

2nd Annual Multi-Agency Contaminated Water Diving Workshop

Report on Proceedings

Presented By: NAVSEA-SUPSALV
Hosted By: NOAA Diving Program
Held On: June 19 and 20 2007
Held At: NOAA Dive Center
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Executive Summary

In July 2006, NAVSEA Supervisor of Salvage and Diving, hosted a Multi-Agency Workshop, “Diving in Contaminated Waters, Past – Present – Future”, in Washington D.C. The workshop brought together representatives from several of the US diving communities and established a forum for working on the many issues and difficulties surrounding Contaminated Water Diving (CWD).

On June 19th and 20th, 2007 the 2nd annual Contaminated Water Diving Workshop was held at the NOAA (National Oceanic and Atmospheric Administration) Diving Program Center, in Seattle Washington. Again, multiple dive communities, including military (US and Canadian Navy) Federal Agencies (EPA, FBI, NOAA), and commercial diving companies were present. In addition, based on the last workshop, equipment manufacturers, and a consulting/research non-profit organization participated.

Day one was given over to presentations and related Q & A discussions. Each presentation is summarized within this report and a link is provided to that presentation, if available.

The second day was a discussion session chaired by the US Navy. The discussion included:

- Review of last year’s action items, showing progress in a lot of different areas (see section 6.1)
- Discussion on the six key action items (see section 6.2).
 - Agree common CWD definitions.
 - Identify common database or web link for CWD sources.
 - Agree/practicality of CW testing (Biological/Chemical).
 - Agree best practice for cooling during CWD ops.
 - Agree best practice for decontamination post CWD Ops (decontamination solutions)
 - Identify the best in terms of current equipment available for CWD.

The conference was a success on all accounts. It showed significant progress has been made and is continuing and that awareness and interest in CWD is on the rise.

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1 PURPOSE

To continue forward momentum in developing solutions to Contaminated Water Diving (CWD) issues that are scientifically based, realistically achievable, and designed to protect all diving personnel from potential adverse health effects related to diving in contaminated waters.

2 BACKGROUND

The first Multi-agency CWD Workshop “Diving in Contaminated Water Past, Present, and Future” was held in July 2006 and was chaired by NAVSEA Program Manager Anke Wilhelm.

The workshop was intended to bring together members of the diving community to discuss diving in contaminated water and to begin the process of communication and cooperation in working together to develop CWD best practices. Representatives from the Navy, Federal agencies, scientific, public safety, & commercial diving communities attended.

After presentations and discussions, the group broke out into work groups and a series of action items were agreed and assigned. The U.S. Navy accepted the lead role in coordinating these actions and the Naval Experimental Diving Unit were identified as best placed to examine some of the scientific aspects of CWD to come out of the working group. Other participants were tasked with actions and Dave Dinsmore, Director of the NOAA Diving Program, offered to host the next working group in 2007.

NAVSEA Project Manager Lt Jim Pearson RN, relieved Anke Wilhelm as the project manager for the USN’s CWD program. and a CWD web site was set up at <http://www.supsalv.org/00c3> to serve as a central repository for CWD related communication, information, research, links, etc.

3 GOALS AND OBJECTIVES

The goals and objectives of this workshop were:

- Continue improving communication among stakeholders – the CWD web site is one tool aiding this effort.
- Identify manageable short-term areas for improvement. – What are the things we can do to help on tomorrow’s dive?
- Identifying long-term areas for improvement – What are the top areas for research and study that will in time provide real benefit. How realistic is it?

Specific objectives for this workshop were to:

- Agree common CWD definitions.
- Identify common database or web link for CWD sources.
- Agree/practicality of CW testing (Biological/Chemical).
- Agree best practice for cooling during CWD ops.
- Agree best practice for decontamination post CWD Ops (decontamination solutions)
- Identify the best in terms of current equipment available for CWD.

See section 6.2 for more detail.

4 ATTENDEES

Due to other commitments not all of last years attendees were able to attend, however the group did benefit greatly from more representatives from the commercial diving community as well as representation from the Canadian Navy who have an excellent appreciation of CWD. A list of attendees is provided below:

Randy Baron	Global Diving & Salvage
John Clarke	NEDU
Dave Dinsmore	NOAA Dive Center
Mark Ehrnschwender	Phoenix International
Ruben Finger	Phoenix International
Sue Fox	USACE
Bob Gjestvang	Paragon
John Gray, CDR	NAVSEA-00C3B
Patrick Hennessey, LCDR	NEDU
Kevin Horn	FBI, USERT
Alan Humphrey	USEPA ERT
Kevin Johnson	FBI HMRU
Fred Klein	NOBLIS
Rob Pedersen	EPA Region 10
Christopher Pederson, NAC	NEDU
Jim Pearson, LT	NAVSEA 0038
Bernadette Quemerais, LT	CFEME, DRDC Toronto
Don Sutton	Applied Diving Services.
James Tullbane	FBI WFO USERT
Paul Weathersby, Dr	NSMRC
Bob Whaley, Dr	NAVSEA OOC3
Christy Wimberley	Divers Institute of Technology
Jerry Zebor	Divecon Services

5 DAY 1 – PRESENTATIONS

5.1 Welcome and Introductions

Presenter: Dave Dinsmore, Director NOAA Diving Program

Dave welcomed everyone to the session and thanked everyone for taking time out of their busy schedules to participate. Dave provided a short overview of the National Oceanic and Atmospheric Administration (NOAA) diving program and the facility and a brief background on past CWD efforts (there was a lot of effort in the early 80's and last year's workshop) and Lt Jim Pearson was introduced as the chair for this year's workshop.

5.2 U.S Navy CWD Manual (NAVSEA)

Presenter: Lt Jim Pearson RN, NAVSEA CWD Project Manager

Jim continued with a brief background on CWD starting with a quote from *Protection of Divers in Water Containing Hazardous Chemicals, Pathogenic Organisms and Radioactive Material – Bethesda, MD Nov, 1982, NOAA, EPA, Navy, USCG and UMS* (350 page report).

“the resultant hazardous substances diving standard should allow the on-scene coordinator to identify the special hazards which divers would be subjected to; to determine what dress and equipment ... should be used....the necessary decontamination procedures; and to ensure health monitoring of all divers. The need for such a manual is immediate.... objective of this workshop...to identify existing equipment.... to provide immediate protection to the divers”.

The quote was used to highlight that despite a lot of work already being done, the state of CWD has seen little real change. This new effort starting with last year’s workshop did not intend, to reinvent the wheel, but rather build on existing data to find viable topics and ideas to provide real improvement in dive team protection.

Jim highlighted some of the progress since the last workshop:

- Web page established on SUPSALV.ORG website under 00C3 dropdown menu.
- Quarterly CWD Newsletter issued and available on website.
- Survey of divers involved in Katrina CWD.

Lt. Pearson then set the scope and tone for the workshop with new initiatives and potential changes in direction:

- The Navy’s *Guidance for Diving in Contaminated Waters* issued in 2004 is 24 pages long and attempts to cover radioactive contamination. It is currently undergoing a major review and current efforts are to capture “best practices” from workshop stakeholders to produce a meaningful and user-friendly manual for CWD, modeled on the USN Dive Manual format, by 2009.
- Establishing USN East and West coast CWD specialist teams. This concept would make the required investment in training and equipment affordable.
- Developing interim procedures prior to issuing revised CWD Manual. To show progress and direction to the various diving communities.
- Increasing CWD awareness in all communities and introducing CWD training courses. This is necessary to affect a “culture” change among the diving community.
- Aligning USN and NATO CWD definitions. A common terminology at the international level will provide consistency. Current definitions were shown against the new NATO definitions (See section 6.2.1 for more detail).
- Testing for and detection of contaminants has been a stumbling block for numerous reasons; Number of hazards to test for, expense, time delay, changing conditions due to wind, current, rain, etc. We need to determine if real time testing is feasible or if other means like use of historic data and monitoring common sites makes more sense.
- Equipment for each category needs to be assessed with a careful look at the soft components (diaphragms, o-rings and seals). Mandatory dress states for divers and tenders need to be adopted and dive duration limits established, Sur-D/No Stop Dive regulations, heat stress management policy, and equipment life/maintenance needs to be addressed. Assessment of equipment commercially available off the shelf (e.g. cooling vests, decon foams, etc) is also needed.

Presentation link: [U.S Navy CWD Manual \(NAVSEA\)](#)

5.3 Decontamination Procedures and Equipment (Phoenix International)

Presenter: Ruben Finger, CWD Project Manger, Technical Writer

Phoenix International has a contract with NAVSEA to support the CWD project and helped organize and record the 1st workshop. Ruben is the program manager for Phoenix and is working with NAVSEA on research and development of the Decontamination chapter of the revised Navy *Guidance for Diving in Contaminated Waters*. This presentation covered the knowns and some of the undefined issues relating to decontamination following CWD. The need for proper PPE for the dive team (diver, standby diver, and tenders) was stressed.

Dive team decontamination considerations start with the dive plan:

- Is team properly trained on dry suits, PPE, decon procedures, and special equipment?
- Site Evaluation, what do we know? Land or water, are wind/current an issue, site history?
- Equipment, what do we need to do it properly and safely?
- Decon Plan, equipment required, water use, storage capture, disposal.
- Medical concerns, team health, personal hygiene, showers, etc.

Ruben covered his research efforts and some of the equipment he has discovered including a gel pack cooling vest (for possible use by dive team), decontamination foams, containment booms, and decontamination tents.

Presentation link: [Decontamination Procedures and Equipment \(Phoenix\)](#)

5.4 Contaminated Water Threat Assessment (Noblis)

Presenter: Fred Klein, Manager, Noblis - Oceanic, Atmospheric, and Space Systems

Noblis is a non-profit consulting and research organization that only offers its services to governmental entities. In 2003 Noblis was tasked by SPAWAR with performing a threat assessment to “Determine the potential for chemical, biological, and radiological material to pose a threat to US Naval Forces through the saltwater pathway”.

The analysis had to account for the effects of wind, current, tide, type of water body (open or enclosed) as it related to aerosolizing or volatilizing (surface crew inhalation), chemical reaction with water (salt or fresh), dilution and dispersion (plume radius and depth), and deposition (surface, water column, or sediment). The initial premise was in consideration of a terrorist attack, but there was information that directly related to CWD:

- Confirmed Testing and Detection issues:
 - For the chemical threat alone “the number of hazardous and toxic chemicals is very large.” They initially looked at 28 chemical warfare agents in Chemical Weapons Convention Annex on Chemicals, 356 highly hazardous substances in EPCRA Section 302, Chairman’s List, and CDC list – “This group still too large to consider all in detail. “ As a result they analyzed 11 highly toxic chemical contaminants.
- Recommended using previously identified sources – e.g. CAMEO (Computer-Aided Management of Emergency Operations), CHPPM, CDC.
- Active Risk Management issues:
 - Evaluation of extended exposures – based on some model
 - Update instruments for contaminant detection
 - Expand use of AUVs and ROVs

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Presentation link: [Contaminated Water Threat Assessment \(Noblis\)](#)

5.5 CWD PPE Research (Paragon)

Presenter: Bob Gjestvang, Paragon - Space Development Corporation

CWD issues go beyond decontamination after exposure. An obvious goal is to reduce hazard exposure. Paragon, under a SBIR contract designed and performed tests on “Chemical Permeability of Soft Goods and the Consequences for CWD”. Previous studies and presentations indicate the most likely pathways to exposure/contamination are respiration, oral intake, and dermal contact. Aspiration into mask or helmet is a common discussion point.

Diving equipment is designed with the assumption that the environment is benign so materials used in normal diving do not require resistance from chemicals. Equipment soft goods (o-rings, seals, etc) most often used do not meet extreme conditions needs and are the most vulnerable to degradation allowing passage of harmful chemicals beyond acceptable limits.

Using the demand regulator inlet diaphragm (the most critical “soft” part) and the criteria that the contaminant concentration in dive gas should not exceed 1 part per million and mass transfer of contaminants through the material should not to exceed 1.25 or 4 micrograms per square centimeter ($\mu\text{g}/\text{cm}^2$) per mission. Tests were performed on 6 different materials in jet fuel (Jet A), which contains molecules of varying molecular weight, thereby enveloping many other contaminants.

Results (Table 5.1) show that materials exist for all soft goods that can provide enhanced protection in contaminated environments at a reasonable cost. Fluoroelastomers were the best performers and permeability is inversely proportional to the fluorine content and material cost.

Table 5.1 - Soft Goods Permeability Result Summary

Silicone	0.016” Silicone Demand Regulator Diaphragm, exceeded 1ppm in breathing gas after 22 minutes and 1.25 $\mu\text{g}/\text{hr}/\text{cm}^2$ in 3 minutes, extensive deformation. Offers essentially no barrier to the permeation of hydrocarbons, fails rapidly in Jet Fuel.
Nitrile	0.0635” Nitrile exceeded 1.25 $\mu\text{g}/\text{hr}/\text{cm}^2$ in 13.5 hours. Better than Silicone but not effective contamination barrier, exhibited 10% swelling after 25 hours.
Xyfluor	0.040” Xyfluor exceeded 1.25 $\mu\text{g}/\text{hr}/\text{cm}^2$ in 11.5 hours. Better than Nitrile, dive time would be limited and rebuilding required after every dive. Minor swelling, higher off gassing than reported, eventually broke through.
Commercial Viton	0.017” Commercial Fluoroelastomer (Viton), exceeded 1ppm in breathing gas in 1 hour and 1.25 $\mu\text{g}/\text{hr}/\text{cm}^2$ in 26 minutes. Failed rapidly, badly deformed.
Certified Fluoroelastomer	0.011” Certified Fluoroelastomer, after 186 hours 1ppm in breathing gas at ≈ 0.000035 and 1.25 $\mu\text{g}/\text{hr}/\text{cm}^2$ at ≈ 0.0045 .
Perfluoroelastomer	0.019” Perfluoroelastomer contributed only 12 parts per trillion of contaminant to breathing gas and no mass transfer or deformation after 1,125 hours of exposure.

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Presentation link: [CWD PPE Research \(Paragon\)](#)

5.6 PSD (Public Safety Divers) Survey

Presenter: Michael Glenn, Instructor/coordinator Crime Scene Technologies, NC Justice Academy, NC Justice Department

Due to scheduling Mike was unable to attend. This would have been a follow up from last year when Mike introduced us to the world of Public Safety Divers (PSD) and their nation wide PSD survey effort. The survey was rather extensive and intended to capture information on funding, dives/year, dive locations, water quality, equipment used, and injuries or health impacts. *The website isn't up any more, but a PDF copy of the questionnaire is linked below.*

Survey link: [PSD Questionnaire -CWD 2006](#)

5.7 Commercial Diving in Contaminated Environments

Presenter: Jerry Zebor, HSE Manager, Divecon Services, Inc.

Jerry gave the group a précis of his draft peer review paper “Underwater HAZMAT Operations: Commercial Diving in Contaminated Environments” with him.

The paper includes a brief history of diving in contaminated waters and the rising awareness of the attending risks, early equipment progressions as engineering controls and the administrative controls driven by regulation and best practices. Biological, chemical, and radiation CWD hazards are described. A description of current engineering controls (PPE) is provided to inform the non-diving reader followed by a section on equipment selection and levels of protection. The main theme throughout the paper is the unique differences that underwater work brings to the HAZWOPER, decontamination, and exposure/contamination arenas.

PELs – Current PELs (Permissible Exposure Limits) are all land based and little data exists to correlate that with waterborne exposure.

HAZWOPER – Though the 40 hour Hazardous Waste Operations training is an industry requirement it needs to be expanded to include the special techniques used in CWD.

Exposure/contamination – Contaminates may exist on the surface, in the water column, or in the sediment. Though much has been done already in terms of protecting the diver (Helmet and exhaust designs, dry suits, etc.) more needs to be done to protect the dive team.

Personnel awareness and training is key, followed by proper preparation and planning, including JSEA (Job Safety and Environmental Analysis) for a contaminated dive. Little things like planning No-D dives and heat stress management, inspecting all equipment prior to dressing diver, pressure testing the dive suit before entering water, beginning decon with low pressure wash as diver leaves the water, and taking special care that the equipment seal points need to become part of contaminated dive process.

Jerry also enlisted the aid of Tim Beaver, Global Diving and Salvage and Don Sutton, Applied Diving Services to add any job specific lessons learned. The take home message was “Do your homework and err on the side of safety.”

There is no PowerPoint, but a copy of the draft was provided for the above summarization. The final paper will be posted to the CWD website.

5.8 Israeli CWD Model Analysis

Presenters: Paul Weathersby, PhD, Naval Submarine Medical Research Lab, Navy Experimental Diving Unit and LCDR Patrick Hennessey, Navy Experimental Diving Unit

An Israeli delegation consisting of Prof. Barak Herut; Director General Israel Oceanographic & Limnological Research, Dr. Shlomo Almog; Sheba Medical Center, and Prof. Yona Amitai; Israel Ministry of Health Jerusalem presented a proposed model for assessing CWD and associated risk at last years working group. This model was based on the U.S. EPA Clean Water Standards and one of last year’s tasks was for NEDU to review these findings.

Dr. Weathersby opened his presentation by acknowledging this models bold attempt to cover uncharted territory. The model used EPA Clean Water Standards as a baseline and which makes for an acceptable assessment standard. Using data from DOE Oak Ridge website maybe useful and there would be need to make some different assumptions if the US were to utilize a similar model.

The model provided for 3 pathways via which contaminants could enter the body, water in mouth, water on skin, and sediment on skin. The standard diver exposure profile was - wet suit, 250 hours/year, ½ “ in sediment (feet and arm), and “drinking” 6 liters/year (during dives).

Their model is very conservative, as shown at right and had some limitations.

	Drinks (Liter/yr)	Over (# of Yrs)	Cancer Rate EST. (upper level)
Civilians (U.S.)	>1000	70	1:75,000
Diver (Israeli)	6	15	1:10,000

Dr. Weathersby made several recommendations; key was requesting the National Academy of Science to study limits in CWD with funds through Navy Medicine. Expect it to take 18 months and it was vital to provide careful liaison.

Presentation link: [Israeli CWD Model Analysis \(EDU\)](#)

Dr. Hennessey followed with a quick detour to a personal concern “Heat Stress Management”. This issue came up last year and is very pertinent to CWD when considering fully encapsulating the diver. Key points were:

- All NATO countries and Canada fall within the Thermal Safety Zone for dry suit diving. The U.S. Navy does not.
- CWD guidance and requirements must address the thermal hazards, which may exceed the potential threat from waterborne contaminants via active cooling for diver and standby diver or shortened work times.

There were three pillars to the Israeli CWD Model: 1. Establish sediment and water column contaminate limits based on EPA Clean water Standards for 86 chemicals and elements. 2. Test sediment and water periodically and publish diver dress requirements per given water body. 3. Monitor actual divers’ blood and tissue for contaminate levels.

He then presented current related actions that are or could be implemented for U.S. diving:

- US Army Center for Health Promotion and Preventive Medicine (CHPPM) Directorate of Laboratory Sciences contracted to test sampled sediment and water for 78 DWS chemicals.
- Establishment of sediment and water column limits (using modified Israeli model).
- Limit diving in specific area and/or limit to dry suit when practical.
- Initiate biological monitoring using 2nd class diver, EOD, and UCT graduates of NDSTC.
- Navy safety center to report CWD related “illness” with dive location, etc.
- Modify Dive Recording System to establish diver exposure assumptions used in model.
- Water and sediment testing to expand to all major U.S. ports.

Presentation link: [CWD - Thermal concerns & Israeli Model-U.S. Diving](#)

5.9 Intro to FBI USERT Dive Program (FBI)

Presenter: Kevin Horn, USERT Program Manger, FBI

This presentation was an introduction to the FBI’s Underwater Search and Evidence Recovery (USERT) dive program that Kevin was unable to give last year as he was called away at the last minute.

USERT’s mission is to conduct underwater crime scene investigations in order to locate and recover evidence in Federal and local (domestic police cooperation) investigations (No render-safe missions and No tactical missions.) and to provide advice, guidance, and training to the Public Safety Diving community.

They have 4 regional teams (48 divers total each with a full-time job as special agents) and 1 full-time manager. All divers receive the same training:

- FBI USERT basic course – 2 weeks
- United States Navy Dive School – 3 weeks
- Underwater post blast investigator's course
- Certifications and GETA training: dry suit diver, ice/rescue diving, mixed gas/nitrox, tech/deep water, swift water, and sonar

USERT divers typically deploy using traditional scuba or surface supplied air, full face masks (AGA's) with communications, Superlite 17s (quad exhaust), dry suits. Other equipment employed includes: J.W. Fischer metal detectors, side scan sonar, sector scan sonar, and remotely operated vehicles (ROV).

Several case studies were presented.

Presentation link: [Intro to FBI USERT Dive Program \(FBI\)](#)

5.10 FBI HAZMAT/CWD Brief

Presenter: Kevin Johnson, FBI Hazardous Material Response Unit

This was a very interesting presentation on which to end an informative day. This was a primer into the world of HAZMAT. Explosives, bio toxins, industrial chemicals, bio pathogens, radioactive isotopes, military chemical agents, and fissile (nuclear) materials were covered. Detail on the hazard presented, precautions required, resource information, and case examples was provided.

Important points included:

- That this stuff was all out there and you had to be ready for it.
- HAZMAT training an essential tool to protect the dive team.
- Radioactive materials are an important part of CWD and should perhaps be included in any guidance.

Presentation unavailable due to sensitive and confidential information.

6 DAY 2 – FORUM

Day two's first session looked over last year's action items as part of a progress check and validation process. Results listed in section 6.1 with input from this workshop include and noted as **Actions**. Actions are broken into "immediate" (what about tomorrow's dive?) and "long term" actions.

The 2nd session formed a discussion on the goals of this workshop and are listed in section 6.2.

6.1 Progress Review

Action Item: Establish Centralized database and unclassified web-page(s) for CWD and create a link for CWD workshop materials.

Result: Web page set up at www.supsalv.org under OOC3.

Action Item: Issue Multi-agency CWD Survey Questionnaire.

Result: PSD survey out, Navy survey of Katrina divers out, ADC survey ?

Action Item: Establish NOAA database and web-page(s) for CWD.

Result: Done http://www.ndc.noaa.gov/rp_cwd.html

Action Item: Include CWD as an agenda item during Underwater Intervention 07.

Result: Almost happened in 07, now looking to 08.

Action Item: Identify key subject matter experts. To include missing stakeholders such as: Dry suit manufacturers, Life Support Equipment Engineers, other agencies Los Alamos National Labs, Diving Physicians, Diving Researchers, Commercial Diving Company Representatives.

Result: 2 commercial companies, 1 dive physician, Paragon and Noblis attending.

Action Item: Review Dutch Study on diving mask performance and decide on any requirement for further facemask trials / development in the U.S.

Result: Done.

Action Item: Collate and report results of Multi-agency CWD Survey Questionnaire.

Result: Not done.

Action Item: Produce new 'Guidance for Diving in Contaminated Waters' for the USN.

Result: Slated for draft in 08 in process. Goal is to publish in 09.

Action Item: Review and evaluate Israeli Bio-monitoring program and provide program progress report.

Result: Done.

Action Item: Review and evaluate Israeli 'Diving in Polluted Water Model and Guidelines'.

Result: Done.

Action Item: NOAA to host CWD Workshop July 07

Result: Done - one month early.

Action Item: Investigate equipment needs & the development of operational standards.

Result: Investigations ongoing. Current efforts on: Cooling vests for heat stress management, Containment booms, decon foams and shower systems for Decon, and Paragon's research on soft goods permeability, for better diver protection.

Action Item: Commission a Critical Review Paper of status of CWD from existing CWD Literature.

Result: Not done – Time and funding issue.

Action Item: Develop CWD Diver Training Curriculum.

Result: Not done. Discussion at conference indicated course currently existed at DIT (Divers Institute of Technology). Jerry Zebor offered to write parallel curriculum. Discussion held on type of training (hands-on, CBT, hybrid). Agreed hands-on for initial others possible for refresher.

Actions: **Immediate-** Send select USN diver to DIT for training to Kick Start and generate interest/demand.

Long term- Develop parallel CWD Diving training course.

Action Item: Produce Water Contaminant Guidelines.

Result: Through an inter agency agreements Jim Pearson (NAVSEA) and Alan Humphrey (EPA) will be doing some water sampling in Norfolk. NEDU and USA CHPPM Directorate of Laboratory Sciences will be sampling at Panama City.

Actions: **Immediate-** These initial tests will sample for a wide spectrum baseline using historical use information, USN Environmental data, and other sources.

Long Term- Collect and collate data for use in CWD model, diving categories and guidance. Expand to other common dive sites.

Action Item: Produce a database of National Environmental Sediment and Water Data.

Result: See above action item for detail. Collect data from other sites to develop site dive condition database.

Action Item: Identify testable markers of biological response for chemical contaminants.

Result: In-process, see Investigate improving through life monitoring of Divers Exposed to Underwater Contamination (below).

Action Item: Identify organisms that cause acute illness.

Result: In-process, see Investigate improving through life monitoring of Divers Exposed to Underwater Contamination (below).

Action Item: Provide a list of compounds that we should test for in the water column.

Result: In-process, see Produce Water Contaminant Guidelines (above).

Action Item: Provide a list of compounds that we should test for in the sediment.

Result: In-process, see Produce Water Contaminant Guidelines (above).

Action Item: Investigate the potential for utilizing PEL, TLV and REL system, used by NIOSH, for surface contamination incidents for use with underwater contaminants.

Result: Not Done. Jerry points out in his paper that there is little data correlating land based PEL, LEV, and RELs to a waterborne environment.

Action Item: Investigate improving through life monitoring of Divers Exposed to Underwater Contamination.

Result: Arrangements made to begin blood test and MRI testing for biological monitoring baseline using 08 graduates of NDSTC.

Actions: **Immediate-** Test & wait pursue modifying dive reports to include dive site information.

Long term- Review data, review model, assumptions, and method as required.

Action Item: Develop a Pan Agency Consensus document on CWD Procedures and Equipment.

Result: Discussion indicates this may be difficult as risk management assumption vary greatly within the working group. Tech bulletins/guidance/decisions by the group are more likely and would have value coming from the group in terms of outreach and awareness of CWD.

6.2 Specific Workshop Goals and Outcomes

A summary of discussions related to the workshop's specific goals is provided below.

6.2.1 Common CWD Definitions

CDR Gray and LT Pearson have been working on common terminology at the international level to provide consistency. These definitions (Table 6.1) are defined loosely, allowing all dive groups to tailor their own limits and responses based on the own risk assessment/management models.

Common definitions provide obvious advantages, especially for dive sites previously categorized by log-term on-going monitoring programs or for site-specific joint operations.

- Radioactive contamination would be excluded as this is highly specialized and separate guidance is provided in specific documents.

Outcome: Everyone understood the intent and value, but there was no immediate resolve, as this issue needs to go through vetting at each organization prior to adoption.

Table 6.1 - NATO Categories

Contaminated Water Categories	Definitions	Previous Categories (for comparison)
Cat 1	a. Grossly Contaminated b. Extreme Risk of Injury (or even death) (Note 1) c. Fully Encapsulated Diver (including Surface Exhaust) (Note 2)	N/A
Cat 2	a. Heavily Contaminated b. High Risk of Injury (Note 3) c. Fully Encapsulated Diver (in water exhaust) (Note 2)(Note 4)	Cat 1
Cat 3	a. Moderately Contaminated b. Some Risk of Injury (especially if ingested) c. Full Face Mask (skin covered as necessary)(Note 5)	Cat 2 and 3
Cat 4	a. Baseline Contamination (EU Bathing Water 'Sufficient' or better) b. Low Risk of Injury (Note 6) c. Standard Diving Dress	Cat 4

- Notes:**
1. Diving is not recommended in Cat 1 environments and only properly qualified and equipped diving teams should dive Cat 1. The diving task must be mission essential and the dive team must have express approval from their Commanding Officer for the dive.
 2. Fully encapsulated means a vulcanized rubber dry suit (or other CWD approved dry suit) with integrated boots mated to dry glove with ring system. In addition gloves must be taped and/or clamped to the suit. Equalization tubes between glove and cuff must not be used.
 3. Injuries may be major or minor and could include such things as skin irritations, rashes, eye or sinus irritation etc.
 4. In water exhaust must be at minimum a double exhaust (e.g. Mk 21) but quadruple exhaust (e.g. KM37 (NS)) should be used if available.
 5. Positive Pressure whenever practicable.
 6. Low risk only refers to risk from contaminants and does not relate to any other aspect of the dive. A full risk analysis is still required.

6.2.2 Common Database or Web Link for CWD Sources

There was general agreement that a single-point source for CWD information, with links to related sites and information was best.

Outcome: <http://www.supsalv.org/00c3> would serve as the CWD website/Home page.

6.2.3 Agree/practicality of CW Testing (Biological/Chemical)

All agreed that “real time” testing would be the best. However no equipment currently exists that will test for all the possible hazards. Current lab testing methods have a time delay that renders them ineffective due to changing conditions at the dive site (wind, current), their cost increase with each hazard tested, and transport of samples is complicated by dive site location. The few pieces of equipment showing promise in this area have limited availability and an expensive price tag.

Developing dive site profiles based on historic data and uses, long-term on-going monitoring, testing by public health officials and other agencies will provide a better tool for operations planning. In this regard, through inter agency agreements Jim Pearson (NAVSEA) and Alan Humphrey (EPA) will be doing some water sampling in Norfolk. NEDU and USA CHPPM Directorate of Laboratory Sciences will be sampling at Panama City. These initial tests will sample for a wide spectrum baseline using historical use information, USN Environmental data, and other sources. Long-term the data will be collated for use in CWD model, establishing diving categories and guidance. With planned expansion to other common dive sites.

6.2.4 Agree “Best Practice” for Cooling During CWD Ops

Heat management of the divers, standby divers, and topside personnel is a key issue in warmer temperature zones and especially when the divers are fully encapsulated. Methods discussed:

Ice – Packing the suit with ice pack is relatively easy and time tested, but requires freezing the packs and does not allow for temperature control. Dive times are limited to current guidelines and cooling time and vary with water temperature.

Gel pack diving vests – A variation on the ice packs using chemical gels that “freeze” at higher temperatures (80° versus 32°) and are arranged in a diver worn vest. Dive times are limited to current guidelines and cooling time and vary with water temperature.

Closed-loop circulation – Pumping refrigerated water into the suit from topside cooling system. Could allow thermal control and extend dive times. There were concerns about intrusion at the suit connection and warming of the cold water before it reaches the diver. Don Sutton of Arizona based Applied Diving Services has used this approach and found some warming but thinks a large diameter hose would help.

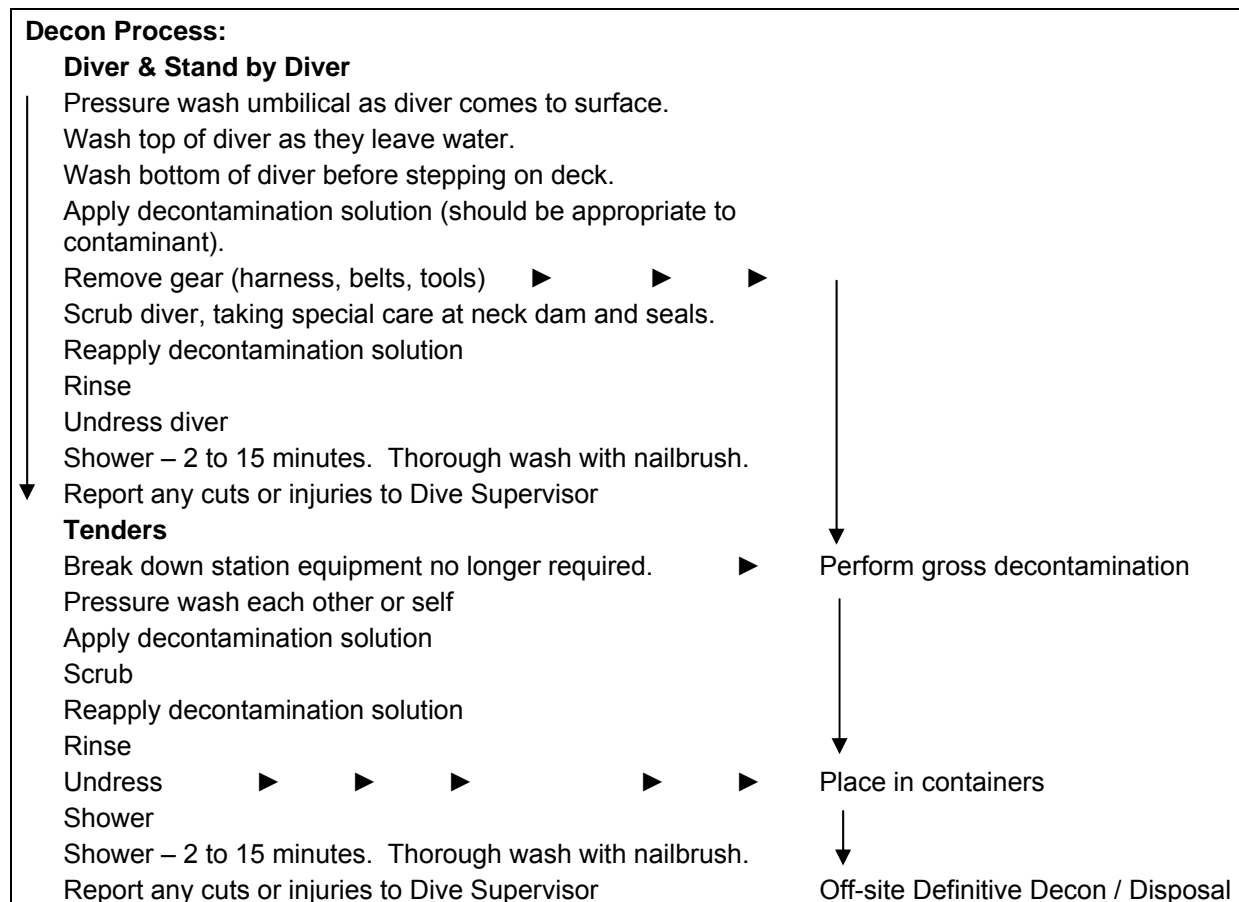
Venturi cooling systems – A surface supplied vest with capillary tubes that has been used successfully in dry chambers, but not viable for dry suits.

Immediate action is to continue using ice, but more research into the gel packs and closed-loop systems is warranted.

6.2.5 Agree “Best Practice” for Decontamination Post CWD Ops (Decontamination Solutions)

- Like surface HAZMAT operations the zone management system separating the “Hot” or high contamination, low contamination, and clean areas should be used.
- Plan for as much 1-time use PPE as possible.

- Decon solution should be appropriate to contaminant, see [Diver Decontamination Solutions](#) by U.S. EPA Environmental Response Team.



6.2.6 Current Equipment Available for CWD

Equipment covered several areas and training was considered a valuable tool. Equipment selection and use is dependant upon the site conditions, contaminants present, and the organization's operating procedures.

- Alan Humphrey provided a document, *Diver Decontamination Solutions* by U.S. EPA Environmental Response Team that details decon solutions currently used.

6.2.6.1 Air Monitors

Setting up air monitors, one measuring ambient for tenders in topside hot zone and one in-line with diver's air supply to ensure against airborne contamination via respiration and compressor intake.

6.2.6.2 Decontamination

Since deck decon is very similar to land based decon there is commercial off the shelf (COTS) decon equipment, like containment booms, inflatable decon shower tents, and decontamination foams available and ready for use. Training in the use and care of this equipment is required.

It was also recognized there needs to be a set of basic decontamination guidelines which can be used by those without access to expensive decontamination equipment.

6.2.6.3 Topside PPE

This is well documented for land-based HAZMAT operations and ranges from gloves, Tyvek over suits, rubber boots and face shields to Level 3 APRs. Training in the use and care of this PPE and personal hygiene is required.

6.2.6.4 Diving Equipment

The Viking vulcanized dry suit seems to be the standard. There is a need for training, Viking has a CD, but hands-on still needed.

Helmets/full facemasks lead to discussion on need for “soft goods” compatible with the diving environment and of surface exhaust (e.g. the USN’s KM37), quad exhausts (e.g. Superlite 17s) and positive pressure systems.

There were concerns over how those dive teams who did not dive hard hats could dive in Cat 2 water.

The AGA mask with positive pressure was of specific interest and the question of whether anyone has studied water intrusion on positive pressure AGAs was raised. It was then brought up that if positive pressure effectively prevented water intrusion, the Navy could use the MK 12 helmets they have rather than buying more surface exhaust systems. There seems to be value in pursuing this issue.

6.2.6.5 CWD Training

Training is necessary at all levels of CWD operations. The dive team needs to take the 40-hour HAZWOPER course and that course needs to be modified to include underwater work.

- In this regard Jerry Zebor committed to developing such a course.

The dive supervisor needs training in assessing the dive site. What to look for (industry, outfalls, odors, etc.) and where to find existing data and information, local contacts for historic information and recent events.

Divers and tenders need training in decontamination planning, procedures, and equipment and PPE.

6.2.7 Other Outcomes

Radioactive decontamination is a very special situation fully documented in manuals specific to that topic. Radcon would be mentioned in the new CWD manual’s introduction with references to other manuals.

The next workshop will be held in June 2008 and tentatively will be hosted by the US Army Corp of Engineers subject to confirmation.