DEVELOPMENT OF EXPOSURE SUITS [*]

By EMERGENCY RESCUE EQUIPMENT (ERE) 1943

Ferrisburgh, Vermont, U.S.A.
rch@gmavt.net

Dedicated to my father, Earle (1903-1980), who worked so tirelessly to save life, while all around him others were destroying it.

INTRODUCTION

The renewed concern of the past decade regarding hypothermia (sometimes called 'exposure') is of great interest to me, for the lethal effects of exposure and the development of "exposure suits," during World War II, have been known to me all my life.

We are indeed indebted to Dr. John Hayward and others for rekindling our concern. But, when discussing with him the work done during World War II, I was intrigued that he was unfamiliar with the extensive research and development that was done then. It appeared that much of this information was "lost." We are fortunate that members of my family, who participated in those past efforts, saved much of the original documentation concerning the research and development that was carried out in 1943 by the Emergency Rescue Equipment Section (U.S. Navy Department, Coordinator for Research and Development).

This paper provides background on the reasons for, and the development of, The Liaison Committee for Emergency Rescue Equipment, the Emergency Rescue Equipment Section (ERE) and its eventual evolution into Air Sea Rescue, and a discussion of the concern, research, and development that led to the production of exposures suits for military personnel.

My effort has been to bring together information that heretofore has apparently been unavailable to many of you, who are the experts in the effects of hypothermia and its prevention, in the hope that some may find this discussion fascinating enough to justify further investigation into the recent history of emergency rescue equipment.

---

[*] Originally presented at the International Hypothermia Conference and Workshop, University of Rhode Island (Kingston), January 1980, with editorial, but not substantive, changes 1999, 2003.

PART I

THE LIAISON COMMITTEE FOR EMERGENCY RESCUE EQUIPMENT

Today it is assumed in the United States that the U.S. Coast Guard (USCG) has always been the primary service involved in air and sea rescue. While it is true that the Coast Guard has carried on rescue work since its inception, it was not until 1944 that the Coast Guard (then under the Navy Department) assumed command of Air Sea Rescue. [33]

To fully appreciate the development of exposure suits during World War II, an understanding of the events preceding the consolidation of Air Sea Rescue in the Coast Guard is necessary, for it was between April 1943 and early 1944 that much research and development was carried out by the Liaison Committee for Emergency Rescue Equipment.

The urgent need for air sea rescue was a direct result of the military conflict of World War II. This was the first time in history that so many ship and planes operated under such adverse weather and battle conditions.

The British military learned, during the Battle of Britain, that a coordinated effort was necessary to retrieve downed fliers, and in February 1941 they established an Air Sea Rescue Service. [33]

In late 1941, when the United States entered the conflict, British developments in Air Sea Rescue assisted the U.S. rescue effort, as the U.S. had no consolidated command for air sea rescue. In early 1943 there was a concentrated effort to overcome the U.S. deficiency. It is this effort that we will examine.

Recognizing the necessity for a more coordinated effort, the U.S. Joint Chiefs of Staff on 15 April 1943* issued Memorandum for Information No. 58 *Plan for Organization of Committee on Emergency Rescue Equipment*, directing the Navy Department to –

- Coordinate the efforts of all services and agencies with regard to research and development of emergency equipment.
- Evaluate and disseminate information pertaining to emergency equipment.
- Maintain a liaison with other “United Nations” rescue efforts.

A Liaison Committee on Emergency Rescue was appointed with representatives from the Navy Department, the Army Air Forces, the Maritime Commission, the Office of Scientific Research and Development, and the Offices of Strategic Services. [3]

On 20 April the Navy Department directed the Office of Coordinator of Research and Development to head the Liaison Committee authorized in Memorandum No. 58. [4]

On 26 April Assistant Coordinator of Research and Development, Captain Lybrand Smith, USN, requested all the agencies named in Memorandum No. 58 to appoint a representative to the “Liaison Committee on Emergency Rescue Equipment.” [5]

The substance of the first meeting of The Liaison Committee, held on 4 May, is contained in a letter of 5 May from Captain Smith to the Commandant of the U.S. Coast Guard. Several important considerations were outlined, and the Committee agreed to the need for a –

* Various date formats are use in the documents used for this paper, for the convenience of the reader we have converted all dates to a day, month, year format.

- Technical Aide to the Coordinator
- Secretariat
- Technical Literature Research Section
- Exhibit Section

The Office of Strategic Services (OSS) was requested to furnish personnel (except the Technical Aide), office and exhibit space, equipment and funding for the Committee.

The choice of the Technical Aid was given special consideration. It was agreed that "because of the vast experience of the Coast Guard in connection with emergency rescue" that a Coast Guard officer "would be most fully qualified to cover the whole broad subject." Further, since the outbreak of the war, the Coast Guard had been developing special protective and emergency equipment.

In his letter to the Commandant of the Coast Guard, Captain Smith requested, "Lieutenant Commander Hiscock (be) ordered to report for duty to the Coordinator of Research and Development as Technical Aide for Emergency Rescue Equipment."[6] *

Earle Hiscock had a varied career before joining the Emergency Rescue Equipment Section (ERE) in May of 1943. He was born in Maine in 1903, grew up in Quincy Massachusetts, spent much of his childhood experimenting with ham radio. During World War I he served as a radio operator in the U.S. Navy. Later he served in the same capacity aboard fishing and merchant vessels. He attended Harvard College and graduated from MIT in 1932 with a degree in Naval Architecture and Ship Operation. During the depression he was a steamboat agent office manager in Portland Maine.

In 1935, after the *Morro Castle* and other passenger ship disasters, he joined the Steamboat Inspection Service. † He helped pioneer the development of new standards for U.S. passenger and merchant vessels, applying modern principles of subdivision and fire protection.

In 1936 he transferred to the Inspection Division to serve as Assistant Chief. Later he was released, by mutual agreement to, the Maritime Commission to supervise (as 'resident inspector for BMIN) the construction of the first large passenger/transport vessels built under the new government regulations for passenger vessel at the Bethlehem Steel yard, Sparrows Point Maryland.‡ When construction was completed in 1940, he returned to the Bureau as Chief of Inspection.

At the outbreak of the war he drafted safety regulations for all American merchant vessels, including special equipment and installation requirements, and authored *Wartime Safety Measures for Merchant Marine* for the U.S. Coast Guard. [1]

In March of 1943, before the establishment of ERE, LCDR Hiscock (Principal Traveling Inspector, BMIN) conducted, for the Bureau, tests in Miami Florida on lifesaving and rescue equipment, including: signal mirrors, fluorescent dye, kites, night distress signals, reflective

---

* Earle F. Hiscock (1903-1980) was my father; it is because of him, and my mother Alice Hiscock that I am able to compile this report.

† The Steamboat Inspection Service was part of the Commerce Department and in 1936 became the Bureau of Marine Inspection and Navigation (BMIN).

‡ The vessel were the: SS *DELBRASIL* (O.N. 239616) later USS *GEORGE F. ELLIOT* (AP 105) later SS *AFRICAN ENDEAVOR*; the SS *DEORLEANS* (O.N. 239932) later USS *CRESCENT CITY* (AP 40); and the SS *DELTARGENTINO* (O.N. 240124) later USS *J. W. McANDREW* (also an AP), later SS *AFRICAN ENTERPRISE*. *AFRICAN ENDEAVOR* and *AFRICAN ENTERPRISE* were both owned by Farrell Lines and used in passenger service between New York and Cape Town in the post-war era and scrapped at Baltimore Maryland in 1969

buttons, life preserver lights, color visibility, and the desirable angle for best visibility. [2] *

It was because of his background in safety and his experience at sea that LCDR Hiscock joined ERE. Others, who assisted in the Miami tests were also assigned to the ERE staff –

- Lieutenant N. S. Bartow, from Navy Air Force Training Center, Jacksonville Florida
- John Bader, Special Forces Section, Army Quartermaster Corps.
- Dr. Henry Field, as liaison for OSS.

Others who joined the staff included –

- Lieutenant Colonel George W. Holt, Army Air Flight Surgeon. †
- Captain C. M. Murphy, Air Transport Command.
- Julia McWilliams (now Julia Child) to head the Secretariat Staff. ‡
- Alice M. Carson (now Mrs. Earle F. Hiscock) to head the Exhibit Staff. §

When the Liaison Committee held its second meeting on 15 May, several developments had already transpired. Classification of the work of ERE was changed to "unrestricted" to allow for the widest possible distribution of information concerning emergency rescue equipment. A notice to all services and agencies outlining the responsibilities of ERE and requesting their cooperation had been published and given wide distribution. The Committee also approved a plan for the establishment of the Emergency Rescue Equipment Section (ERE) of the Office of the Coordinator of Research and Development. [7,8]

The most significant decision reached at the second meeting was the realization that the efforts of the Committee would require *definitive recommendations* "that certain equipment be adopted." Candidates for immediate recommendation bulletins were: life preserver lights, rescue signal mirrors, and *lightweight exposure suits*. [8]

The Committee held a third meeting on 5 June [9] and approved one *Information* bulletin [10] describing the purpose of the *recommendation* bulletins and the three *recommendations* [11, 12, 13] discussed at the second meeting.

Recommendation Number 3 [13] is of most interest to us: *Substitution of Protective Exposure Suits for 'Lifesaving suits' on Merchant Vessels and Military Transports*. The so-called 'lifesaving suits' had proved dangerous and the Committee strongly recommended replacement with the 'protective exposure suit' developed for the U.S. Coast Guard by the B. F. Goodrich Company. The suit had a neoprene coating and weighed less than six-pounds packed in a buoyant bag. The Bulletin advised "that the primary need of survivors is for an overall garment which will protect them from exposure and which is of such character that it may be comfortably worn in boats and on rafts and of such weight as to be readily accessible and available in time of emergency." [13] This is the first reference by the Committee to exposure suits, for naval and merchant seamen. Soon the Committee and ERE will turn its efforts to providing protection for fliers.

On 27 July the Liaison Committee held a Special Meeting to discuss "recommending the formation of a land-air-sea rescue force under one command and operations group." Despite

* At the beginning of the war the Bureau of Marine Inspection and Navigation (BMIN) was transferred to the Coast Guard, where it remains today. Personnel in BMIN were commissioned in the U.S. Coast Guard Reserve.
† In 1979, Dr. Holt was a practicing neurologist in Denver Colorado he has since died.
‡ Julia Child 'The French Chef' is now living California.
§ Alice C. Hiscock (1908-2001) was mother of the author -.

some concerns by the Army Air Force that “the transition to a single command organization at the present time would be necessarily be slow,” it was *unanimously agreed that because of the Coast Guard’s background and experience in the rescue field that they should assume command of all land-air-sea rescue operations.* [14]

On 29 July the Coordinator of Research and Development (Navy Department) wrote a letter to The Joint Chiefs of Staff recommending “that immediate steps be taken to place the responsibility for the organization in the Navy Department under the immediate command of the U.S. Coast Guard.” [15]

It was not until February 1944 that The Joint U.S. Chief of Staff requested that the Secretary of the Navy “establish in the Coast Guard the Air Sea Rescue Agency to coordinate studies conducted in these fields by the various Untied States services and to maintain liaison with services of Allied governments.” [33]

On 9 September 1944 the Coast Guard’s new role was announced in a press release issued by Vice-Admiral Waeshe, Commandant, U.S. Coast Guard, “coordinating war time Air Sea Rescue and organizing a peacetime agency for rescue work with expanding commercial and private flying has been made a U.S. Coast Guard responsibility ... the ‘know how’ for the job has been developed by (the Coast Guard) from 150 years of rescue experience ... development of Air Sea Rescue has been an interesting story.” [31] Thus the role of the Coast Guard and Air Sea Rescue is confirmed for the remainder of the war and the beginning of their peacetime purpose is established.

The next part of this paper will concentrate on the development of “lightweight exposure suits” for airborne personnel carried on by The Committee and ERE, prior to the establishment of the Air Sea Rescue Agency.

PART II

THE DEVELOPMENT OF THE EXPOSURE SUIT BY ERE

The Emergency Rescue Equipment Section (ERE) and the Liaison Committee developed many survival equipment items that we take for granted today. [16] An investigation of all these developments would be illuminating, but the primary concern of this paper is the development of “lightweight exposure suits.” It is of particular interest that of all the items developed by ERE exposure suits was the most critical to successful rescue. [19] Unfortunately, exposures suits received little attention in the civilian world after the war.

That we are here, years after the end of the war, at an International Conference on Hypothermia indicates a new urgency. It is distressing that a great deal of the research on exposure and exposure suits was done during the war, and apparently ignored when that crisis of survival ended.

The information that I have complied is by no means complete, but there is sufficient documentation to demonstrated the efforts of ERE to develop and provide lightweight exposure suits for airborne and naval personnel.

What follows is a brief examination of the material available (to me at this time) regarding ERE and exposure suits. I hope this will excite the interest of others who may have access to additional records that may still exist.

As we have seen, ERE expressed a concern regarding protective exposure suits for naval and merchant seamen in mid-1943. [13] However, there is evidence that in 1917 Walter L. Fry

developed a “lifesaving suit” that was tested by the U.S. Navy in January 1918 at the Brooklyn Navy Yard. He considered the following to be important design criteria –

- A man had to be an individual unit in himself.
- The suit had to be so constructed that it could be worn all day long and still be ventilated and comfortable. When closed, it has to be as hermetically sealed as (it) could get.
- Simplicity. [20, 26, 27]

Similar considerations are still discussed today, and were discussed again in 1943.

Prior to the establishment of ERE, there were several references to the problems of exposure and the use of exposure suits. In *Wartime Safety Measures for Merchant Marine* there is a discussion of the use of “lifesaving suits” as exposure suits, and the treatment of “immersion foot” and “prolonged exposure to cold.” [1] As noted earlier, it is these “lifesaving suits” that later proved t be unsafe and should be removed from all vessels. [13, 18, 21, 23] *

On 20 August 1943 ERE held a conference in Washington DC on: Rafts, Survival Equipment, and Seasickness. Attending the conference from the ERE staff were LCDR Hiscock, Mr. Bader, LT Bartow. COL Holt, and MAJOR Murphy. In addition, representatives of Naval Medical Research (particularly Dr. L. H. Newburgh), the Army Air Forces, the Royal Air Force, Trans-World Airlines and Boston City Hospital. The report of this conference, detailing many aspects of sea survival, reveals the urgent need for exposure suits. [17]

Dr. Newburgh’s experimental work at the Naval Medical Research Institute in Bethesda Maryland had demonstrated that fliers are subjected to a double hazard: first, when immersed in water, they rapidly lost body heat, and secondly, after climbing into a raft, wind vaporized the water in their clothing causing further loss of body heat. His data also indicated that personnel immersed in water between 60° and 70°F “could not survive many hours in the absence of an exposure suits.” His most surprising revelation was that water of less that 92°F would cause significant slow body cooling. The conference unanimously recommended that –

- There exists a general and immediate need for a *light weight exposure suit* for all airborne personnel as part of the sea survival equipment.
- This need is such as to necessitate giving serious consideration to immediate production of such suits for use in existing rafts.
- An exposure suit of the most improved design, constructed, and light weight (maximum weight for approximately 26oz.) should be provided for all new rafts.
- The exposure suit provided for use on existing rafts should be of such character as to be packed in buoyant containers or otherwise readily accessible for jettison when rafts are thrown off the plane.
- On new rafts provision be made to pack the exposure suits as part of the raft equipment, and that new rafts be provided with insulated (inflatable) floors “to provide protection against cold water.” [17]

On 27 October 1943, ERE held a conference specifically devoted to Exposure Suits for Aircraft. COL Holt of ERE staff, and Dr. Louis H. Newburgh of Naval Medical Research Institute were the Chairmen for the conference. Also attending, in addition to LCDR Hiscock from ERE, were Wing Commander M. M. Foss, Royal Canadian Air Forces (RCAF) and other members of the Canadian Joint Staff, the Canadian National Research Council, and the U.S. Office of the Quartermaster Corps textile and plastics division. [19]

All agreed that the primary need was to design an exposure suit that could be used by both

* There is no evidence that these “lifesaving suits” are related to Fry’s efforts of 1918 and 1943.

bomber and naval personnel, realizing that the problems presented by fighter pilots would have to be dealt with at a later date, as fighter pilots would need a suit that could be worn continuously. What was needed immediately was a suit that was –

- As light as possible, for the least amount of bulk.
- As simple as possible, without watertight zippers.
- Had the hands free, with adequate wrist closures.
- Used a separate flotation jacket underneath; and could be stowed on the back of a life-vest or jacket.

There follows a fascinating discussion – particularly considering the limited availability of new materials during war-time – of design considerations for prototype exposure suits –

- The virtues and drawbacks of using nylon (a new material) versus cotton
  - How many layers of material to use; and whether the material should be coated with neoprene, one or both sides, with how many coats, was discussed at length.
  - The flammability of nylon was a major concern, a coating of neoprene seemed to solve this problem
  - Whether a nylon suit would be packaged tightly enough to reduce bulk were other concerns with the materials to be used.
- Zippers versus drawstrings were discussed, with many opposed to zippers because of skepticism regarding mass production of a truly watertight zipper.
- The suits are designed for wear over winter flight clothing and boots, but it was felt that the hands must be free to allow survivors to abandon the craft and use other survival equipment.
- Possible wrist closures discussed were: an inflatable tube around cuff; a stiff cuff, so that gloves could be pulled over the cuff; or a watertight zipper at the sleeve opening.
- The use of additional flotation was ruled out as most services felt that their personnel would be, or should be, wearing flotation equipment during combat, thus additional buoyancy in the suits should not be necessary.[*]
- Quick donning, proper placement of the suits was discussed, along with the possibility of having additional suits in liferafts for survivors who had to abandon their craft before donning a suit.

CDR Foss expressed at the afternoon session of the conference the urgent and immediate need for exposure suits – "Why didn't we realize before, that without this item (exposure suits) all our elaborate items are not worth a darn. We (the RCAF) have come to the conclusion that without this item we might as well leave out the equipment we carry during the winter season. It is embarrassing to say that the emergency equipment doesn't mean anything without the suit."[19]

The immediate need for prototype exposure suits, to conduct field trials, and obtain the necessary results needed to 'sell' exposure suits to the various services was expressed be many of the conferees. It must be pointed out here that although ERE and members of the RCAF were well aware of the lethal effect exposure was having on downed naval and airborne personnel, not all the service 'brass' were convinced that exposure was a primary killer of those who survived the initial catastrophe.

It was understood – as the conference concluded – that Goodrich would have two-dozen suits ready for testing by mid-November. Plans were made with CDR Foss to conduct trials at a Canadian base near Halifax, Nova Scotia.

[*] The manufacture of the prototype suits, the B.F. Goodrich Company, was attempting to add a small amount of flotation across the chest and arms of the new suits.

On 17-19 November 1943 the Joint United States – Canadian Air Sea Rescue Equipment trials were held near Halifax for the purpose of testing prototype light-weight exposure suits produced since the October conference in Washington. [20, 25, 28]

COL Holt of ERE was chairman of the trials. Also traveling to Halifax for ERE were LCDR Hiscock and Mr. Bader, and others from the United States including representatives of the Army Air Forces and the National Defense Research Committee. CDR Foss led the RCAF team of thirteen, in addition to two members of the Canadian National Research Council.

The principal purpose of the trials was expressed by COL Holt, “to determine the course of events following an individual’s immersion in the North Atlantic with and without a watertight protective exposure suit.” [20]

At the time the trials (1500 hours on the 17 November to 0600 hours on 18 November 1943) the sea temperature was 42°F, air temperature 36°F, winds from the North and West at 18 to 25 MPH, with moderate snow at time during the night.

At least thirteen Canadian airmen participated in the trials. All were checked by the Medical Officer prior to the test and found to be in excellent physical condition. Vital signs, particularly body temperatures, were recorded for later comparison.

Six subjects entered the water and climbed aboard rafts dressed in flight clothing *with* exposure suits; two other similarly dressed *without* exposure suits. Two other subjects were transferred directly to rafts wearing only normal flight clothing. To simulate a ditching procedure, and to test the exposure suit neck closures and valves, three subjects jumped in the water; two *with*, one *without* suits.

In all cases the subjects *without* exposure suits failed to complete the tests and had to be removed to the sick bay.

The first entered the water swam 35-yards to a rubber raft and had to be pulled on board. He had great difficulty donning his exposure suit and forty-minutes later was ordered to the sick bay. His rectal temperature had dropped 3°F; he had marked erythema (redness) of the hands and feet, and decreased superficial sensitivity to pinprick and deep pressure in both feet.

The second entered the water, swam 25-yards and with some difficulty climbed on board a raft and donned his exposure suit (without shearling-lined flight boot). He was able to play cards, but after a total of fifty-minutes he was removed to the sick bay. His rectal temperature had dropped 1.8°F. It was noted that the foot that had been in the wet shearling-lined boot showed marked erythema (redness), while the other foot showed no change.

Two subjects wearing winter flying clothing but no exposure suit were transferred directly to rafts. The first remained in the raft for nine hours but during the night, while asleep, his right foot dropped into the water. When he awoke 35-minutes later, his foot was numb with no sensation, nor could he feel pressure when standing on the foot. When examined, the foot was found to be markedly erythematous (reddened), pronounced in the digits. His rectal temperature had dropped 0.8°F.
The second subject requested to be removed from the raft in less than nine hours. His clothing was wet through from spray. He was shivering with cold hands and feet. When examined, he showed mild erythema (reddening) of the feet otherwise the extremities appeared normal. His rectal temperature had dropped 2.6°F.

Three men jumped into the water – two wearing exposure suits over winter flying clothing, one

with only flying clothing. The subject *without* the exposure suite was unable to remove his parachute harness or open the dinghy and had to be rescued in 4-minutes.

In neither case, of the subjects who jumped using exposure suits did the neck closure rupture and the valves freely expelled air. One jumped from a height of 16-feet, swam with ease 40-yards to a raft and stayed there for 15-hours. Although he showed a rectal temperature drop of 2.4°, he did not complain of the cold and was completely dry at the end of the trials. The other subject jumped into the water from a height of 5-feet, opened the dinghy and boarded with in 10-minutes.

Six personnel wearing various combinations of winter flying clothing and exposure suits entered the water and swam to and entered rubber rafts. All remained in the rafts for the duration of the trials – up to 15-hours for some subjects. Their rectal temperature drops ranged from 1.2° to 3.2°F. All felt that they could have stayed in the rafts much longer, up to several days if necessary. Some even slept through the snow squalls during the night.

Of the six, three used single-ply nylon suits that seeped some water causing a greater temperature drop than in those using suits that did not leak. In addition, the completely watertight suits provided greater buoyancy and allowed easier boarding of the rafts.

The medical officers made some additional observations regarding shivering and the observed temperature drops in some of the subjects.

It is not uncommon, they note, to observe a temperature drop of up to 2.0°F in a normal subject during the early morning hours (the trials ended at 0600) when compared to early evening hours. The fact that the subjects were resting could affect rectal temperatures, as could a change from an upright to a sitting position. Further, the effect can be even greater if an individual lies down after mild activity.

With regard to the shivering observed in some subjects they note that shivering indicates a great increase in the rate that body is producing heat, that violent muscle contractions can increase heat production up to three to four times that found in a resting state. Shivering is a clear indication that the subject is attempting to compensate for repeated heat loss. But if the conditions are severe there will continue to be a fall in internal body temperature, despite violent shivering.

Answering many of the questions raised by earlier discussions were the observations of the participants – recorded following the trials – summarized here –-

- When an exposure suit was worn over winter flying clothing, subjects floated at the nipple-line, could maintain a vertical position, and if desired, could float in a horizontal position for up to 3-hours (probably longer if necessary). That the additional buoyancy provided by the air trapped in dry clothing made swimming and boarding rafts much easier.
- That single-ply nylon-neoprene suit allowed too much seepage and is therefore unsatisfactory.
- That neck closures must be reasonably, but not absolutely, watertight.
- Loose fitting exposures suits are easier and quicker to don over wet or dry clothing, but they would be difficult to wear while flying. The close fitting suits are particularly difficult to don over wet flying clothing.

- Even with wet winter flying clothing, it was possible to survive longer if an exposure suit is used.
- Without the additional flotation provided by an exposure suit, it is very difficult to board a

raft. (The addition of a stirrup ladder and knotted lines was recommended to assist exhausted men in boarding rafts.)
- That in further developments of exposure suits "the incorporation of an inflatable chamber in the head and neck region to keep the neck closure above water when the subject is floating on his back" be considered and "provision for draining the suit through the feet may also be desirable in the event of considerable leakage." [20]

When all the reports were complied the joint group concluded –

- The major problems of a castaway are exposure, dehydration and rescue.
- Exposure is a highly lethal hazard to military and civilian personnel operating in northern latitudes. A human body cools when immersed in water of a temperature of less than 92°F. The warmest open ocean water in any latitude at any time of the year is 84EF. Individuals exposed to water of this temperature undergo significant cooling, and need the protection of a waterproof suit in the water. Individuals, even in such warm climates, while sitting on liferafts, loose body heat rapidly due to evaporative cooling, unless provided with a waterproof suit. The rate of loss of body heat increases rapidly as the temperature of the air and water drop. For example, personnel in the Aleutian areas survive less than thirty minutes.
- Severity of exposure to cold as a lethal factor is dependent on such variables as wind velocity, temperature of air and water, degree of wetness of clothing, humidity, physical activity of the individual, duration of exposure and variation in individual susceptibility.
- Long exposure to water – though not server enough to kill – and a general chilling of the body acts locally causing gangrene.
- It is exceedingly difficult and sometimes impossible for personnel to climb into a liferaft after heavy flying clothing has become water soaked. Moreover, even if such sodden individual manages to get into the liferaft, he will shortly be incapacitated through evaporative cooling, and will be unable to operate emergency equipment.
- An exposure suit of the type tested when worn over a flying suit, or similar clothing, will protect an individual for many hours in cold water or in a liferaft. [20]

LCDR Hiscock provided additional conclusions in his trip report for ERE –

- The principles demonstrated … completely justify the adoption and immediate procurement of such an exposure suit.
- A joint development program should be inaugurated to bring about improvements in the efficiency of the present type of suit, but that this should not delay the procurement of one or other of the present types, or of a basic type that incorporates the best features of each type tested.
- The following definition of Aviation Exposure suit was adopted – "The Aviation Exposure suit is one which will protect personnel who are immersed in water, or on rafts, against loss of body heat."
- It was further agreed that an immediate effort be made to adopt a general specification governing the type of exposure suit to be used by all airborne personnel. [20]

This concludes the discussion of the 'Halifax Trials.' * A conversation with Dr. Holt (in 1979) confirms the conclusions of the trials of 1943. [34] He recalls some other observations not found in the written reports of the time –

- In water of 32°F, mental activity stops in eight minutes and death occurs in ten minutes.
- During World War II, Sir Thomas Lewis, a British heart specialist, concluded that in many

* We have attempted to secure a copy of the film taken by the U.S. and Canadian teams [20, 24], with no success to date.

case of rapid hypothermia, death is due to ventricular fibrillation.

- That at the time of the 'Halifax Trials' over 1500 men were in Canadian hospitals suffering from 'trench' or 'immersion foot.'
- At the height of the bombing of Germany only 20% of the airman downed in the English Channel were saved. An average of 800 men per day were lost, most due to the effects of exposure.
- There was a cold chamber build at Wright Field (Dayton, Ohio) by the Army Air Forces, but the largest chamber was built at Orlando, Florida where temperatures could be dropped to -75°F and simultaneously simulate pressures the equivalent of 60,000 feet altitude.

The efforts of ERE in the development of exposure suits that culminated in the 'Halifax Trials' ultimately led to the production of aviation exposure suits for the Navy and Army Air Forces. [32] These were not produced until very late in the war. It is not known how many were manufactured or by whom. It is significant that they were produced at all considering the lack of interest demonstrated, early on, by some services, particularly the U.S. Army Air Forces (AAF). [22] But, by May of 1944 the AAF was conducting tests – on their own – of exposure suits at Wright Field, and they were preparing to authorize production. [30]

In February 1944 the Air-Sea Rescue was formed. [33] The Liaison Committee continued for some time after the formation of the new group – some ERE were transferred to Air Sea Rescue some, such as the Earle and Alice Hiscock and Julia McWilliams went on to other projects. [29]

ERE had by this time demonstrated the need for and had pioneered the development of exposure suits in the United States.

It is indeed unfortunate that recent investigators and designers of modern 'survival suits' did not have the benefit of the work done by ERE and Air Sea Rescue. Despite my life-long knowledge of the hazard of exposure and the need for protective clothing, I never dreamed that I would be the one to bring this information together.

My hope is that others of you will pursue missing information, not only regarding exposure suits, but other items of emergency rescue equipment that were developed by ERE during that short period from May 1943 until February of 1944. Some are just being rediscovered today. It may be that in examining the accomplishments and failures of the past, we can save more lives in the future.

POSTSCRIPT

It is interesting that the interest in hypothermia, in the 1980's is, in part, the result of the realization that in many marine casualties victims succumb to 'drowning' after suffering from acute hypothermia. This is born out by the Coast Guard's recent concern for 'level flotation' in recreational craft and the development of 'float-coats' and 'survival suits.'

That exposure is a primary killer of maritime 'accident' victims was realized many years ago. Why did it take so long to again realize that without protection from hypothermia "all our other (safety) items are not worth a darn"? [19]

Maybe there is a need for a new liaison committee for emergency rescue equipment, with international participation, to coordinate all efforts, not only with regard to hypothermia, but also in the development of emergency rescue equipment items necessary for successful survival and rescue.

ACKNOWLEDGMENTS

To Earle and Alice Hiscock, and George Holt for their remembrances, and the material they saved. And to Dr. John Hayward, for encouraging me in this endeavor of 'historical perspective to keep us humble.'

REFERENCE LIST

Chronological order by date of publication

1] *Wartime Safety Measures for Merchant Marine*.
U.S. Coast Guard, Educational Series No. 2, January 1943.
U.S. Government Printing Office, Washington, DC, 1943.
Pages:82, 110-111.

2] U.S. Department of Commerce,
Bureau of Marine Inspection and Navigation.
Memorandum.
From: LCDR Earle F. Hiscock, Principal Traveling Inspector.
To: Chief, Merchant Marine Inspector.
Subject: Tests on lifesaving and other rescue equipment at Miami, Florida, from 22-26 March 1943 inclusive.
Dated: 31 March 1943.

3] U.S. Joint Chiefs of Staff, Washington, DC.
Memorandum for Information No. 58 (Copy No. 18).
Plan for Organization of Committee on Emergency Rescue Equipment.
Dated: 15 April 1943.

4] U.S. Navy Department, Washington, DC,
Office of the Chief of Naval Operations, Washington, DC.
Letter.
From: Vice-Chief of Naval Operations.
To: Coordinator of Research and Development.
Subject: Committee on Emergency Rescue Equipment.
Dated: 20 April 1943.

5] U.S. Navy Department, Washington, DC.
Letter.
From: Coordinator of Research and Development.
To: Commanding General, Army Air Forces,
Chairman, Maritime Commission,
Director of Scientific Research and Development,
Director, Office of Strategic Services.
Subject: Liaison Committee on Emergency Rescue Equipment.
Dated: 26 April 1943.

6] U.S. Navy Department, Washington, DC.
Letter.
From: Coordinator of Research and Development.
To: Commandant, U.S. Coast Guard.
Subject: Emergency Rescue Equipment, Liaison Committee and Technical Aide.
Dated: 5 May 1943.

7] U.S. Navy Department, Washington, DC,
Office of Coordinator of Research and Development.
Notice re – Liaison Committee on Emergency Rescue Equipment.
Dated: 12 May 1943.

8] U.S. Navy Department, Washington, DC.
Minutes of Second Meeting, 15 May 1943.
Liaison Committee on Emergency Rescue Equipment.
Dated: 22 May 1943.

9] U.S. Navy Department, Washington, DC.
Minutes of Third Meeting, 5 June 1943.
Liaison Committee on Emergency Rescue Equipment.
Dated: 24 July 1943.

10] Coordinator of Research and Development, U.S. Navy,
Liaison Committee on Emergency Rescue Equipment.
Emergency Rescue Equipment Section – Information Bulletin No. 1.
Dated: 5 June 1943.

11] Coordinator of Research and Development, U.S. Navy,
Liaison Committee on Emergency Rescue Equipment.
Emergency Rescue Equipment Section – Recommendation No. 1.
Subject: Lenses, color of, life preserve lights.
Dated: 5 June 1943.

12] Coordinator of Research and Development, U.S. Navy,
Liaison Committee on Emergency Rescue Equipment.
Emergency Rescue Equipment Section – Recommendation No. 2.
Subject: Signal mirror, tempered glass type.
Dated: 5 June 1943.

13] Coordinator of Research and Development, U.S. Navy,
Liaison Committee on Emergency Rescue Equipment.
Emergency Rescue Equipment Section – Recommendation No. 3.
Subject: Substitution of protective exposure suits for “lifesaving suits” on Merchant Vessels and Military Transports.
Dated: 5 June 1943.

14] U.S. Navy Department, Washington, DC,
Liaison Committee on Emergency Rescue Equipment.
Minutes of Special Meeting, 27 July 1943.
Subject: Consolidation of land-air-sea rescue under one command.
Dated: 28 July 1943.

U.S. Navy Department, Washington, DC.
Letter.
From: Commander-in-Chief, United States Fleet and Chief of Naval Operations.
To: Joint Chiefs of Staff.
Subject: Consolidation of Air-Sea Rescue under one command.
Dated: No date.

15] U.S. Navy Department, Washington, DC.
Letter.
From: Coordinator of Research and Development, U.S. Navy.
To: Joint Chief of Staff.
Via: Vice-Chief of Naval Operations.
Subject: Land-Air-Sea Rescue Operations.
Dated: 29 July 1943.

16] U.S. Navy Department, Washington, DC,
Liaison Committee on Emergency Rescue Equipment.
Agenda and Minutes of Fourth Meeting, 2 August 1943.
Dated: 2 August 1943.

17] Office of Coordinator of Research and Development, U.S. Navy,
Emergency Rescue Equipment Section.
Report of Conference, 3, 4, 5 August 1943.
Subject: Airborne Rubber Rafts and Sea Survival Equipment and Seasickness.
Dated: 20 August 1943.
Pages: 1-2, 4, and 6.

U.S. War Department,
Headquarters, Army Air Forces, Washington, DC.
AAF Memorandum No. 20-10.
Subject: Organization of AAF Emergency Rescue Branch.
Dated: 25 August 1943.

Office of Coordinator of Research and Development, U.S. Navy,
Emergency Rescue Equipment Section.
Memorandum to Personnel.
Subject: Organization of AAF Emergency Rescue Branch.
Dated: 6 September 1943.

Coordinator of Research and Development, U.S. Navy,
Emergency Rescue Equipment Section.
ERE publication #2, *Survival Hints*.
Dated: September 1943.
(Reproduced from – *Wartime Safety Measures for Merchant Marine*, U.S. Coast Guard, January 1943. See [1] above.]

U.S. War Department,
Headquarters, Army Air Forces, Washington, DC.
AAF Regulation No 20-23.
Subject: Organization – Air Communications Officer.
Dated: 1 October 1943.

18] Coordinator of Research and Development, U.S. Navy,
Liaison Committee on Emergency Rescue Equipment.
Emergency Rescue Equipment Section.
Bi-Weekly Report No. 5 (Copy No. 12).
Dated: 16 October 1943.
Page: 12.

U.S. War Department,
Headquarters, Army Air Forces, Washington, DC.
AAF Memorandum No. 20-10A.
Subject: Amendment to memorandum No. 20-10.
Dated: 26 October 1943.

19] Coordinator of Research and Development, U.S. Navy,
Emergency Rescue Equipment Section.
Report of Conference – Exposure Suits for Aircraft, 27 October 1943.
Dated: 27 October 1943.

20] Coordinator of Research and Development, U.S. Navy,
Emergency Rescue Equipment Section.
Royal Canadian Air Force Flying Clothing Committee.
Reports of: Joint United States/Canadian Air Sea Rescue Equipment Trials,
Washington-Montreal-Halifax-Toronto.
Dated: 21 November 1943; 25 November 1943; 30 November 1943; 6 December 1943.

21] U.S. Navy Department, Washington, DC,
United States Fleet,
Headquarters of the Commander-in-Chief.
Memorandum for Mr. H. W. Jackson.
Subject: “Vaco” rubber life saving suits.
Dated: 27 November 1943.

22] Emergency Rescue Equipment Section.
Memorandum for file.
By: Lt. Colonel, George W. Holt, M-C.
Dated: 27 November 1943.

Office of Strategic Services, Washington, DC.
Letter.
From: LCDR Earle F. Hiscock, USCGR,
Technical Aide for Emergency Rescue Equipment.
To: Wing Commander M. M. Foss, Air Member, Air Staff
Director of Operational Requirements,
Royal Canadian Air Force,
Toronto, Canada.
Dated: 29 November 1943.

23] U.S. Navy Department, Washington, DC,
Office of Chief of Naval Operations, Washington, DC.
Chief of Naval Operations Armed Guard Bulletin 25-43.
From: Chief of Naval Operations.
To: Armed Guard Officers.
Subject: Rubber Life Saving Suits.
Dated: 1 December 1943.

24] Emergency Rescue Equipment Section.
Letter.
From: LCDR Earle F. Hiscock, USCGR.
Technical Aide for Emergency Rescue Equipment
To: Director of Photography
Photo Science Laboratory
Naval Air Station
Anacostia, VA.
Subject: Film of Halifax Trials on Exposure Suits.
Dated: 6 December 1943.

U.S. Navy Department, Washington, DC,
Coordinator of Research and Development.
Agenda for Seventh Meeting.
Liaison Committee on Emergency Rescue Equipment.
Dated: 15 December 1943.

25] Emergency Rescue Equipment Section.
Letter.
From: Lt. Colonel, George W. Holt, M-C.
To: Wing Commander M. M. Foss.
RCAF, AMAS/DOR,
3102 Lisgar Bldg.,
Ottawa, Canada.
Subject: Neoprene treated nylon for exposure suits, with sample of same.
Dated: 23 December 1943.

26] Emergency Rescue Equipment Section.
Letter.
From: George W. Holt, Lt. Colonel, M-C.
To: Mr. Waldemar Dietz, Technical Aide.
Office of Scientific Research and Development (Section 11-2),
1703 32nd Street, NW,
Washington 25, DC.
Subject: Cooperation with Walter L. Fry, re: Exposure Suits.
Dated: 23 December 1943.

27] Memorandum.
From: Walter L. Fry
2740 Cass Ave.,
Detroit, Michigan.
Subject: Fry Lifesaving Suit,
Dated: No date.

28] Emergency Rescue Equipment Section.
Letter
From: LCDR Earle F. Hiscock, USCGR,
Technical Aide for Emergency Rescue Equipment.
To: Dr. L. H. Newburgh,
University of Michigan,
Ann Arbor, Michigan.
Subject: Review of amended reports of Halifax Trials on Exposure Suits, Nov. 1943.
Dated: 28 December 1943.

U.S. Navy Department, Washington, DC.
Letter
From: Coordinator of Research and Development
To: Certification, Dispersing Division,
Bureau of Supplies and Accounts
Subject: Refund request for Earle F. Hiscock for travel to Ottawa, Canada as he was unable to make trip due to illness.
Dated: 31 December 1943.

Coordinator of Research and Development, U.S. Navy,
Liaison Committee on Emergency Rescue Equipment.
Emergency Rescue Equipment Section.
Bi-Weekly Report No. 9 (Copy No. 16).
Dated: February 12, 1944.

Memorandum for LCDR Hiscock (ERE).
From: W. Lloyd George.
Re: Draft Agenda for Liaison Committee Meeting, 22 February 1944.
Dated: 18 February 1944.

Liaison Committee on Emergency Rescue Equipment.
Agenda for Meeting, 22 February 1944.
Two different copies.

Coordinator of Research and Development, U.S. Navy,
Liaison Committee on Emergency Rescue Equipment.
Emergency Rescue Equipment Section.
Bi-Weekly Report No. 10 (Copy No. 12).
Dated: 26 February 1944.

29] Office of Strategic Services, Washington, DC.
Memorandum (two copies).
From: CAPT Harold J. Coolidge, Jr.
To: The Staff of the Emergency Rescue Equipment Section, prior to 15 Feb 1944.
Dated: 17 April 1944.

30] Air Sea Rescue Agency.
Survival Activities, Periodical Report.
By: C. M. Murphy, Major, A.C.
(Special Duty Officer, Air Sea Rescue Agency)
Visit to Wright Field (Dayton, Ohio) -- May 16-20,1944
Dated: 22 May 1944.

Office of Air Sea Rescue Agency.
Circular 3-44.
Subject: Chain of Command.
Dated: 21 June 1944.

Office of Air Sea Rescue Agency.
Memorandum 2-44.
Subject: Staff Officers, Special Assignment for.
Dated: 22 June 1944.

31] U.S. Navy Department.
Press Release.
Air Sea Rescue Agency Assigned to Coast Guard.
Dated: 9 September 1944.

32] Air Sea Rescue Bulletin, No. 10.
United Stated Coast Guard, Air Sea Rescue Agency.
Dated: April 1945.

Air Sea Rescue Bulletin, Vol. II, No. 2.
United Stated Coast Guard, Air Sea Rescue Agency.
Dated: October 1945.

33] Air Sea Rescue Bulletin, Vol. II, No. 3.
United Stated Coast Guard, Air Sea Rescue Agency.
Dated: November 1945.
Pages: 3, 4, 13, and 39.

Conversations with over the years...
Earle F. Hiscock and Alice C. Hiscock.
Chatham, Massachusetts, U.S.A.

34] Conversation with Dr. George W. Holt
Denver, Colorado, U.S.A.
Date: 1 December 1979

Note: The above listed documents are the property of the author. This and other material pertaining to ERE can be made available to interested researchers.

Since compiling this paper, in 1979, the complete records of the Emergency Rescue Equipment Section have been located in the National Archives, College Park Maryland. [Record Group 226.2.3 "Records relating to the Emergency Rescue Equipment Section (ERE)]. With the following historical note –

> "**History:** ERE (also known as Emergency Rescue Equipment Committee) established by JSC Memorandum 68 (sic), April 15, 1943, as an interagency organization under the supervision of the Navy Department. Responsible for coordinating development of maritime emergency rescue procedures and equipment. OSS was represented on policy-making Liaison Committee, and furnished personnel and equipment for Exhibit, Technical Literature Research, and Information Exchange Sections. ERE abolished, with functions transferred to U.S. Coast Guard, by Office of the Chief of Naval Operations Directive Op-01-MD, Serial 39702, February 28, 1944, implementing JSC Memorandum 659/1, February 22, 1944."

It is interesting to note that neither the U.S. Coast Guard nor the U.S. Navy have any records, or copies of records regarding ERE.