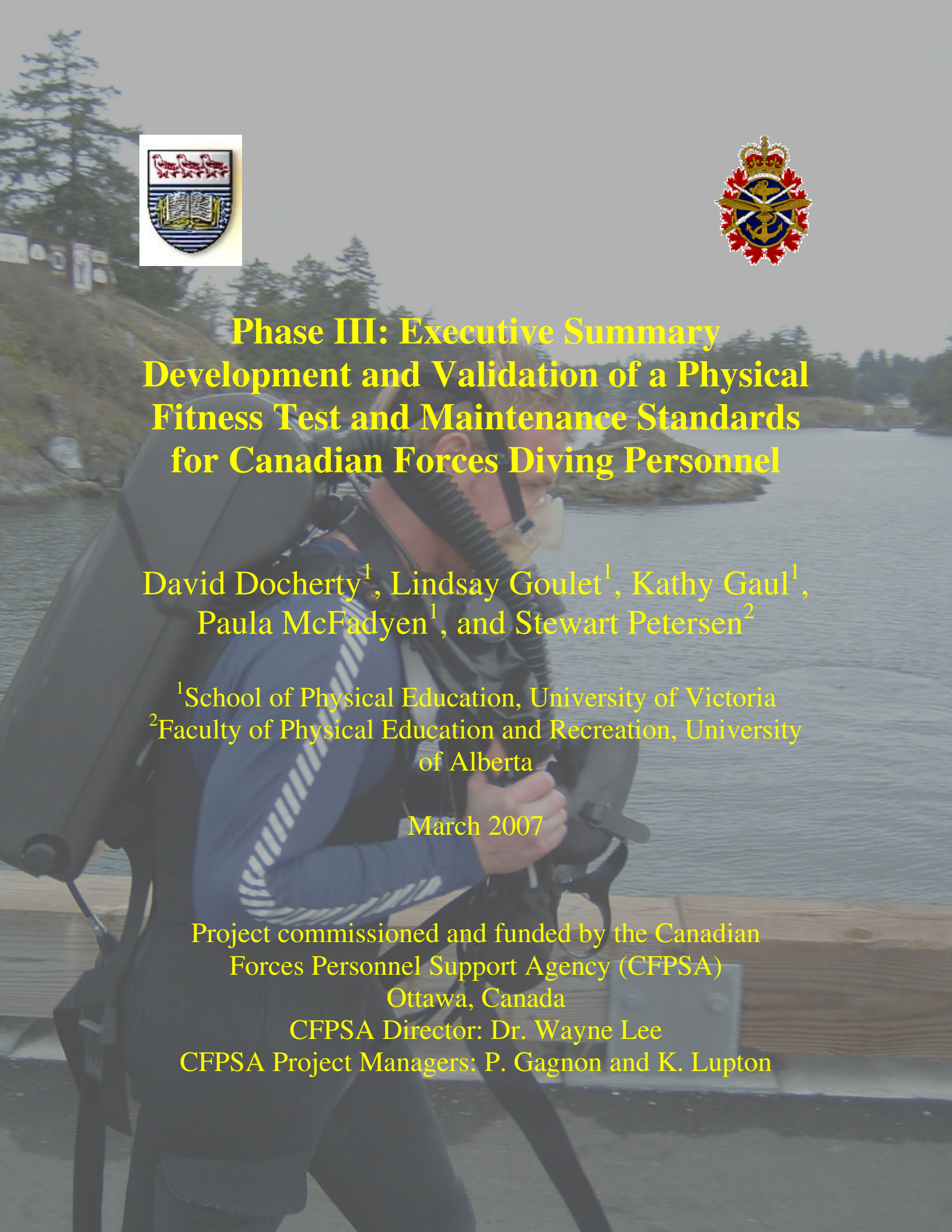

Phase III: Executive Summary Development and Validation of a Physical Fitness Test and Maintenance Standards for Canadian Forces Diving Personnel

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March 2007

Project commissioned and funded by the Canadian Forces Personnel Support Agency (CFPSA)
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1.1 Acknowledgments

The University of Victoria Project Team wishes to thank the many people and personnel who were involved with all three Phases of the CF diving research project. In particular, we would like to express our appreciation to all the Clearance, Ship's Team, Port Inspection and Combat divers who gave generously of their time and wisdom and allowed members of our research team to job shadow and monitor them while performing their dive tasks. Their feedback during Phase III has been invaluable and we believe has strengthened the validity and relevance of the tests and standards.

At each CFB and dive unit, the COs and dive supervisors were excellent resources and gave generously of their expertise and knowledge of the job requirements. We appreciated their time and help in providing divers and the opportunity to develop a test with extensive input from the divers and the dive supervisors. Specifically we would like to thank:

- FDU(P): LCdr Dowker, LCdr MacDonald, CPO1 Dubeau, CPO2 Oliver, PO1 McKay, the training staff and all the divers;
- FDU(A): LCdr Depersio, Lt (N) Leyte, CPO1 Ford, the training staff and all the divers;
- Army Dive Centre: Major Gale, WO Scott, the training staff and all the divers;
- CANFLEET: LCdr Flath, Lt(N) Dreimanis, CPO1 Wolfe and divers on the HMCS Winnipeg, HMCS Calgary, HMCS Ottawa, HMCS Regina, HMCS Protecteur, HMCS Algonquin, CFB Esquimalt and CFB Halifax base dive teams and MOG 4;
- Port Inspection: CPO1 Munro, CPO2 Jones, PO1 Magwood and all Port Inspection divers involved in this phase;
- Director of Dive Safety: LCdr Latus.

This project was funded by the Research and Development branch of the Canadian Forces Personnel Support Agency, under the direction of Dr. W. Lee, Ben Ouellette, Patrick Gagnon, Sue Jaenen and Kelly Lupton. We appreciate both the

financial and professional support they have committed to this project over the past four years and the opportunity to work with them. Their insight related to working within a military setting was of great assistance.

There is no doubt that we have gained much insight into the important work performed by the Canadian Forces and especially those involved with dive duties. Their commitment and belief in what they do is most impressive, as are the sacrifices they and their families make to serve Canada and all its citizens.

David Docherty, Lindsay Goulet, Kathy Gaul, Paula McFadyen, & Stewart Petersen

EXECUTIVE SUMMARY

Background information on the Canadian Forces Diving Project

The University of Victoria (UVic) was contracted by the Canadian Support Personnel Support Agency (CFPSA) in August 2002 to develop and validate a physical fitness test and maintenance standards for Canadian Forces (CF) Diving Personnel. The project was divided into three phases:

- *Phase I - Task Analysis*
  A comprehensive task analysis to describe the work performed by the different diving groups in the CF and to identify a representative subset of physically demanding tasks for each diving group.
- *Phase II - Physical and Physiological Demands*
  Documentation of the physical and physiological demands of the representative subset of demanding tasks identified in Phase I.
- *Phase III – Physical Fitness Test Battery and Standards*
  Based on the data and work samples from Phases I and II, a fitness test battery was developed and standards were established to help ensure that CF divers are able to perform their duties in a safe and efficient manner.

At the outset of the project it was decided by the CFPSA, in consultation with the Project Management Team (PMT), that the project would be delimited to four diving groups, including a) Clearance divers, b) Combat divers, c) Port Inspection divers, and d) Ship's Team divers.

Recommended guidelines for the development of *Bona Fide* Occupational Requirements (BFORs) for physically demanding occupations were developed during a "Consensus Forum" in 2001 by a group of Canadian experts in this field (Gledhill et el., 2001) and used as a template for this project. The 2001 *Consensus Guidelines* include:

1. Formation of a Project Management Team (PMT).
2. Job familiarization.

3. Job review and physical demands analysis.
4. Selection of a representative subset of the essential, physically demanding tasks reported and identified in the job review.
5. Physiological assessment and characterization of the representative tasks.
6. Development of test protocol based on the representative tasks.
7. Establishment of standardized testing procedures.
8. Determine the reliability and validity of the test protocol.
9. Develop performance standards and cut scores.
10. Evaluate the results of applying the test to incumbents.
11. Implement the test protocol.
12. Continuously review new technology brought into the workplace and re-evaluate protocol.

The objectives of Phase I entailed:

1. Identification and briefing of a project management team (PMT) consisting of representatives from all stakeholders.
2. A review of diving physiology, especially applications to diving work in the CF.
3. Identification and description of the four diving groups including an organizational structure.
4. Knowledge of the diving tests and standards used by the military in other countries.
5. Thorough understanding of the duties and tasks performed by the four diving groups through the use of interview with divers from the four groups, completion of survey questionnaires, analysis of training manuals, observation of specific diving exercises and viewing of instructional videos.

Phase I fulfilled steps one through four of the *Consensus Guidelines,* including:

- Development of the PMT.
- Job familiarization.
- Job review and physical demands analysis.

- Development of a representative subset of the essential, physically demanding tasks identified in the job review.

Based on the analysis of all the information, the most physically demanding and most commonly performed tasks were identified. Subsequently, the research team presented these finding to representatives from each of the four diving groups holding supervisory positions (e.g., Commanding Officers, Training Officers) for validation purposes. Members of this group were recognized as subject matter experts (SMEs) with respect to the work performed within their specific dive group.

The SMEs validated the selected tasks and confirmed they were representative of the most physically demanding aspects of the work-related tasks for each of the diving groups. Additionally, the SMEs provided further recommendations and offered input on the planning for Phase II. The final report for Phase I was submitted to the PMT on December 23, 2003 and approved by the PMT shortly thereafter (McFadyen et al., 2003).

The objectives for Phase II entailed:

1. The physical and physiological characterization of the most physically demanding tasks identified for each of the four CF dive groups.
2. Update review of associated physiological factors that occur with diving.
3. Update review of the validation and implementation procedures for BFORs utilized by international militaries.
4. Review of environmental factors and other variables (e.g., sleep deprivation) that may contribute additional physiological stress on divers.

Phase II fulfilled step five of the *Consensus Guidelines:*

- Selection of a representative subset of the essential, physically demanding tasks reported and identified in the job review.

Information was gathered during simulated ("work samples") and live dive operations in which physiological information was recorded using a variety of methods

(e.g., heart rate monitors, oxygen consumption, video analysis, observations and interviews). Recently acquired CF diver-related equipment, or equipment changes that occurred after the final report of Phase I were identified, weighed and documented. In addition, interviews and observations were used to gather information necessary to integrate the physiological data with the physical characteristics of the work (e.g., duration of effort, the weight of the equipment that is carried, distances traveled to work sites, rest periods between work tasks, etc.). Further review of the effects of sleep deprivation and psychological stress were also considered.

The results of Phase II were presented at the PMT meeting in January 2005. Subsequently, the report was circulated and approved by representatives from the four dive groups (Docherty et al., 2005).

The research in Phase III involved steps six through ten of the *Consensus Guidelines.* These included:

- Development of a test battery based on representative physically demanding tasks
- Standardization of assessment procedures required during test protocol implementation.
- Validation and reliability of the test protocols.
- Development of the minimum performance standards of the tests.
- Validation of the minimum performance standards by the SME. This included the potential "adverse impact" from implementation of the tests and standards based on the performance of the divers involved in this part of the project. Input from the SMEs was essential in the development and refinement of the tests and standards.

Statement of Work for Phase III

The primary objectives of Phase III were to:

1. Develop and validate a physical fitness test battery and maintenance standards. It is important to note that each dive group was interviewed separately, and validation procedures were completed independently with the four dive groups because it was possible that the physical demands of each group and performance expectations may differ. Development and validation procedures took place through the use of focus groups, task and video analyses, interviews and observations. In addition, the physiological characteristics of each test/task item were measured and used to confirm that the test protocol characteristics resulted in similar physiological responses compared to work-related duties.

2. Phase III concludes with recommendations for a CF Diver Physical Fitness Test (CF DPFT) and Standards for each dive group and completes the Phase III contract between the Staff of the Non-Public Funds, Canadian Forces Personnel Support Agency (the "Agency") and University of Victoria (the "Contractor").

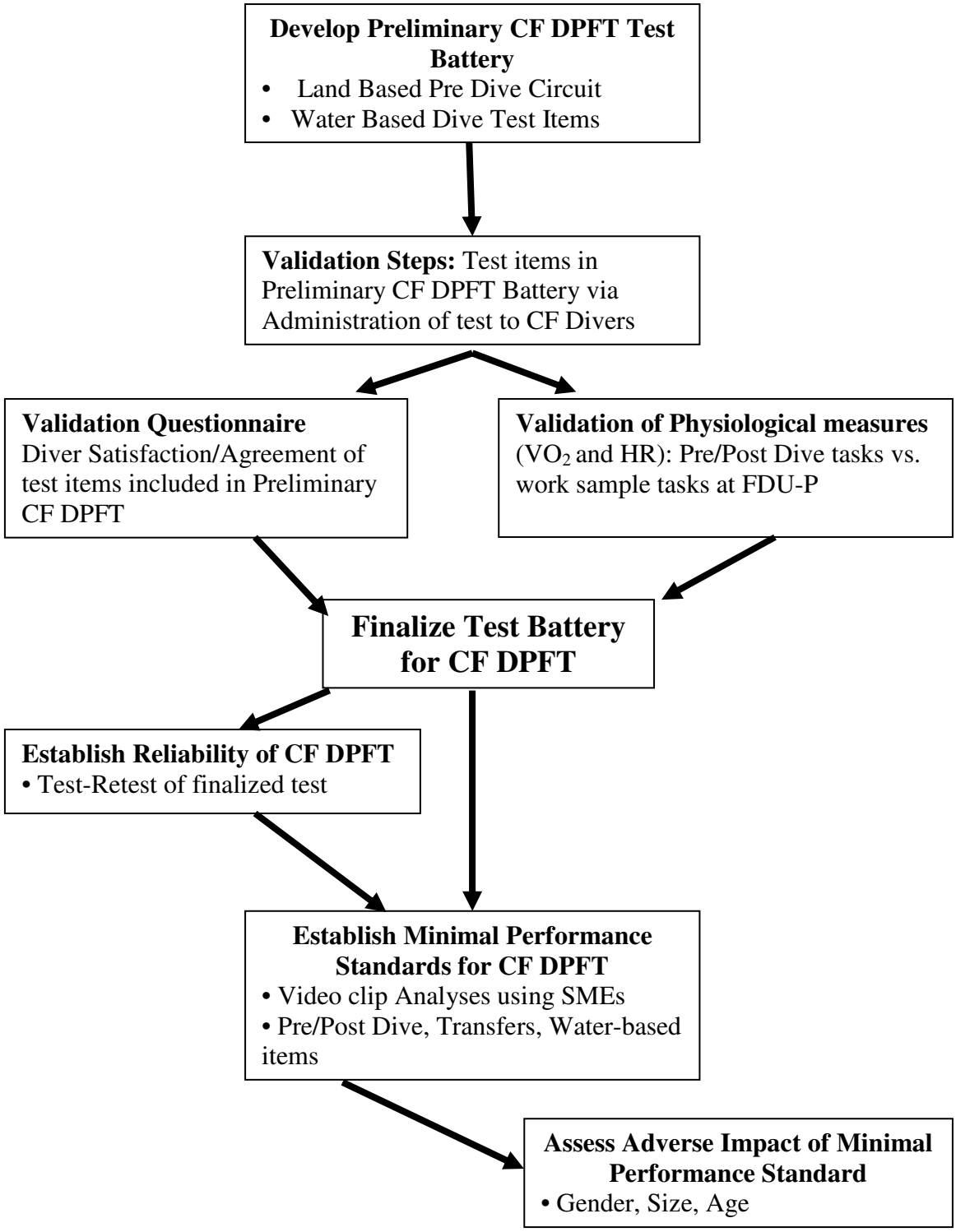
Summary for Phase III

The objectives of Phase III were to develop a physical fitness test battery and maintenance standards for Canadian Forces Diving Personnel, specifically Clearance (Cl), Ships' Team (ST), Port Inspection (PID) and Combat (Cbt) divers. Phases I and II were used to identify potential test items that could be administered as a battery of tests reflecting the physical and physiological demands of diving in the Canadian Forces (CF).

Phase III involved a number of sequential stages in order to validate the test as a Bona Fide Occupational Requirement (BFOR) should it ever be legally challenged. The validation process involved the use of "convergent validity" in which a variety of sources of information are used to help establish that the test battery is measuring what it purports to measure (i.e. ensuring that CF divers have the fitness to perform their duties in a safe and efficient way). The sources of information used in this project included a comprehensive task analysis, focus groups, individual interviews, questionnaires, video analysis, physiological assessment, and consideration of tests used by other international military diving groups. The reliability of the tests was also established, as a test cannot be valid if it is not reliable.

The project also involved establishing valid standards of performance for each task of the test battery. This part of the project relied heavily on the use of Subject Matter Experts (SMEs) consisting of supervisors for each of the dive groups. The SMEs were fundamental in identifying acceptable levels of performance of the test battery. It was also important to provide some information on the potential impact of the test implementation and standards based on the population that assisted in the validation of the test battery. Figure 1 provides a diagram describing the chronology of the steps that were followed during Phase III.

Figure 1. Flow chart of steps followed in Phase III



Stage 1: Development of a preliminary test battery

Based on the information from Phases I and II the UVic Research Team (UVicRT) identified potential test items for inclusion within a test battery for CF divers. The potential test items were presented to focus groups with representation from each dive group. A questionnaire was developed to help direct the feedback and input from the focus group participants. The composition of the focus groups included CF representation from across Canada, gender, rank, and years of dive experience. In addition, the various tests were piloted using civilian and military individuals to assess feasibility of the testing procedures and the order of the tests.

Based on the feedback and the pilot test results, a preliminary test battery was developed that included both land-based and water-based components.

Stage 2: Establishing the validity of the test battery

The preliminary test battery was administered to the four dive groups at their respective work sites. Site visits included the Fleet Dive Unit Atlantic (FDU-A), Fleet Dive Unit Pacific (FDU-P), CFB Esquimalt, CFB Gagetown and CFB Petawawa. During these site visits, information was obtained from the divers with respect to each test item and its similarity to their CF dive duties. Using a 5-point Likert scale, the divers were asked to rate the different test items in regard to how well each test item reflected the physical demands of their CF diving duties, and the level of importance of the fitness components being tested for the safe and efficient performance of their diving duties.

Divers were also invited to make recommendations on how the tests could be modified. Heart rates (HR) were monitored during the performance of the land and water-based tests. Heart rate data were used to determine how well performance of the test battery reflected the physiological demands of the work samples in Phase II.

At the conclusion of this stage of the procedures the divers strongly agreed that the tests were representative of their CF diving duties. In addition, the physiological responses were very similar to those required by the work samples.

Stage 3: Confirmation of the pre/post dive test battery validity

An additional step was taken to confirm the validity of the pre/post dive circuit. Oxygen consumption (VO_2) and heart rate (HR) responses of CF diving personnel were compared between typical pre/post dive activities completed at FDU-P and the pre/post dive test circuit that had been developed during Stage 2.

The results further confirmed that the physiological demands of the pre/post dive circuit were very similar to the physiological demands during the work samples performed in the field.

Stage 4: Standardized testing protocols for the proposed Canadian Forces Diver Physical Fitness Test (CF DPFT)

As a result of the first three stages, a final test battery was established. **Prior to finalizing the test battery, the feasibility of implementation across Canada to four different dive groups was extensively reviewed in consultation with CFPSA**. The components of the tests consist of:

Land-based Components

- Pre/post dive circuit that involves the divers manipulating, lifting and carrying a selected set of CF diver related equipment three times around a 100 m circuit including over and around obstacles.
- Diver casualty simulation (simulated stretcher carry) around a 100 m circuit.
- Line pull that requires pulling a weighted milk crate (equivalent to 100 lbs of force) a distance of 20 m two times.

Water-based Components

- Vertical weighted fin kick.
- 400 m underwater swim.
- 100 m surface swim.

[Note: A full description of the test protocols and procedures is included in Appendix A.]

Stage 5: Establishing reliability of the CF DPFT

Reliability is the relative consistency of test scores such that repeated measures of the test will produce the same results. Reliability is considered an integral part of validity. This stage involved a sub-study undertaken to determine the reliability of the proposed CF DPFT.

Based on the results of this sub-study, the proposed CF DPFT, including both land-based and water-based test items, is considered to be reliable. Results indicate that this reliability could be enhanced by providing divers with more opportunity to practice the tests.

Stage 6: Establishing Minimal Performance Standards

Once the test battery had been validated, the next step was to identify the levels of performance, or standards, that the incumbent divers would be required to attain and maintain. The procedures for developing the standards for the land and water-based components were slightly different due to the nature of the tasks and the environments in which they were conducted.

Land-based Components

Pre/post dive circuit: Four steps were followed to identify the minimal standards for each test item included in the land-based portion of the CF DPFT.

Step 1: The objective of step one was to determine the average time and standard deviation (SD) CF diving personnel took to complete the simulated pre/post dive circuit.

Step 2: The objective of step two was to develop a video showing seven different paces of the pre/post dive circuit based on the average time and standard deviations of completion times obtained from step one.

Step 3: The third step involved the use of SMEs to define a minimally acceptable pace from the seven videotaped options for moving through the pre/post dive

circuit and the diver casualty simulation with a sense of purpose or with purposeful movement.

Step 4: The final step involved the use of SMEs to determine the minimally acceptable rate of work for transferring and maneuvering equipment throughout the circuit.

The final standards were determined from combining the minimally acceptable pace for the circuit with the minimally acceptable time to transfer all equipment included in the circuit. The line pull was not included in this determination as it is a completion test for which divers pass or fail based on correct completion of the task.

Water-based Components

The water-based test items were conducted in a pool and one of the test items required subjects to swim under water, changes in pace were difficult to observe. Therefore, video analyses, which were used in establishing the standards for the land-based tests, were not appropriate in establishing the underwater swimming standards. Mathematical computation of the meters of progression a diver would attain swimming at different rates were used to establish the standards for the 400 m underwater swim and the 100 m surface swim. SMEs were asked to rate the different progressions they would expect against a 1 knot current underwater and on the surface.

The vertical weighted fin-kick test was a completion test for which a 5 minute standard was established as reflecting the physical demands required in working unsupported underwater for prolonged periods of time.

Based on the SMEs responses the following recommended standards were established for the CF DPFT land and water-based tests:

CF DPFT Test Items	Dive Group	Minimum Standards
Pre/post dive circuit (min:s)	All	6:35
Diver casualty simulation (min:s)	All	1:01
Line pull	All	Pass/Fail
Vertical weighted fin-kick	All	Pass/Fail
400 m underwater swim (min:s)	Clearance	13:00
	Ship's Team Port Inspection Combat	13:16
100 m surface swim (min:s)	Clearance Ship's Team Port Inspection	2:54
	Combat	2:47

Stage 7: Assessing Adverse Impact

Implementation of tests and standards may result in direct or adverse effect discrimination, which is a violation of the Canadian Human Rights Act. Adverse affect discrimination, also known as adverse impact, occurs when a standard is implemented and at face value is neutral when applied to all employees but in fact unfairly discriminates against specific groups. An additional study was undertaken to determine whether implementation of the minimum standards established for the CF DPFT would result in any adverse impact specifically related to gender, size, or age.

Based on the several different methods of assessing adverse impact, including the 80% test and a Fisher's Exact Test, it was concluded that the current proposed standards did not adversely affect any of individuals that have been tested to date in regard to gender, size, or age.

Conclusion:

The UVic Research Team recommends the implementation of the CF DPFT and standards in the belief that it is a valid method for assessing the fitness of military divers to safely and efficiently perform their diving duties.

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Appendix A. Standardized Testing Protocols for Canadian Forces Diver Physical Fitness Test

1.0 Land- based tests

1.1 Pre/post dive circuit

The gymnasium floor layout for the land-based pre/post dive circuit, including distance measurements, is shown in Figure 2. The layout is in the shape of a "U" and totals 50 m (20 m in length and 10 m wide). The diver is instructed to go through the circuit one way, turn around at the 50 m mark and then complete the circuit in reverse order, totaling 100 m in distance for each pass. There are few occasions when a diver is required to complete pre/post dive activities in a straight line and on stable terrain so obstacles have been included in the circuit to reflect this challenge. The following obstacles are included in the pre/post dive circuit: 1) two sets of stairs, with two steps going up and down to simulate a small incline and decline; 2) three hurdles (six inches high) spaced 2 m apart to simulate stepping over logs, hatchways and rocks; and 3) two sets of three cones with four foot dowelling through the center to simulate moving equipment in a confined space.

Rationale for inclusion of the Simulated Pre/post dive Circuit: All tasks included in the pre/post dive circuit were validated by CF divers as being reflective of their CF diving job demands. CF divers validated all distances and weights. The layout of the pre/post dive circuit, including all obstacles places throughout the circuit, created a varied terrain, which was important because CF divers rarely work in a straight line or on flat terrain.

The protocols and criteria for successful completion of the pre/post dive circuit are as follows:

Step One:

- Diver lifts a set of twin 80 SCUBA tanks from a table, places them onto the ground, and slides them underneath the table so the manifold is completely underneath the table.
- Diver slides the tanks out from underneath the table and lifts the tanks back onto the table, placing them so they are laying flat on the table.
- Diver picks up the tanks and carries them using either the manifold or out in front with both arms; the diver is not allowed to carry the tanks on the shoulders or head.
- Diver carries the tanks 40 m beginning at the start line, walking 20 m to a marked cone and back; diver is required to complete the stair obstacles in both directions.
- Diver places the tanks on a bench (30.5 cm in height) sits down and puts the stab jacket and tanks on, ensuring all buckles and straps are clasped.
- Diver stands up with tanks on back.

Although this portion of the CF DPFT is not timed, divers are required to move with a sense of purpose, or with purposeful movement. This portion is not times because

divers are required to don dive tanks and, for safety purposes, the evaluator is required to ensure that all buckles and straps are done up correctly before the diver begins walking through the 100 m course.

Step Two:

- The timed portion of the test begins when the diver crosses the start cone and begins walking through the 100 m circuit.
- Evaluator must use a stop watch that has split times.
- Once the diver completes the 100 m, including all obstacles, he/she will sit on the bench and take the tanks and stab jacket off.
- Diver lifts the tanks off the bench, places them on the ground and slides them underneath the table so the manifold is completely underneath the table.
- Diver slides the tanks out from underneath the table and lifts the tanks back onto the table, placing them so they are laying flat.
- Diver begins a 40 m transition walk where the diver will walk without any equipment from the start line, up and over the steps to the 20 m cone where he/she will circle around the cone and return to the start line. Transition walks simulate the time after a diver drops off a piece of equipment at the dive site and has to walk back to the dive locker or truck to pick up another piece of equipment; the divers are still required to work with a sense of purpose or with purposeful movement.

Step Three:

- Diver lifts a crate weighted to 50 lbs to a height of 1.2 m, marked by a dowelling; diver must touch the bottom of the crate to the top of the dowelling and set the milk crate back onto the floor.
- Diver picks up a 25 dumbbell in each hand and completes the 100 m circuit, completing all obstacles.
- Diver sets down the dumbbells and picks up the 50 lb crate and lifts the crate to the 1.2 m height, setting it back onto the floor after the lift is complete.
- Diver completes the 40 m transition walk.

Step Four:

- Diver lifts a CF issued dive bag (weighted to 60 lbs) from the floor onto a table (1 m in height).
- Diver carries the dive bag through the 100 m course; divers are allowed to carry the dive bag any way, except on top their shoulders or head. Most divers choose to wear the dive bag like a rucksack on their back.
- Once the 100 m circuit is complete, the diver places the dive bag onto the table and lowers it back onto the floor.
- The timed portion of the simulated pre/post dive circuit ends once the diver places the dive bag back onto the floor; the evaluator will press the “Start/Split” button on the stop watch and record the time for the pre/post dive circuit, leaving the cumulative time running for the “Diver Casualty” simulation.
- Diver will not complete a transition walk and will move directly into the “Diver Casualty” simulation.

Step Five

- Diver picks up the 50 lb kettle bell and completes the circuit carrying the kettle bell in one hand at the side.
- The steps are included to simulate a small incline and decline and the diver is instructed to walk/jog through the circuit, omitting the hurdles and cones for safety purposes.
- Once the diver reaches the 50 m turn-around point, he/she must switch the kettle bell to the opposite hand and carry the weight through the circuit using the other hand.
- The timed portion of the "Diver Casualty" will end when the diver sets the kettle bell on the floor. The evaluator presses "Stop" on the stop watch and records the split time for the "Diver Casualty".

1.2 Line pull

Rationale for inclusion of the line pull: CF divers may be required to use a hand-over-hand motion to recover a number of items, including dive clumps, anchors, or a diver during a diver casualty situation. CF divers identified this type of recovery as being physically demanding and an important aspect of their job as it is a task that may be required during an emergency situation. A cable tensiometer was used at FDU-P in order to find out the amount of force that is required to lift a 25 lb clump from a depth of 30'. The weight in the crate may vary at each location depending on the floor surface on which the test is conducted. The 3 min recover period was imposed because divers are rarely required to complete a line pull task directly after carrying the equipment required for diving.

Note: A cable tensiometer will need to be used at each gym location to determine how much weight is required in the crate to equal 100 lbs of horizontal force.

The protocols and criteria for successful completion of the line pull are as follows:

After a 3 min recovery period following the pre/post dive circuit the diver pulls a weighted milk crate (weighted to 100 lbs of force), using ¾" width line. The diver uses a hand-over-hand motion to pull the weighted crate 20 m towards them. The crate must fully cross the 20 m line. The diver then walks to the opposite end and pulls the crate another 20 m. The diver must keep his/her feet planted once the line pull has begun and may only pull the crate using the hand-over-hand technique.

Subsequent to the line pull, the diver has 12 min to move to the pool for the three water-based tests.

2. Water-based Tests

Three water-based tests have been included in the test battery for the CF DPFT. One of the tests requires the diver to breathe compressed air from their breathing apparatus; therefore, due to CF dive regulations a Dive Supervisor must be present during all testing where divers are submerged. A standby diver is not required as the test is conducted in a controlled environment (i.e. pool) where a lifeguard will be present. Protocols for successful completion of the water-based tests are as follows:

2.1 Vertical Weighted Fin-kick

Rationale for inclusion of the Vertical Weighted Fin-kick: CF divers are required to work unsupported underwater for prolonged periods of time. To maintain position underwater, CF divers use a vertical fin-kick to complete tasks such as hull scraping, propeller changes and sonar dome repairs/removals (McFadyen, Docherty, Gaul and Gellhaus, 2003).

The protocols and criteria for successful completion of the vertical weighted fin-kick are as follows:

- Diver dresses in swimsuit, stab jacket, twin 80 tanks and fins, no weight should be added to the buoyancy control device (BCD).
- Diver enters the water and finds neutral buoyancy, which is defined as the point at which a diver maintains their position after full exhalation where water is at eye level. The diver may have to add or remove air from the BCD to find neutral buoyancy. It is the responsibility of the Dive Supervisor to verify the diver is neutrally buoyant.
- Six pounds of weight, using CF issued dive weights, is added to the weight pouches and placed in the BCD; a two pound dive weight is held in one hand out of the water.
- The diver is instructed to maintain a vertical position**,** with the head, both hands and both wrists held out of the water. Divers are to use a vertical fin-kick similar to what they would use while working unsupported.
- The 2 lb weight is transferred from hand to hand approximately every 20 seconds.
- Two warnings may be given to the diver to either keep their hands and wrists out of the water, maintain a vertical position, and/or keep their head above water. After two warnings, the diver has failed to complete this test.
- Successful completion of the vertical fin-kick involves maintaining a vertical position with the additional weight while fin-kicking for 5min.
- After the required 5 min of vertical fin-kicking, the diver may either swim to the side of the pool or inflate their BCD.
- Divers are required to take off their fins, set them on the pool deck and exit the water using the ladder; the dive weights are to be removed from the BCD subsequent to the ladder climb.
- 5 min of recovery time, in which the diver is resting comfortably sitting on the side of the pool, has been allotted between each water-based test.

2.2 Underwater Swim

Rationale for inclusion of the Underwater Swim: CF divers are required to swim underwater, against current, for a number of CF diving tasks, including seabed searches, jetty searches, search and recovery, navigation swim and reconnaissance. Although it is ideal to swim with the current, many divers indicated that they are required to swim against current for a number of these tasks. It is important for a diver to be able to move against a current in order to complete required CF dive tasks. Divers may be required to

swim between 10-1000 m against a current, and they must complete these tasks in a timely manner (McFadyen et al., 2003).

The protocols and criteria for successful completion of the underwater swim are as follows:

- A 50 m rectangular circuit, usually running 20 m in length and 5 m wide, is marked in the pool using buoys with line attached to a weight on the bottom of the pool.
- Diver is dressed in a stab jacket, weights (if required for diving), tanks, fins and mask.
- Diver is instructed to submerge to three to four feet underwater and complete one 50 m circuit to familiarize themselves with the layout of the test, adjust buoyancy and determine pace.
- Following the warm-up lap the diver surfaces to ask any questions he/she may have and to receive final instructions from the tester.
- A method of communication between the evaluator and the diver (preferably an underwater microphone) needs to be agreed upon in which the diver can verify the number of laps he/she has completed and/or if he/she has slowed to an unacceptable pace. If an underwater microphone is not available, the evaluator may use a series of taps to communicate with the diver (e.g. 2 taps on the metal stairs means the diver needs to move more quickly), or some kind of signage could be used to communicate to the diver their lap times (e.g. waterproof whiteboard).
- Diver submerges to three to four feet below the surface, breathing from the regulator, and completes eight laps of the 50 m circuit.
- The tester is responsible for keeping track of the number of times the diver has completed the 50 m circuit.
- This is a timed test and the tester will use a handheld stopwatch to record the final time of the test after the diver has completed the required eight laps.
- Once the diver has completed the underwater test, he/she will surface and swim to the side of the pool.
- Divers are required to take their fins off, set them on the pool deck and exit the water using the ladder.
- 5 min of recovery time, in which the diver is resting comfortably sitting on the side of the pool, has been allotted between each water-based test.

2.3.1 Surface Swim (Cl, ST, PID)

Rationale for inclusion of the 100 m Surface Swim: CF divers may be required to swim on the water's surface for a number of diving tasks, including a rescue swim, diver casualty, or they may be required to swim to a dive site that a vehicle cannot get to. The average surface swim is 100 m (McFadyen et al., 2003).

The protocols and criteria for successful completion of the pre/post dive circuit are as follows:

- Wearing a swimsuit and fins, and carrying a mesh bag weighted with six pounds of dive weights, the diver is required to surface swim 100 m (e.g. four laps of a

25m pool). The mesh bag is included in this test to give the diver something to work against. As the test is completed in a pool environment, the diver does not have to work against current, chop on the surface, wind or other environmental issues. The 6 lbs in the mesh bag was validated by the divers as creating the same physical demands as surface swimming in the ocean.

- Diver uses the surface swim technique taught during their CF dive training, in which they swim on their side with one hand extended overhead.
- The diver may carry the weighted mesh bag in one hand any way he/she feels is the most comfortable.
- Diver must touch each end of the pool but may not push off the side for additional power and speed.
- This is a timed test and the evaluator will use a handheld stopwatch to record the final time to complete 100 m of surface swimming.
- The test is complete when the diver completes 100 m.
- Diver then places the weighted mesh bag on the side of the pool, takes off his/her fins and exits the pool using the ladder.
- Completion of this test signifies the end of the CF DPFT.

2.3.2 Surface Swim (Cbt)

Rationale for inclusion of the Surface Swim for Cbt divers: Cbt divers indicated that one of the most important and urgent tasks requiring surface swimming was exiting after a mine placement. Divers may swim underwater with the mine to the emplacement site, but swim on the surface following emplacement. According to CF Standard Operating Procedures (SOPs), vehicles (e.g. zodiacs) are required to stop 100 m from an emplacement site; Cbt divers swim on the surface after emplacement in order to swim directly to the vehicle. Cbt divers would keep their tanks on and swim on their backs for this task, therefore the surface swim for this group of divers differs from the other three.

- Wearing a swimsuit, tanks, stab jacket and fins, and carrying a mesh bag weighted to six pounds using dive weights, the diver is required to surface swim 100 m (four laps of a 25 m pool).
- Diver fully inflates their BCD prior to beginning the surface swim.
- Diver uses the surface swim technique taught during their CF dive training, in which they swim on their back.
- The diver may carry the weighted mesh bag in one hand any way he/she feels is the most comfortable.
- Diver must touch each end of the pool but may not push off the side for additional power and speed.
- This is a timed test and the evaluator will use a handheld stopwatch to record the final time to complete 100 m of surface swimming.
- The test is complete when the diver completes 100 m.
- Diver then places the weighted mesh bag on the side of the pool, takes off their tanks and fins and exits the pool using the ladder.
- Completion of this test signifies the end of the CF DPFT.

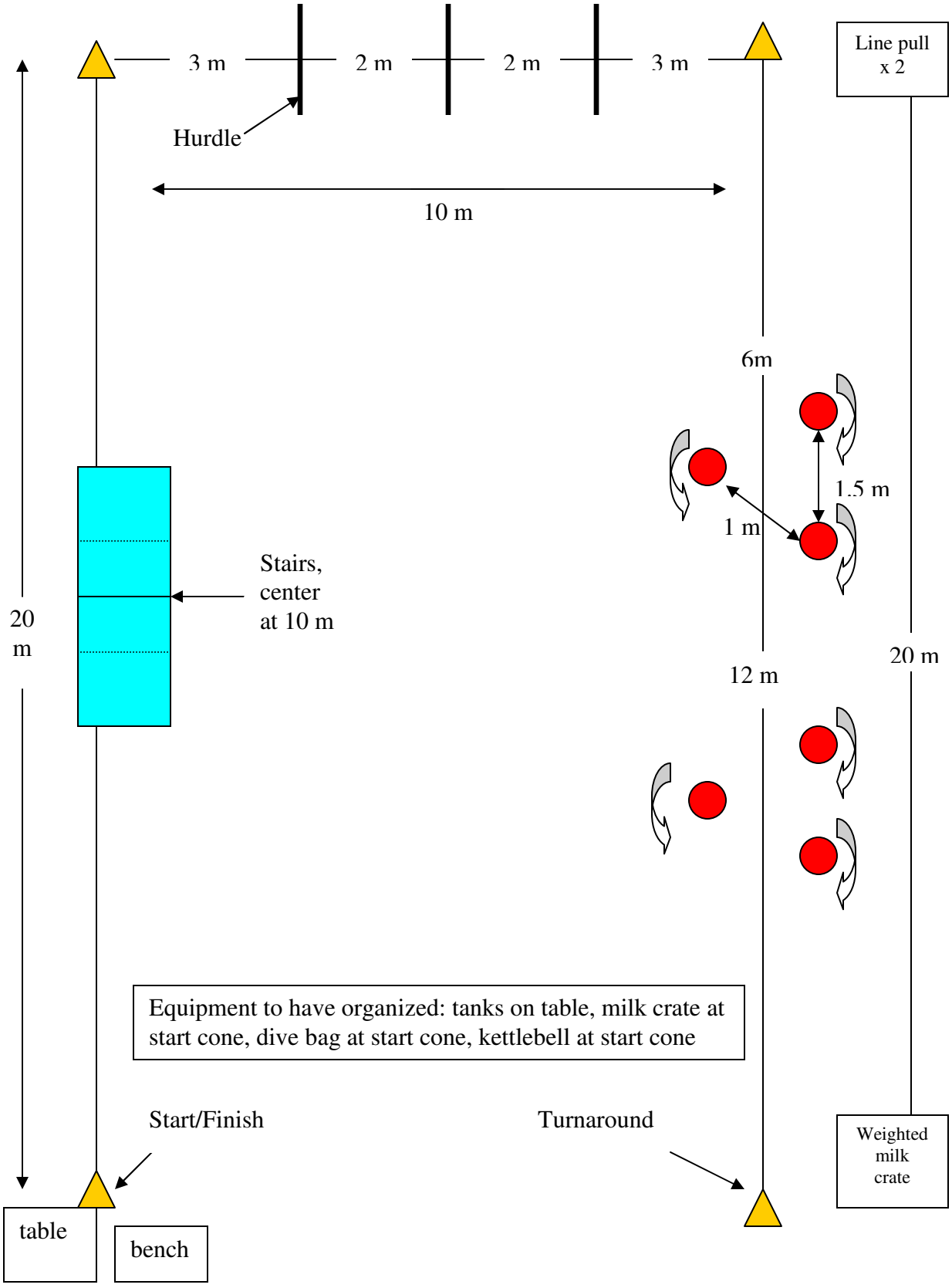

Figure 2. Gym Floor Layout for the Land-based Pre/Post-Dive Circuit

Recommended Standards for CF Diver Physical Fitness Test

CF DPFT Test Items	Dive Group	Minimum Standards
Pre/post dive circuit (min:s)	**All**	**6:35**
Diver casualty simulation (min:s)	**All**	**1:01**
Line pull	**All**	**Pass/Fail**
Vertical weighted fin-kick	**All**	**Pass/Fail**
400 m underwater swim (min:s)	**Cl**	**13:00**
	ST, PID, Cbt	**13:16**
100 m surface swim (min:s)	**Cl, ST, PID**	**2:54**
	Cbt	**2:47**