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COLD WEATHER DECONTAMINATION STUDY

by

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TABLE OF CONTENTS

COLD WEATHER DECONTAMINATION STUDY

I. INTRODUCTION.

A. Objectives.

The objectives of this study are:

(1) To collate existing data pertinent to radiological decontamination under cold weather conditions.

(2) To identify requirements for additional cold weather decontamination experimental data needed to provide input for a cold weather addendum to the manual TM 3-225 (NAVDOCKS TP-PL-13) "Radiological Recovery of Fixed Military Installations."

(3) To design an experimental program to provide the needed input data on cold weather decontamination.

B. Authority.

This work was authorized under project 4C12-10-007-04, "Protection Against Radiological Hazards."

II. BACKGROUND.

A. Temperate Weather Historical Background.

Radiological decontamination has been intensively investigated during the past decade by a number of different agencies. Although a portion of this work has been accomplished at nuclear weapons tests, laboratory experiments and field tests involving the use of radioactive fallout simulants have also provided much of the basic input data in this field.

Early laboratory work consisted of contamination-decontamination studies of small panels of various surfaces using reactor produced nuclides in solution or fallout samples obtained from nuclear weapons tests such as Operations GREENHOUSE and JANGLE.

The results of these laboratory studies were used to compare methods of decontamination or phenomena associated with different types of surfaces. However, much of the data were found to be directly applicable to land target components contaminated by fallout.

At Operation JANGLE, several agencies conducted decontamination studies on model buildings and paved areas. Due to variations in operating technique and instrumentation, however, the results from these tests were not conclusive. Additionally, difficulties were encountered in contaminating the test surfaces due to unpredictable weather conditions thus limiting the significance and validity of the test results.

In 1953, the USNRDL conducted a series of tests on a land target complex at San Bruno, California, using a fallout simulant. The data obtained proved to be of limited value since it was later determined that the simulant used was not a realistic facsimile of actual fallout. In addition, laboratory tests were conducted with liquid contaminants to determine decontamination reactions on various materials. The results of these laboratory tests were extrapolated to large areas to determine decontamination effectiveness. They did not, however, permit an evaluation of the logistic costs of large scale decontamination operations.

During this same period of time the USACWL conducted gross decontamination studies of RW contaminants on various road surfaces and panels of roofing materials. Again the physical properties of the contaminant were quite different from fallout. Any extrapolation of the results to that which would have been obtained using actual fallout was subject to question.

In 1953, the first edition of the manual, "Radiological Recovery of Fixed Military Installations," NAVDOCKS TP-PL-13 (now identified by the Army as TM 3-225) was prepared by the USNRDL under joint Army-Navy sponsorship. The validity of much of the input data in determining cost and decontamination procedure effectiveness was uncertain, and in many cases "best estimates" had to be used. It was therefore determined that decontamination studies were required.

At Operations CASTLE and REDWING, contamination-decontamination studies were conducted on ships, aircraft, and panels of various materials used in the construction of building exteriors which were contaminated by actual fallout. Some of the uncertainties associated with these experiments were due to low intensity levels of contamination, undefined effects of weather on the contaminated surfaces between the contamination and decontamination phases of the experiment, and unknown effects of fallout fractionation. Results obtained had limited application to the studies of the large area decontamination problem.

In 1956 the USNRDL developed a clay and harbor-bottom fallout simulant based on data obtained by their fallout projects conducted at Operations JANGLE, CASTLE, and REDWING. Subsequently, they conducted an extensive series of tests at Camp Stoneman, California, which were jointly sponsored by the Army and Navy. During these tests, structures and pavement were contaminated to mass levels which approximated that of actual fallout at H plus one hour intensity levels of from 1000 to 10,000 R/hr. Data were obtained on the effectiveness of such decontamination procedure as hosing, scrubbing, and sweeping under ideal temperate weather and operating conditions. No limitations were placed in the amount of effort and water used in these operations. In these experiments, the effectiveness data were directly applicable to large areas and were consequently used in revising the manual, "Radiological Recovery of Fixed Military Installations."

Data on the optimum effort for these decontamination procedures were not obtained. The quantity of water used was unlimited. Due to this, a second series of tests, also under joint Army and Navy sponsorship, was conducted at Camp Stoneman in 1958. The objectives of these tests included decontamination as a function of effort, the effectiveness of dry decontamination methods, and the efficiency of land reclamation procedures for various soil conditions. Most data on effectiveness as a function of effort followed a mathematical model based on theoretical considerations. Dry decontamination methods of sweeping and air hosing were very effective. Practically complete decontamination of cohesive soil was obtained by scraping. Residual contamination was apparently due to spillage only.

Since 1958, testing with fallout simulants by USNRDL has been extended to a 5-acre complex of buildings, roads, and grounds at Camp Parks, California. In these tests, the effects of both dry and rainy weather on contamination patterns were measured over a two-week period after contamination. The two-week period was selected to correspond to the emergency period in which personnel in a heavily contaminated area must remain in shelters prior to the actual commencement of decontamination operations. Next,actual logistic requirements for an integrated radiological recovery operation on this complex were determined and compared to that which had been predicted. Results have not, as yet, been reported.

A list of background references for the foregoing work is included in the bibliography of this report. Specific references to the field of cold weather effects on decontamination procedures cited in the following text are also included in the bibliography.

B. Cold Weather Historical Background.

In 1958 the USNRDL prepared a study on the potential delay in radiological recovery due to cold weather encountered in the United States (1). In this study, the concept of a hosing cutoff temperature was introduced. Operations involving water would not be considered feasible below this value. Since there were no data upon which to estimate the water hosing cutoff temperature, the analysis of data presented the potential delay for a series of possible cutoff temperatures down to 0°F. For a hypothetical cutoff temperature of 0°F, negligible delay would result for normal winter temperature based on climatological studies of the United States. However, delays would increase if the cutoff temperature were higher, to the point where the mission recovery time would be delayed in excess of a month from a cutoff temperature of 30°F.

During early 1960, the Naval Civil Engineering Laboratory (NCEL) conducted a series of tests at Fort Greely, and Pt. Barrow, Alaska, to determine (1) the cutoff temperature of water for hosing and building washdown (2) the effectiveness of power sweepers on packed snow; and (3) whether frozen ground could be surface softened by freezing point depressants. Local sand (non-radioactive) was used as the fallout simulant in these tests. Only qualitative observations could be made for test results. Water spray from fire hoses and building washdown nozzles did not freeze at windchill values to 1450 (at 9°F). Windchill is defined as the combined effect of wind and air temperature on heated bodies, and is expressed in kilogram calories per square meter per hour. Slow leaks and wind-borne mist did freeze. The water runoff did not immediately freeze, and in fact still runoff water took 15 minutes to crust when in contact with ocean ice at 7°F and a windchill index of 1200. Power sweepers were effective on packed snow except at temperatures near freezing. At these temperatures, surface softening due to the onset of thawing apparently trapped the contaminant preventing the sweeper from effectively picking it up. The use of salt depressants to soften ground surface did not appear to be effective.

Much of the data on decontamination effectiveness and work rates contained in the Manual TM 3-225 is based on the Camp Stoneman tests which were conducted under temperate climatic conditions. The NCEL is presently writing an interim addendum to this manual incorporating all known factors of cold weather as they effect decontamination operations.

III. COLD WEATHER DATA.

TM 3-225 (2) presents methods and data necessary to perform decontamination operations on fixed military installations. As previously mentioned, these methods and data are based on contamination and decontamination under temperate weather conditions. Certain sections of this manual, such as radiological defense concepts, estimating processes, and methods of recovery planning, will be largely unaffected by the advent of cold weather. The application of basic recovery criteria will have to be modified, however, and in some cases alternate methods will have to be employed. The cold weather addendum to TM 3-225 would present the necessary technical information so that responsible personnel may estimate the recovery effort(in terms of personnel, materials and equipment) and the overall effectiveness of various recovery methods under cold weather conditions.

A study has been conducted by this Laboratory of the phenomena associated with cold weather conditions and their expected effect on decontamination recovery operations. As a result of this study certain problem areas have been highlighted. The most significant of these relating to the cold weather recovery problem are listed below. It is concluded that the most urgent requirements for information needed for a cold weather addendum to the recovery manual will be met by pursuing a program including these areas of consideration.

A. Human Engineering.

Exposure of personnel to cold weather will necessitate the physiological adjustment of body functions, the use of winter clothing, and other general discomforting requirements which will in general lower the nominal work output expected of an individual.

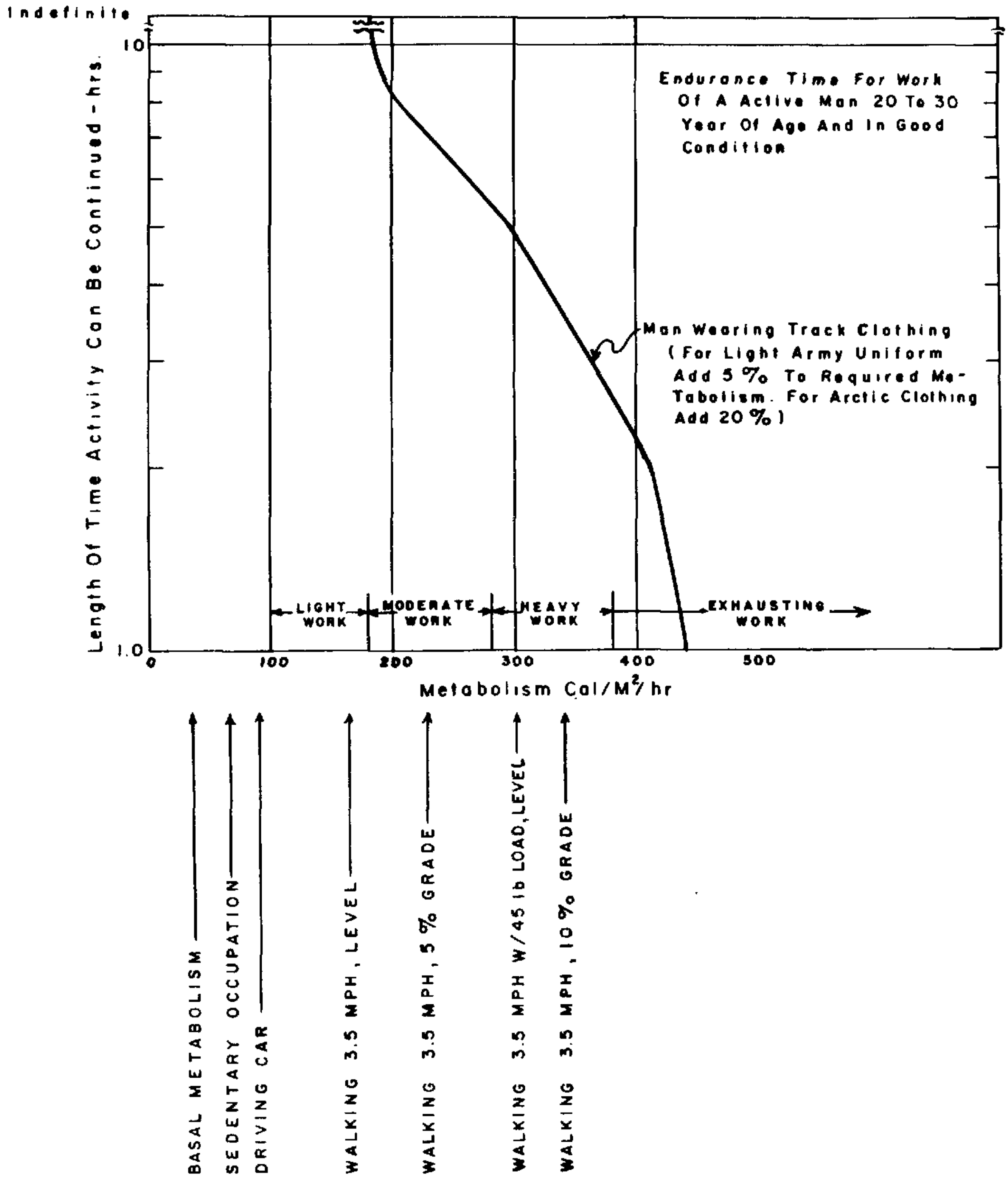
1. Summary of Known Information.

The metabolic cost of performing various grades of work has been investigated by the U. S. Army Quartermaster Corps. Test results are based primarily on treadmill experiments. Figure 1, taken from data in reference (3), shows the length of time that various grades of work can be continued by young healthy men. These data are an average for many persons and great deviations can be expected for individual cases. However, this does provide guidance for application to cold weather work. It is reported that the metabolic cost, as shown in Figure 1, will be increased by 20 percent when wearing arctic clothing.

It has been estimated by Dr. F. N. Craig of the USACWL Physiology Division that radiological recovery effort falls into the category of "moderate work." Examination of Figure 1 shows that moderate work can be continued for a four hour shift even allowing for the 20 percent added metabolism required by arctic clothing.

Exposure of personnel in below freezing environments can be a limiting factor in a recovery effort. Temperature, wind, and solar radiation are the prime factors affecting cold sensations. The effects of temperature and wind have been combined into the empirical windchill formula which has been correlated with comfort sensations at various levels of windchill (4). The effect of solar radiation is to decrease the windchill index value by about 200 Kg Cal/M^2/hr. Although windchill

Fig 1


Indefinite
10
1.0
Length Of Time Activity Can Be Continued - hrs.
0
100
200
300
400
500
Metabolism Cal/M²/hr
Endurance Time For Work Of A Active Man 20 To 30 Year Of Age And In Good Condition
Man Wearing Track Clothing (For Light Army Uniform Add 5 % To Required Metabolism. For Arctic Clothing Add 20 %)
LIGHT WORK
MODERATE WORK
HEAVY WORK
EXHAUSTING WORK
BASAL METABOLISM
SEDENTARY OCCUPATION
DRIVING CAR
WALKING 3.5 MPH, LEVEL
WALKING 3.5 MPH, 5 % GRADE
WALKING 3.5 MPH W/45 lb LOAD, LEVEL
WALKING 3.5 MPH, 10 % GRADE

is based on the cooling of naked bodies, the comfort sensations of the clothed body follows the index fairly well, since the face area is always exposed.

Figure 2 shows a plot of windchill values for various temperatures and wind speeds. The value of 1000 corresponds to a "very cold" sensation. It is also described as "pleasant conditions for travel (in Antarctica) cease on foggy and overcast days." The value of 1200 produces the same sensation on clear sunny days. A value of 1400 is considered dangerous as "freezing of human flesh begins" (4). Since travel in Anarctica is judged to be moderate work, the windchill index of 1000 (1200 on sunny days) is probably the upper practical limit for decontamination work. At -10°F, the corresponding wind speed for this condition is only 2 MPH. However, this is mitigated by the fact that "lowest temperatures in any locality always occur with calms or very light winds." (5). In any case, operations inside closed cabs of vehicles would be feasible at -10°F and operations in the open highly probable, provided that the proper type of clothing is worn.

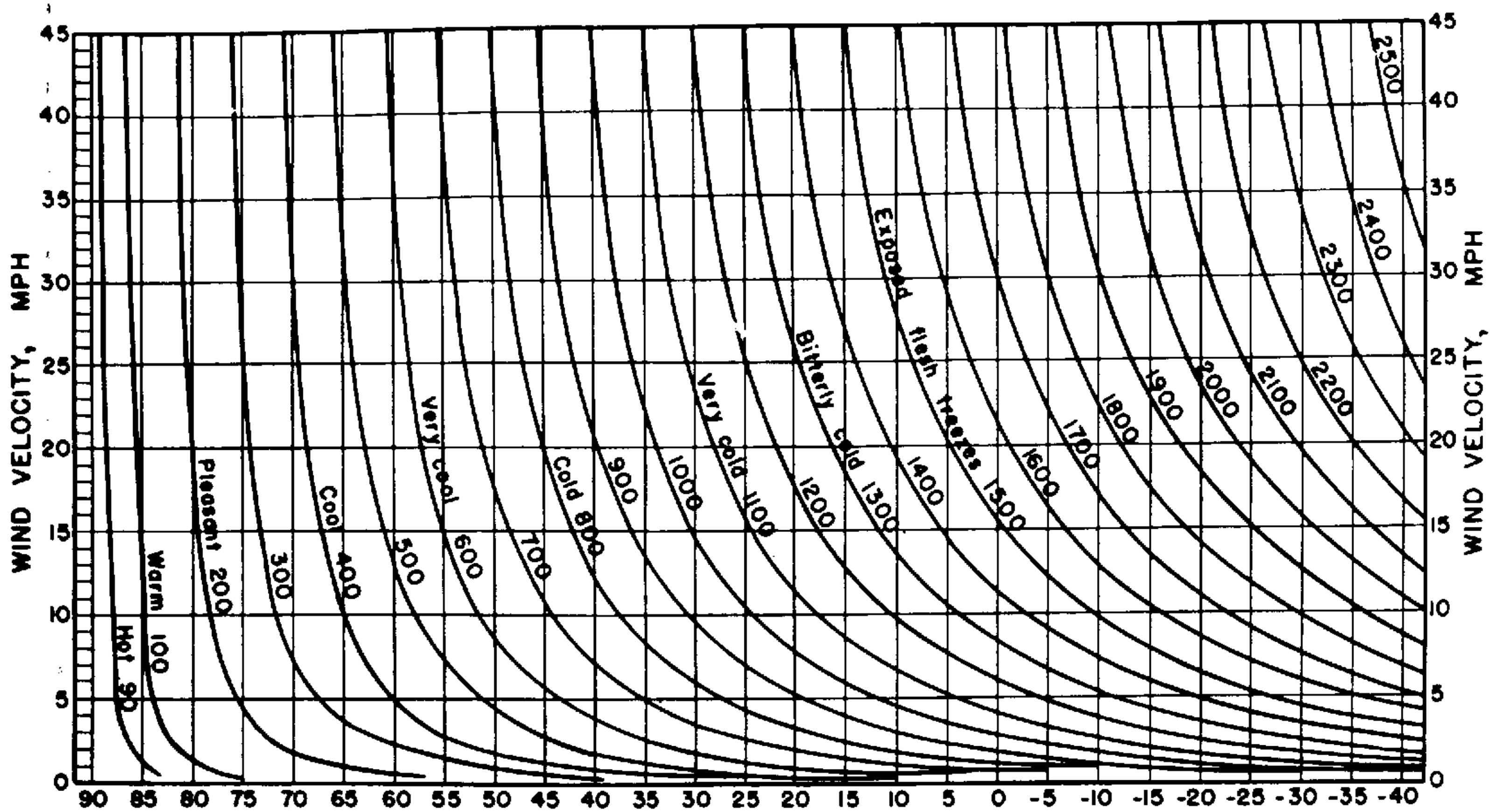
2. Human Engineering Requirements.

A collation of existing cold weather environmental and physiological data, which would be applicable to decontamination operations, is necessary. This collation would include establishing the metabolic rates for various decontamination tasks such as hand sweeping and shoveling, fire hosing, and engineer equipment operation. From these data, graphs similar to Figure 1 would be prepared. Also included would be estimates of effort loss due to decreases in dexterity caused by the wearing of winter clothing, plus recommendations on the proper type of arctic clothing to be worn for various tasks.

B. Equipment Engineering.

With proper procedures, most engineering type equipment, both military and civilian, can be operated in cold weather. However, the work output of this type of equipment will be adversely affected by various cold weather extremes, i.e., deep snow, frozen ground, thawing ground, etc.

Figure 2



Windchill Index

1. Summary of Known Information.

There is little problem in the operation, per se, of earth-moving and engineer equipment in cold environments. Obvious precautions such as the use of proper grades of lubricants and operation of pumps and hose lines to prevent freezing must be followed. However, there are reductions in efficiency in the output of some machinery that are dependent upon such factors as depth of frozen ground for earthmoving equipment, the presence of liquid water on surfaces at temperatures near the thawing point that would make dry sweeping inefficient, and the decrease of operator dexterity when wearing winter clothing. The limitations apply to any construction type work under cold conditions. The ERDL and NCEL are collating data at the present time on these subjects and on the logistics of snow removal.

The contamination of engineer equipment by operation in a contaminated area has not proven to be a military problem under temperate conditions. Reference (6) points out, however, that wet snow will pack on the track, suspension, idler wheels, and sprockets of tracked vehicles. This requires occasional halts to remove the accumulation.

2. Equipment Engineering Requirements.

Existing applicable data is being collated by ERDL and NCEL, and experimental effort will be planned following analysis of these data. Preliminary discussion with representatives of ERDL has indicated that tests may be necessary in establishing the limitations of engineer earthmoving equipment in scraping thin layers of frozen ground. Tests will also be necessary in investigating the contamination of equipment operating in snow covered contaminated areas.

C. Water Flow.

The possibility exists that runoff water from hosing operations may freeze thus concentrating the contamination contained in this water. The parameters causing freezing of this runoff water for various temperatures and types of terrain are undefined.

1. Summary of Known Information.

The major problem in the use of water streams from fire hoses in decontamination operations, down to temperatures as low as -10°F, is the fate of the runoff water. It was observed during the recent Fort Greely and Point Barrow tests that 32°F runoff water did not quickly freeze, but ran freely down slight slopes. Under the worst drainage condition, where the runoff was on level ocean ice, visible crusting was noted only after fifteen minutes stagnation at an air temperature of 7°F and windchill index of 1200.

Most fixed installations have well drained surfaces, at least around buildings, so that runoff water should reach a drain within a few minutes. However, the factors that control the freezing of running water are not well defined. Variables include initial water temperature, water film thickness, air temperature and wind speed (windchill), surface temperature, slope, and solar radiation.

2. Water Flow Information Requirements.

A study will be necessary to evaluate the effects on the freezing time of water film at various conditions of initial water temperature, water film thickness, air temperature, wind speed, surface temperature, slope, and thermal radiation. It appears such tests could best be performed in a wind tunnel cold chamber. Application of these data, in the form of charts or nomograms, to the environment and physical features of installations should provide the necessary planning guidance for using water in decontamination operations.

D. Fallout Migration on Snow.

Any migration of fallout on snow, either horizontal or vertical, will have a pronounced effect on the decontamination procedure to be used.

1. Summary of Known Information.

a. Vertical Migration.

The vertical movement of deposited solid fallout into the ground is negligible under temperate conditions, and a similar circumstance would be encountered when the ground is frozen. However, the fallout may settle through snow and ice by a combination of gravity and thermal action. Since the location of the fallout with respect to the surface of either snow or ice will determine the decontamination procedure to be followed, it is necessary to understand the phenomena associated with fallout migration.

The NCEL has reported that sand, deposited on snow, migrated a maximum vertical distance of 1-1/2 inches until solar radiation no longer had an effect. Little else is known of this phenomena and consequently further information is required.

b. Horizontal Migration.

The movement of contaminant by wind under drifting snow conditions may materially alter the initial fallout pattern, as contrasted to the situation where the snow is crusted. The formation of "hot spots" on the leeward sides of buildings, embankments, etc., may be expected. This effect and possible decontamination implications have not been studied.

2. Fallout Migration on Snow Information Requirements.

The scarcity of information on this subject will require the performance of necessary tests to determine both the settling rate of fallout on ice and snow, and the relative movement and characteristics of fallout under drifting snow conditions.

E. Dose Factors.

The effect of snow cover on dose rates in the case of snow fall subsequent to the arrival of contamination must be considered. The dose rate from loads of contaminated snow, of importance in snow removal procedures, must be defined.

1. Summary of Known Information.

The operators of equipment such as mechanized scrapers, loaders, and dump trucks should receive a greater dose from a contaminated load of snow than from a contaminated load of soil. This is due to the lower bulk shielding characteristics of snow compared to soil.

The magnitude of this increased dose, and its possible significance requires investigation. In addition, there is the possibility of shielding afforded by snow fall subsequent to a contaminating event. The degree of this shielding and its significance should be studied.

2. Dose Factors Requirements.

To delineate the magnitude of the increased dose received by snow removal equipment operators, and its possible significance, both theoretical and field studies are necessary. In addition, the effect of snow cover as a radiation shield must be determined.

F. Decontamination Effectiveness and Techniques.

The residual numbers for temperate decontamination operations will require modification for certain cold weather conditions. Modification or substitution of certain techniques, such as hosing, sweeping and scraping, will be necessary during cold weather decontamination operations.

1. Summary of Known Information.

Only limited experimental data have been published on the decontamination effectiveness of any method at low temperatures. Reference (7) contains some data on the decontamination of tarpaper and galvanized iron at $0^{o}F$ using 8 psi and 40 psi water hosing. The contaminant was not representative of fallout but was particulate in nature. For the fire hosing pressure of 40 psi, there was little difference in overall effectiveness on originally dry surfaces at $0^{o}F$ and $70^{o}F$. However, the effort required increased by as much as a factor of two when ice or snow was present on the surfaces initially. At the lower hosing pressure of 8 psi, the effectiveness on tarpaper noticeably decreased at the cold condition.

2. Decontamination Effectiveness and Technique Requirements.

Such factors as residual numbers, effort required, limitations and modifications to temperate decontamination techniques can only be obtained by actual decontamination field tests under cold weather conditions. Ideally, a field test of the Camp Parks and Stoneman magnitude should be conducted. However, due to numerous uncertainties under cold weather conditions, such as efficiency of engineering equipment, hosing operations, human efficiency, only a limited field test operation is considered feasible during FY 1961. The information gained from these tests and the other studies to be conducted during FY 1961 will more clearly define the magnitude and urgency for further field testing.

IV. COLD WEATHER TESTING CONSIDERATIONS.

The selection of adequate test facilities, both laboratory and field, and the availability of an active fallout simulant at the field test facility is imperative to satisfy certain portions of the experimental test program. A temperature range of -10°F to 32°F is required at these test facilities. This is considered the significant temperature range wherein a major portion of the United States could be affected for an extended period of time. Presented in this section are the requirements and present status of test site selection and the development work necessary for simulant availability at the field test site.

A. Test Site Requirements.

Much preliminary work can be done in a suitable cold room with inactive simulant where precise control of testing conditions can be maintained. Facilities under consideration for use would be the USACWL climatic chamber, the Quartermaster Environmental Protection Laboratory at Natick, Mass., the Air Force Eglin Field facilities and contractor-owned facilities. The availability of any of these facilities for FY 1961 testing is being investigated.

The selection of a suitable field test site presents many problems. Ideally, the test site would have the following features in order of importance:

1. January mean temperature of 0 - 10°F, and one foot snow cover.

2. Approval to use isotopes and restrict use of test and operating area for a year.

3. A test area, isolated by one mile from habitated areas, which would include paved streets, several buildings, electricity, and a water supply system with fire hydrants.

4. An operating area with a heated warehouse building for simulant production and a suitable building for a change house.

5. Construction equipment, maintenance facilities, and machine shops.

6. Operating motor pool.

7. Camp facilities for approximately 50 people.

8. Emergency procurement office.

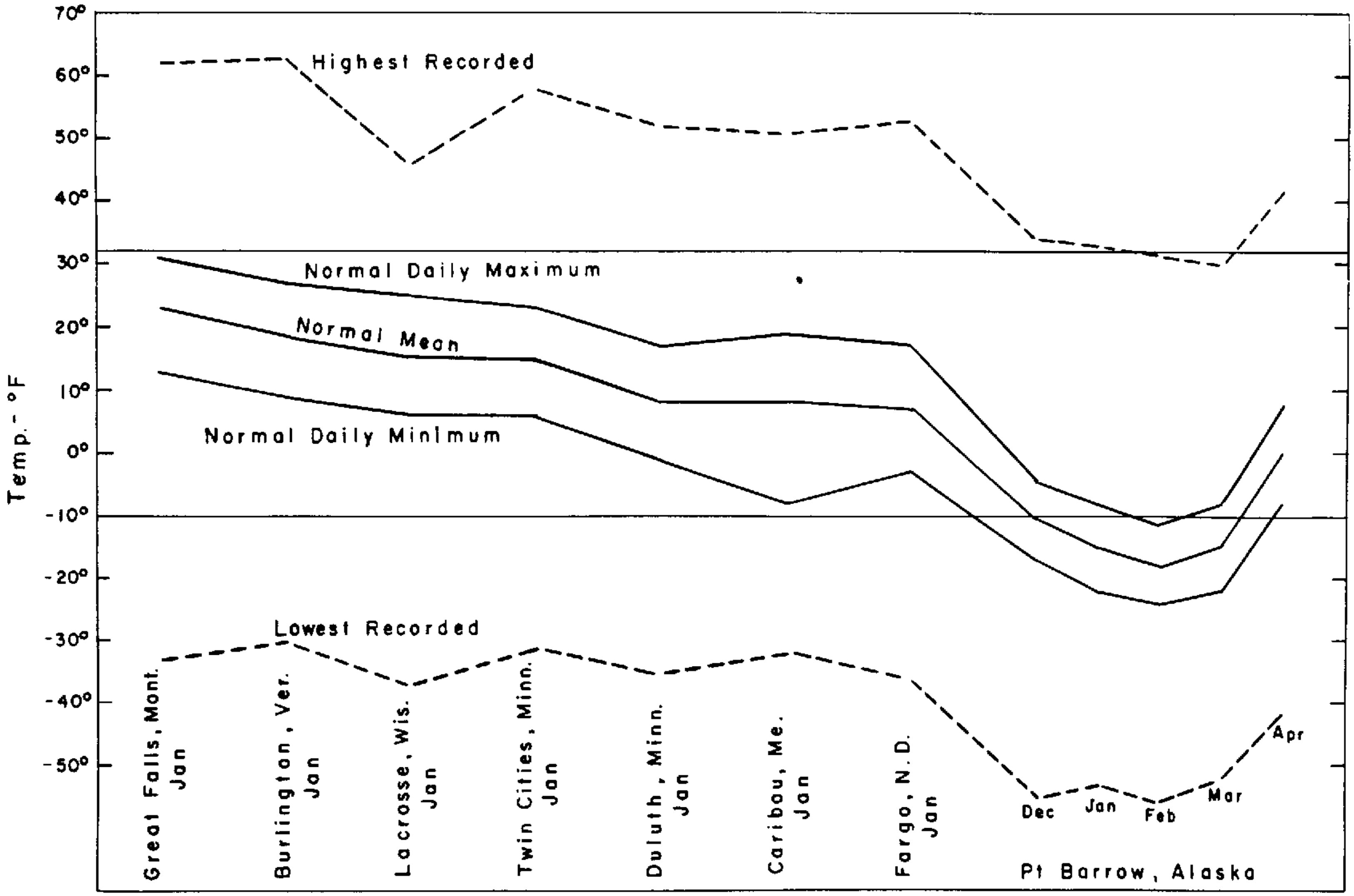
An investigation of possible sites is being conducted. No one site is expected to have all desired characteristics; however, items 1 through 4 are considered mandatory. The other items can be satisfied by off-site arrangements, at reduced efficiency or increased costs. From climatic data available it appears that the temperature requirement could be satisfied by a site in Alaska, Minnesota, North Dakota, and part of Wisconsin. Possible inactive Army installations in these areas are under consideration, including Camp McCoy, Wisconsin, and Twin Cities Arsenal, Minnesota. Active Army installations in these areas do not possess the desired characteristics. Weather data for the areas, plus some in upper New England, Montana, and Michigan are presented in Figure 3.

One site which has the necessary support and housekeeping facilities is Point Barrow, Alaska. However, this site has many drawbacks such as remoteness and the necessity of constructing many of the test surfaces.

Camp McCoy and Twin Cities Arsenal will be inspected during July 1960, plus any additional sites that may be suggested as the result of the weather survey.

Other possible cold weather test sites such as Mt. Washington, New Hampshire, and Ft. Churchill, Minnesota, have been discarded as the weather is too severe (too windy). The use of Ft. Greely, Alaska, has been investigated, but the lack of buildings available for the tests eliminates it from further consideration.

Fig 3
Meteorological Data - Temperature



After evaluating the merits of the various possible test sites and keeping in mind that larger scale testing may be required in FY 1962 or beyond, the best site will be selected and a request made for the use thereof.

B. Fallout Simulant Requirements.

The USNRDL has a facility at Camp Parks, California, where fallout simulant is prepared on a multi-ton production basis. Isotopes of barium or lanthanum are sprayed onto dry beach sand carrier material and fixed by the adhesive action of a waterglass spray It is understood that the radioactive tracer in this product is not leachable in water, but that an effect has been noted where prolonged intimate contact with clay and water results in some migration of activity from the simulant particles to the clay. This is most probably due to an ion exchange mechanism. In recent discussions with USNRDL personnel, it has been reported that a stabilizing step has been added to the simulant production process to correct this undesirable effect by heating the particles to 900°C.

It is desirable to use the USNRDL simulant in future cold weather studies as direct comparison of cold weather test results can then be made with existing temperate climate results. The USNRDL fallout simulant is the result of a development program of several years duration, and is based on the physical properties of fallout as determined by their measurements at nuclear test sites and supplemented by comparison with a fallout model.

For test operations at a cold weather site it will be necessary to have available a small simulant production facility. The short half-life of the tracer material plus the large quantities of shielding material necessary for shipment probably rule out shipping active simulant in bulk from Camp Parks to a remote cold weather test site. Also, since outdoor testing is critically dependent upon proper weather conditions, it will be necessary to have the capability of being able to contaminate test areas on less than a one-day notice. This is feasible where a supply of barium 140 is on hand,and upon receipt of favorable weather forecasts, the daughter isotope lanthanum 140 can be "milked" from the mixture and tagged onto the carrier material.

This laboratory has requested the USNRDL to assist in the design of a portable simulant production facility. (See Appendix A) They have advised us that this will cost approximately $85,000, and have been forwarded $9,000 of available FY 1960 funds to commence this phase of the work, including requisitioning of long lead time procurement items.

The Radiological Laboratory USACWL will investigate the disseminability characteristics of the fallout simulant in cold weather to determine the effect of moisture on spreading characteristics. In addition, the Radiological Laboratory is preparing for laboratory scale production of the simulant.

V. PROPOSED PROGRAM.

Successful completion and data analysis of the proposed program contained herein, during FY 1961, should provide the necessary input data for the publication of a cold weather addendum to the manual TM 3-225 (NAVDOCKS TP-PL-13) "Radiological Recovery of Fixed Military Installations."

A. Human Engineering.

It appears little or no test work is needed to satisfactorily delineate the solutions associated with this problem. A collation of existing data, and then presenting these data in proper form, as covered in Section III, is warranted. This work can best be performed under contract by a group knowledgeable in this field.

B. Equipment Engineering.

Necessary investigations into the limitations of earthmoving equipment will be contracted to an appropriate agency.

The contamination of equipment by usage in operations will be investigated as part of the decontamination effectiveness tests. Equipment used will be monitored periodically and any build-up of activity noted. If decontamination of this equipment is necessary, field expedient methods, such as chipping and brushing, will first be evaluated. If further decontamination of this equipment is necessary, other methods such as water hosing and salt application will be evaluated.

C. Water Flow.

A suitable wind tunnel cold chamber is present at CWL. Tests to satisfy the requirements as outlined in Section III are planned to be conducted at this facility.

D. Fallout Migration on Snow.

It is proposed to measure actual vertical migration through various snow and ice surfaces. Inactive fallout simulant will be dispersed on new, old and packed snow and ice in a relatively windless area and allowed to settle for periods of up to two weeks. The air temperature and solar radiation levels will be noted. By taking core samples and sectioning them vertically, the migration versus depth can be determined after thawing each section and weighing the sand.

Wind tunnel experiments in a cold room will yield data on the relative horizontal migration of contaminant on bare earth and snow. This work will depend on obtaining a supply of the proper types of snow required for the study. A suitable wind tunnel cold room exists within CWL. Tentatively, experiments are planned in this facility to compare the movement of inactive sand fallout simulant versus wind speed on powdered snow, crusted snow, and bare frozen earth. Relative migration horizontally will be determined either from air samples downwind or measuring the residual simulant mass levels of surface samples.

E. Dose Factors.

A theoretical study will be made based on various snow densities packed into the vehicle load container and distributions of the contaminant in the load. During field testing, in FY 1961, the dose to operators from the carried loads of snow will be determined from portable survey instrument measurements and compared with NRDL data on doses from soil loads.

The shielding afforded by a snow cover (fallen subsequent to the contaminating event) will be calculated in FY 1961 for various conditions of snow cover and snow density.

Theoretical studies will be done by contract.

F. Decontamination Effectiveness and Technique.

Tests will be conducted to determine the residual numbers, effort required, and limitations and modifications to temperate decontamination technique under cold weather conditions. Test areas will include outside areas of roofs, pavement, and terrain and will be approximately 2,000 square feet per trial to correspond with the areas used at the Camp Stoneman tests. Weather permitting, trials will be repeated for temperature conditions in the ranges -10°F to 5°F, 5°F to 20°F, and 20°F to 32°F. The following trials are planned:

1. Sweeping of packed snow, bare pavement, and bare frozen ground.

2. Scraping of snow.

3. Hosing of roofs, bare pavement, packed snow, and bare frozen ground.

4. Vacuuming of packed snow and bare frozen ground.

5. Mechanized scraping of frozen ground, within capability of scraper.

As many trials as possible will be performed depending upon availability of simulant and weather conditions. Data to be taken will include meteorological conditions, initial and final radiation measurements, and documentation of the effort expended.

Present levels of funding are not adequate for any greater level of test site effort in FY 1961. Experience gained in conducting the individual trials should provide guidance to the area of future research and testing, and to the desirability of conducting a large scale (5 acre) target complex decontamination effort in the future.

The use of chemical and engineer troops to perform the actual work will be requested. Necessary task leaders will be requested from cognizant military laboratories and/or obtained by contract from other testing organizations.

Funds in the amount of $200,000 are available, plus possibly another $100,000 of Navy service funds for field testing. R and D funds will be apportioned as follows:

Item		
Direction of program	2 MY	$40,000
Simulant facilities, design and fabrication		85,000
Simulant testing	1/4 MY	5,000
Water flow studies	1 MY	20,000
Migration studies	1 MY	20,000
Human engineering collation	1/4 MY	5,000
Decontamination Effectiveness under Cold Conditions (service funds - see below)		
Dose studies	1/4 MY	5,000
Incidental travel		5,000
Supplies, misc.		10,000
Isotopes, sand, chemicals		5,000
	Total	$200,000

The service funds would be apportioned as follows:

Technical direction of tests	3 MY	$60,000
Test site per diem		10,000
Transportation		5,000
Maintenance, shop work		5,000
Transportation of test equipment		10,000
Contigency		10,000
	Total	$100,000

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APPENDIX A

1. Project Title Fallout Simulant for Cold Weather Decontamination Studies	2. Security UNCL 4. Index Number	3. Project Number 5. Report Date 6 June 1960
6. Basic Field or Subject	7. Sub Field or Subject	7a. Technical Objective
8. Cognizant Agency BuShips 9. Directing Agency BuShips	12. Contractor and/or Laboratory U.S. Naval Radiological Defense Laboratory San Francisco 24, California Mr. P.D. LaRiviere, Proj. Leader	
10. Requesting Agency U.S.A. Cml Warfare Lab 11. Participation and/or Coordination	13. Related Projects 14. Date approved	17. Est. Compl. Dates Res. Dev. Test Op. Eval.
	15. Priority 16. Major Category	FY 18. Fiscal Estimates 59 None 60 $9,000 61 $76,200
19.		

20. Requirement and/or Justification

21. Brief of Project and Objective

a. Objective:

To design and proof test a portable production facility to provide synthetic fallout for proposed cold weather decontamination experiments.

b. Approach.

The production of synthetic fallout can be divided into three distinct operations, each of which requires equipment. The three operations are:

(1) Isotope preparation
(2) Bulk carrier preparation
(3) Tagging of bulk carrier

The necessary facilities, equipment, and supplies required for each operation are given below:

Operation (1), Isotope Preparation:

The radionuclides La^{140} and Ba^{140} have been used as radioactive tracers in the synthetic fallout prepared for decontamination studies conducted by NRDL. The isotope La^{140} has been used for short term experiments and the mixture Ba^{140}-La^{140} for long term experiments. A stock solution of the radioisotope(s) selected is prepared, assayed and adjusted to the desired concentration. An aliquot of the stock solution is then atomized onto soil particles in a mixing chamber. The basic facilities, equipment and supplies needed for isotope preparation are:

(1) Hot Cell (shielding wall)
(2) Viewing Window (zinc bromide filled)
(3) Master Slave Manipulators
(4) Exhaust system
(5) Isotope processing apparatus (glassware, heaters, mixers, pressure and vacuum system)
(6) Standardized counting equipment for assaying solutions
(7) Air sampling monitor and alarm system
(8) Necessary chemicals

Item (1) would be designed for construction at the proposed test site. The other items would be purchased and/or fabricated and transported to the test site.

Operation (2), Bulk Carrier Preparation:

The bulk carrier presently used at the Camp Parks decontamination experiment consists of Monterey sand, or equivalent, graded into distinct sieve fractions. The material cannot be obtained commercially in the particle size distribution required to simulate fallout material. The separation of the sand can be accomplished with commercially available sieving machines at the rate of 500 lbs to 2000 lbs per day depending upon the gradation required. Facilities and equipment required for sieving the material are:

(1) Sieving apparatus and screens (dry sieving)
(2) Wet sieving apparatus (for separation of material less than 74 microns)
(3) Material handling equipment (hoppers, containers)

Operation (3), Tagging of Bulk Carrier Material:

The tagging of the bulk carrier material is accomplished in a modified concrete mixer. The mixer is charged with the required amounts of sand, up to 500 lbs, and pre-heated. The radioisotope solution is then atomized onto the sand particles as the mixer is rotating. A second step, that of spraying a silica gel solution into the mixer is accomplished after the radioisotope has been atomized. A drying period is then necessary to thoroughly dry the sand before discharging. To insure fixing of the radioisotope onto the sand, it is necessary to heat the sand to above 800°C for a short period of time. The facilities and equipment required for tagging the bulk carrier material are:

(1) Modified Concrete Mixer
(2) Spraying equipment
(3) Furnace
(4) Handling equipment (hoppers, conveyors, transit mix truck, etc.)

The design, construction and proof-testing of the production facility would be conducted at USNRDL (Camp Parks). A USNRDL representative would supervise the installation and operation of the facility at the cold weather test site.

c. Subtasks:

None.

d. Background History and Progress:

Previous work by NRDL investigators has produced a synthetic fallout material for use in development and evaluation tests of radiological countermeasures. Equipment has been designed and constructed for the production of this simulant in ton quantities and for its dispersal over test areas. Improvements have been made in the simulant as better information has become available regarding the physical and chemical characteristics of actual fallout materials and as techniques of simulant production have been developed. The simulant has been used only in a temperate climate and its performance in freezing conditions has not yet been studied.

e. Future Plans:

A proposal for continued work in FY 1962 will be prepared if required to meet the stated project objectives.

f. References:

None

g. Other Information:

The level of NRDL investigator effort proposed for this project is 2 man months in FY 1960 and 12 man months in FY 1961. A cost estimate for the work described is provided below.

Item	Estimated Cost FY 1960	FY 1961	Total
Salaries (plus overhead)	$3,000	$17,000	$20,000
Equipment and Supplies	6,000	48,200	54,200
Travel and Transportation	-	5,000	5,000
Contingency		6,000	6,000
	$9,000	$76,200	$85,200

A listing of the equipment and supply requirements included in the above cost estimate is attached.

Operation 1, Isotope Preparation:

a.	Hot Cell	\$3, 000
b.	Viewing Window	1, 500
c.	Master Slave Manipulators	10, 000
d.	Exhaust System	1, 200
e.	Isotope processing apparatus	1, 500
f.	Counting equipment	6, 000
g.	Air sampling, monitor system	2, 000
h.	Necessary chemicals	500
		\$25, 700

Operation 2, Bulk Carrier Preparation:

a.	Dry sieving apparatus (FY 1960)	\$6, 000
b.	Wet sieving apparatus	2, 000
c.	Material handling equip.	1, 000
		\$9, 000

Operation 3, Tagging of Bulk Carrier Material:

a.	Modify concrete mixer	\$2, 000
b.	Spraying equipment	500
c.	Furnace	15, 000
d.	Handling equipment	2, 000
		\$19, 500
	TOTAL	\$54, 200

The above estimates do not include:

1. Purchase and transportation of isotope
2. Purchase of bulk carrier material
3. Transportation of equipment to test site.