, and high winds. Inappropriately light or porous clothing allows body heat to escape. Also, clothing made damp by rain or perspiration loses much of its insulating properties and allows further heat loss.· .

Immersion Hypothermia. Because of the very high thermo conductivity of water (25 times that of air), the body loses heat rapidly when submerged, however, patients with submersion times of up to 40 minutes have been successfully resuscitated with no subsequent neurological impairment.

Risk Factors. Risk factors for hypothermia include: alcohol or drug intoxication, receiving medications such as barbiturates, phenothiazine, general anesthetics, reserpine, tricyclic antidepressants. Some medical conditions may also be predisposing factors such as adrenal insufficiency, diabetes, neurological, cardiovascular disease with diminished cardiac output, acute or pre-existing skin conditions.

A.2 SIGNS AND SYMPTOMS

A.2.1 Mild Hypothermia - Core temperature is 32° to 35°C or 90° to 95ºF.

1.) Signs and Symptoms

- Skin – The skin is often cool to the touch.
- Neurological – Some mildly hypothermic patients are asymptomatic. Otherwise, neurological findings include ataxia, slow gait, in coordination, and dysarthria. Confusion and apathy may be apparent. Deep tendon reflexes are usually normal or hyperactive. Pupil reactions are normal.
- Cardiovascular – Most patients with mild hypothermia have no significant cardiovascular abnormalities. Decreased or increased heart rate, hypotension, and hypertension have variously been reported.
- Pulmonary – Respiratory rate is generally normal or slightly decreased.
- Musculosketal – Generalized weakness and fatigue are common complaints. Shivering is usually present.

A.2.2 Severe Hypothermia – Core temperature is below 32ºC or 90ºF.

1.) Signs and Symptoms

- Skin – The skin feels cold to the touch and bluish. Edema may be present. Signs of frostbite may develop if the patient was exposed to subfreezing temperatures.
- Neurological – Severely hypothermic patients always manifest altered levels of consciousness, progressing from lethargy and stupor (32° to 27°C) to frank coma (< 27 *DC).* Inappropriate and dangerous behavior, such as paradoxical undressing, may occur.
    0. Confusion and hallucinations may be present, making the patient difficult to manage. Pupils become dilated at 29°C (84ºF). Deep tendon reflexes diminish between 30°C and 20°C (86ºF and 68ºF). Deep tendon reflexes, voluntary motion, and response to pain are absent at core temperatures below 26°C (79ºF). Corneal reflexes are retained the longest and do not disappear until the body reaches 23°C (73ºF).
- Cardiovascular -Decreased blood pressure and heart rate are common at temperatures below 32°C (90ºF). At very low temperatures (26°C or 79ºF) pulse and blood pressure recordings may be unobtainable:
    0. Cardiac dysrhythmias become major considerations at temperatures below 30°C (86ºF). Atrial fibrillation and flutter are fairly common. Premature ventricular contractions (PVC's) are also seen. Spontaneous ventricular fibrillation is possible at core temperatures below 30 °C but becomes more likely as temperatures reach 28°C (82ºF). Ventricular fibrillation and asystole are very likely to occur as the temperature reaches 22°C (72ºF).
- Pulmonary – Respiratory rate decreases at core temperatures below 32°C (90ºF). Bronchial secretions are increased in response to the cold, potentially leading to bronchopneumonia and further respiratory impairment.
- Musculoskeletal – Severe hypothermia is characterized by marked weakness, fatigue, limitation of movement, and sometimes frank rigidity. Shivering is usually absent at core temperatures below 32°C.
    0. In addition to cardiac complications, other important potential metabolic complications include aspiration pneumonia, pancreatitis, decreased renal function, metabolic acidosis, respiratory acidosis, hyperglycemia, hypoglycemia, electrolyte disturbances, and rarely disseminated intravascular coagulation.

A.3 TREATMENT

A.3.1 If hypothermia is suspected, the patient's temperature should be taken with a low range rectal thermometer or probe, capable of measuring temperatures as low as 28°C. In most instances, use of a low -reading rectal probe (laboratory thermometer or commercially available hypothermic thermometer) is recommended.

A.3.2 Pre-hospital

1.) Pre-hospital management of the hypothermic patient consists of four parts:

- Basic and advance life support
- Prevention of further heat loss
- Stabilization of associated injuries
- Rapid transport to the hospital.

A.3.3 Basic and Advanced Life Support

0.) Gentle Handling

- Rough, jerky movements and other stimulation may precipitate ventricular fibrillation in the severely hypothermic patient. Therefore, transfers, movements, and procedures undertaken at all levels of patient care should be done as smoothly and gently as possible.

0. Airway

- Establish an adequate airway. Indications for endotracheal intubations include apnea, severe hypoventilation «6 breaths/min), and inability of the patient to protect the airway from vomit, blood, and secretions. Because intubations may precipitate ventricular fibrillation in the severely hypothermic patient, it should be done as gently and as gently as possible, preferably by the most experienced person. Esophageal obturator airway (EOA) is an acceptable, though far less desirable, alternative to the endotracheal tube for the apneic patient.
- Conscious patients with good airway reflexes do not require intubations; however, they still may need frequent suctioning of secretions. As in all patients with associated known or suspected trauma, airway control should be accomplished without manipulation of the cervical spine.

0. Fluid Therapy

- Volume depletion is often present in the hypothermic patient. Although, usually secondary to plasma volume depletion from cold diuresis, hypovolemia may also be the result of blood loss from associated trauma.
- An intravenous line should be established in the hypothermic patient for both drug and fluid administration. Hypotensive (90mm Hg systolic) patients should receive a 300 mL (5 ml/kg) bolus of isotonic saline (0.9% NaCl) or D5-0.9% NaCI. Patients with persistent hypotension and evidence of blood loss should receive continuous rapid volume infusion.

0. Cardiac Monitoring and Treatment of Dysrhythmia

- Because hypothermic patients are extremely prone to dysrhythmia, a cardiac monitor should be attached as soon as possible. Benign dysrhythmias (atrial fibrillation and flutter, premature atrial and ventricular contractions, sinus bradycardia, and sinus tachycardia) are usually corrected with re-warming and, therefore do not require treatment in the field. Dysrhythmias that result in severely reduced or absent cardiac output (ventricular tachycardia, ventricular fibrillation, complete heart block, and asystole) require immediate attention. Cardiopulmonary resuscitation (CPR) should be started immediately on the unconscious apneic patient who has no pulse or measurable blood pressure. Standard

pharmacologic and counter shock therapy may be initiated with some notable modifications

0. Bradycardia associated with severe hypothermia is usually physiologic and therefore requires no treatment other than re-warming. Atropine is usually ineffective. Isoproterenol, may be arrhythmogenic in the hypothermic patient, and may cause a fall in blood pressure and promote heat loss.
0. PVC's should be watched closely but generally do not require treatment.
0. Ventricular fibrillation secondary to hypothermia usually occurs at core temperatures below 30°C (86 OF). Treatment consists of immediate counter shock, at 200 to 300 joules, followed by a second counter shock, should the first be unsuccessful. CPR is started if effective cardiac output is not re-established. Medications for the treatment of ventricular fibrillation include: Lidocaine HCI, 1 mg/kg bolus, repeat with 0.5 mg/kg after 10 minutes; begin IV drip at I to 4 mg/min; bretylium tosylate; 5 to 10 mgl/kg bolus, epinephrine, 0.01 mg/kg bolus; and sodium bicarbonates, 1 mEq/kg bolus.
0. Hypothermic patients in cardiac arrest may respond to pharmacologic and counter shock therapy, but it is more likely that they will not! The patient with a hypothermic myocardium is relatively refractory to drugs and counter shock, and requires re-warming before these interventions become effective. Treating the hypothermic cardiac arrest victim with multiple drug doses and counter shock is discouraged. Rather, the major emphasis should be on rapid re-warming.
0. Cardiopulmonary resuscitation in the hypothermic cardiac arrest victim should be started as soon as possible and continued as long as necessary. Because of the reduction in cerebral oxygen requirements, severely hypothermic patients (particularly children) can survive several hours of resuscitation and remain neurologically intact. Under no circumstances should resuscitation be discontinued in the field: re-warming to at least 32°C (90 OF) must be done at the hospital before discontinuing resuscitation.
0. Other medications that can be administered are thiamine and D50W, and naloxone. Thiamine and D50W are given because many hypothermic patients are also hypoglycemic, 50 mL of 50% dextrose (D50W) may given intravenously to those patients with altered levels of consciousness. A blood sample should be obtained prior to administration of the dextrose so that laboratory confirmation of hypoglycemia may be made later. Dextrose given to the alcoholic hypoglycemic patient rarely precipitates

Wernicke's syndrome. It is prevented by giving a dose of thiamine, 100 mg IV, before giving the dextrose. Patients with altered levels of consciousness in whom you suspect narcotic use may receive naloxone. The dose is 0.8 mg (2 ampules) for adults and 0.4 mg 0 ampule) for children; both administered intravenously.

A.3.4 Prevention of Further Heat Loss

0.) The pre-hospital provider should take measures to ensure that the hypothermic patient does not become more hypothermic in transit. This precaution is distinct from actual re-warming, which is not a primary goal during pre-hospital care. In fact, many investigators recommend keeping the patient cool during transport.

0.) The activity level of the patient is kept to a minimum. Wet clothing should be removed and replaced with dry clothes and blankets. Areas of the body that lose large amounts of heat, such as the head, neck, and trunk, especially, should be covered. Sips of warm fluids may be given by mouth, but only to the awake, alert patient. Alcoholic beverages are absolutely contraindicated.

0.) The only active re-warming method recommended for field use is warm humidified oxygen. Oxygen heated to 40° to 45°C (104° to 113°F) and administered to the patient via face mask or endotracheal tube supplies a small amount of core heat to the respiratory tree. It also reduces heat lost through ventilation. Although not widely available, a portable device for heating oxygen in the field has been described by Lloyd. Soda lime and water are the heat sources.

A.3.5 Stabilization of Associated Injuries

0.) Appropriate immobilization of the cervical spine is mandatory for patients with known or suspected head and neck trauma and who have altered levels of consciousness. Near-drowning victims often have preceding head and neck trauma resulting in unconsciousness, paralysis, aspiration, and hypothermia.

0.) Immobilization of the cervical spine is best accomplished using a backboard, a rigid cervical collar, and sandbags.

0.) Splinting of injured extremities may be done in the field if the patient is stable and if the time permits. Frostbitten areas should be padded and then loosely wrapped to protect them from further injury. Thawing of frostbitten areas generally should not be attempted prior to arrival at the hospital!

A.3.6 Rapid Transport to the Hospital

0.) The definitive treatment for the hypothermic patient is re-warming. Because it usually cannot be done safely in the field, efforts should be made to transport the patient to the hospital as rapidly as possible.

0.) Hypothermic patients in cardiac arrest should receive no more than one course of drugs and two courses of counter shock therapy in the field. Prolonged pre-hospital resuscitation is generally futile and sometimes detrimental. With CPR in progress, patients should be transported to the hospital, preferably one where cardiopulmonary bypass procedures can be performed if needed. The hospital should be notified prior to arrival so that the 'pump team' and equipment can be readied.

A.3.6 Re-warming Techniques

0.) Definitive therapy for most cases of hypothermia involves re-warming body to near normal temperature. Re-warming techniques include passive external, active external and active core re-warming. Passive External Re-warming. This method allows patients to re-warm themselves without the application of external or internal heat sources. Passive external re-warming, although rather slow, is safe and effective for most thermodynamically stable patients with mild-hypothermia.

0.) By combining the effects of reduced heat loss and endogenous heat gain, core temperature should increase at a rate of approximately 1°C per hour using passive external re-warming. The following procedures are recommended:

. Remove the patient's cold or wet clothing and dry the skin with towels
. Place the patient in a warm room, away from wind and drafts
. Cover the patient with blankets or other insulating material.

0.) Active External Re-warming.

. Re-warming the patient by applying a heat source to the body surface is an old, albeit controversial technique. Although it is a rapid method of re-warming, many clinicians recommend against its use because of potential hypotension from active external re-warming, known as “re-warming shock” and possible ventricular fibrillation.

. Still, there are proponents of active external re-warming techniques. They recommend these methods primarily for patients with hypothermia of short-term duration (e.g., exposure, immersion) whose cardiovascular systems can tolerate the added stress. Also, patients undergoing active re-warming must be closely monitored for dysrhythmias and hypotension and have adequate intravenous access established for fluid replacement in the event that hypotension occurs. The following are active external re-warming techniques

0. Heated blanket, hyperthermic mattresses
0. Hot water bottles placed in areas of rapid heat exchange (e.g., neck, flanks, armpit, and groin)
0. Immersion in warm water bath (40°C, 104°F). Active external re-warming is not recommended in the field!

A.4 PREVENTION

A.4.1 Cold injuries can best be prevented by wearing warm, lose, dry clothing (designed to resist wind and rain) in multiple layers on the head, body, and extremities to prevent heat loss. One should keep dry at all costs; materials lose insulation properties when wet. Wet garments should be replaced as soon as possible with dry one, and constrictive garments should not be worn.

Jobs should be designed so that workers remain relatively active when exposed to cold environments and provided with dry, wind-protected, heated shelters for tasks involving stationary work positions.

Workers exposed to the cold should be physically fit, without underlying vascular, metabolic, or neurologic diseases that place them at increased risk for hypothermia. They should be cautioned

to avoid smoking and drug or alcohol use. New workers should be introduced into the work schedule slowly and. instructed in the use of protective clothing, recognition of impending frostbite and early signs and symptoms of hypothermia, proper warming procedures, and first-aid treatment.

A.5 FROSTBITE

A.5.1 Frostbite is caused by exposure to temperatures below freezing, causing ice crystal to form in tissues. A combination of high winds and cold is much more dangerous than cold alone.

A.5.2 Predisposing Factors:

0.) Subfreezing temperature 20°F (-7°C)
0.) Wind-chill factor
0.) Alcohol and drug intoxication
0.) Underlying illness, diabetes, peripheral vascular disease
0.) High altitude
0.) Conduction injury (e.g., frozen metal object)
0.) Fatigue
0.) Previous history of frostbite injury
0.) Tobacco use

A.5.3 Signs and Symptoms

0.) Frostbite occurs most often on distal and exposed body parts. Fingers, toes, cheeks, nose, and ears are common sites. In mild cases with superficial freezing (frostnip) pain, pricking, itching sensation and numbness will occur without complete loss of sensation.
0.) In more severe deep frostbite skin is white, feels firms, edematous, immobile, no sensation or pain.

A.5.4 Treatment

1.) Rapid thawing of the frozen by part by immersion in warm water is the treatment of choice, methods that are contraindicated are hot-or-cold water immersion, and rubbing the frozen body part with ice or snow.

A.5.5 In the Field

1.) Re-warming may be attempted for frostnip. Immersion in warm water (temperatures of 38° to 43°C (100° to 110°F) is the preferred method. An alternative method is direct contact with one's own skin or with a companion's skin.
2.) In cases of severe frostbite, hospitalization is recommended. Extremities can be re-warmed by removing wet gloves, socks and shoes, drying the extremities and covering them again with dry clothing; and either elevating them or placing them next to a warmer part of the body (e.g., placing the hands in the armpits).

. Caution: Re-warming should not be attempted if refreezing is likely prior to definitive therapy. Re-warming of the frostbitten parts of be body can be accomplished by placing them in water heated to 40° to 42°C and leaving them there until thawing is complete but no longer (often 3

minutes). Dry heat is not recommended. Frostbitten parts should not be exercised, rubbed or exposed to pressure. Dressings and bandages should not be applied. Great care should be taken to avoid any trauma to the extremity during and after thawing. For example, the extremity should not touch the sides or bottom of the re-warming container. Gentle manual or mechanical circulation of the water helps the thaw to be more uniform.

3.) The goal of field management is to protect the frostbitten areas from further injury followed by rapid evacuation to a medical facility.