Use of Surface-Supplied Gas for Scientific Diving

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Portland, ME
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Environmental Response Team (ERT)  
Lockheed Martin SERAS

- ERT Established in 1978
- 41 Experienced Responders
- About 75 Dedicated Lockheed Martin Contractors
- Focus: “Classic Environmental” Emergencies
  - Sampling/monitoring
  - Hazard Evaluation
  - Risk Assessment/Safety
  - Characterization
  - Decon/Disposal

2-chloro-6-fluorophenol
ERT Dive Support

- Contaminated and Clean Water Dive Operations
- ERT’s Divers Support a Variety of Agency Needs
  - Benthic Habitat Assessments/Coral Research
  - Survey of Ocean Dredge Disposal Sites
  - Environmental Criminal Investigations
  - Sunken Drums
  - Multimedia Aquatic Sampling
  - SUPERFUND Assessments
  - Biological Assessments
What is Surface-Supplied Diving?

- Surface-Supplied Air to Diver via Umbilical
  - Virtually Unlimited Air Supply
  - Tanks or Compressors
- Diver Carried Air tanks for Emergency Gas Supply (EGS) Only
- Three Part Umbilical
  - Breathing Gas Hose
  - Pneumofathometer (pneumo) Hose
  - Communication line (comm line)/Strength Member
- Surface Control Box/Station
- Dive Controlled By Surface as Opposed to Diver
Equipment

- **AIR SUPPLY**
  - SCUBA Tanks
  - Air Bank
    - Large Banks – slower air usage
    - Safer and less tank switching
  - Compressor
    - High Volume; Low Pressure
    - Back up with Compressed Air
    - Air Testing/Compressor Maintenance
  - Air or Nitrox* May be Used for a Breathing Gas

*As approved by equipment manufacturer
Equipment

• Dive Umbilicals
  • Sinking or Floating
  • Smooth Polyurethane Spiral-Wound
  • Length Typically Ranges from 150 to 500 feet
  • Three Part Umbilical
    • Air Line (Typically 300 psi and 3/8 inch ID)
    • Pneumofathometer (pneumo) Hose
    • Communication line (comm line)/Strength Member
Equipment

• Emergency Gas Supply (EGS)
  • SCUBA Tank (Bail-Out Bottle) Worn by Diver
    • Size May Range from 6 to 80 Cubic Feet
    • Size Dependant Upon Dive Profile and Dive Environment
    • Attached to Manifold Block
    • Pressure Checked and Open at Start of Dive
    • Visible Tank Pressure Gauge
    • Over Pressure Relief Valve on First-Stage Regulator
      • Prevents hose failure if First Stage Reg. Fails
  • Accumulation Bottle
    • Small Bottle Used with Light Weight (1/4”) Umbilicals
Equipment

- **Manifold Block**
  - Must Always be Accessible to Diver
  - Helmet or Harness Mounted
  - Multiple Ports
    - *Surface-Supplied Air*
      - *Non-return Valve or One-way Valve*
    - Tested Prior to Every Dive
  - **EGS**
    - EGS Valve MUST be Closed Until Needed
  - **Dry Suit Inflator Hose**
  - **Auxiliary Low Pressure Ports**
Equipment

• Harness

  • Must Always Be Worn for Surface-Supplied Dive Operations

  • Attachment Point for:
    • Comm. Line/Strength Member
    • EGS/Bail-out Bottle
    • Possibly Manifold Block

  • Allows Diver Be Safely Pulled
to Point of Entry in an Emergency

  • No Strain on Vital Gas or
  Communication Links
Equipment

• Helmet or Full Face Mask
  • Required for Communications During Surface-Supplied Air Dives
  • Helmet
    • Head Protection
    • Potentially Better Protection from Contaminates when Mated to Dry Suit
    • Potentially Increased Air Consumption Rates
  • Full Face Mask
    • Less Cumbersome
    • Diver Remains more Mobile
**Equipment**

- **Surface Control Box**
  - Dive is Controlled On Surface
    Not By Diver
  - Box Operator Monitors and Controls:
    - Duration/Timing of Dive
    - Diver Depth
    - Air Supply to Diver
    - Communication with Diver

![Diagram of Surface Control Box with labeled components:](image)
Dive Team

- Minimum 4 Person Dive Team
  - Multiple Dives/Deeper Dives Require Additional Team Members
  - Two Divers in Water = 6 Person Team
    - Each Diver in Water Needs a Dedicated Tender
- Dive Team Roles:
  - Diver
  - Stand-by Diver
  - Tender
  - Control Box Operator
  - Divemaster/Dive Supervisor
    - May also act as Control Box Operator or Tender
    - Must be on Surface – Not in Water While Overseeing Operations
Dive Team Responsibilities

• Diver
  • Diver Must Assure All Gear is Present and in Working Order Prior to the Dive
  • Understanding and Implementing Dive Plan
  • Performing In-Water Work
    • Remain Focused on Completing Tasks is NOT Burdened with Monitoring Depth, Bottom Time and Air Pressures
  • Be in Communication with Box Operator
Dive Team Responsibilities

- **Stand-by Diver**
  - MUST Be Ready to Enter Water PROMPTLY in Case of Emergency
  - Typically the Next Diver in the Rotation
Dive Team Responsibilities

- Tender
  - Assist Diver Continuously (Preparation, During Dive, After Dive)
  - Maintain Control of Dive Umbilical
    - Move Freely, But Not Present Entanglement Hazard
  - Tracking Divers Location in Water at ALL Times
  - Watching For Vessel or Other Hazards Enter Dive Area
  - Must Be Trained to Perform Function
Dive Team Responsibilities

- Control Box Operator
  - Dedicated Person Who is Responsible For:
    - Maintaining Sufficient Breathing Gas Delivery to Diver
    - Track Divers Profile (Depth and Bottom Time)
    - Ensure Diver Does Not Exceed Depth or Time Limits
    - Communications With Diver, Tender and Divemaster/Dive Supervisor
Dive Team Responsibilities

• **Divemaster/Dive Supervisor**
  • Overall Person Responsible For Daily Dive Operations
  • May Also Fill Role of Surface Control Box Operator or Tender
  • If Diving, Must Designate Acting Divemaster/Dive Supervisor While In Water
  • Coordinating Between All Team Members While Implementing Dive Plan
Scientific Diving Operations

- Unit Specific SOPs or Consensus of Standards
  - EPA Diving Safety Manual
  - ERT/EPA Surface-Supplied Air SOPs
- Compliance with OSHA Regulations or Dive Program Requirements
- Dive Plan and Health and Safety Plan
- Check Lists/Pre-Dive Checks
- Suitable Work Area/Work Vessel
- Access To Water – Diver Entry/Egress
- Dive Team Rotation – Efficient and Safe Operations
Training and Experience

• All Team Members Must Be Trained and/or Have Suitable Experience Performing Roles on Dive Teams

• Initial and Annual Training with Equipment and Procedures

• Training Occurs In Controlled and Safe Environment NOT on the Job Site!

• Equipment Specific and Emergency Procedures

• Classroom and Hands On Training
Equipment Maintenance

- Daily, Weekly and Annual Equipment Maintenance
- Control Box Serviced on Annual Basis or as Recommended by Manufacturer
- Dive Umbilical Annual Pull and Pressure Test (1.5 x Working Pressure)
- Helmets and Full Face Masks
Modes of Diving

• SCUBA (Old Reliable)
  • Maximum Diver Mobility
  • Least Equipment and Training Intensive
  • Ideal for Shallow Dives Where Objectives Can Be Completed With Air In SCUBA Tank

• Tethered SCUBA (Some Significant Improvements Over SCUBA)
  • Some Additional Equipment and Training Costs
  • Always a Line From Surface to Diver
  • Improved Communication (Hardwired) – Surface Documentation of Diver Data
  • Direct Divers to Targets Using Umbilical and Communications
  • Hold Diver in Position in Strong Currents (SCUBA typically limited to < 1 knot)
  • Decreasing Diver Mobility (situational)

• Surface Supplied Air – All of Line-Tended and…..
Advantages of Using Surface Supplied Air

**DIVER SAFETY - Virtually Unlimited Air to Diver**

- Single Greatest Hazard to Diver is Running Out of Air - This Hazard is Greatly Reduced
- Extended Time If Needed for Decontamination

**Diver is NOT Limited to Bottom Times Based On Air that can be Carried**

- No Need to Interrupt Dive and Return to the Surface Just to Change Tanks
- Minimizes Unnecessary Bounce Dives and Risks Associated With Divers Entering and Exiting the Water
Advantages of Using Surface Supplied Air

• Diver Can Fully Concentrate on Completing Objectives
  • Bottom Time, Depth and Air Pressure Monitored on Surface
  • Can Be Monitored on Surface Even in Zero Visibility

• Some Tasks Can be Completed More Efficiently and Safely Using a Single Diver – Especially in Low/Zero Visibility Environments

• Diver Will Need to Carry Less Weight – No SCUBA Tanks Just Project Appropriately Sized EGS (routinely 13 to 29 Cubic Feet)
Disadvantages of Using Surface Supplied Air

- Additional Equipment
- Additional Training
- Larger Dive Team
  - Typically Four Person Dive Team
- Umbilical Drag or Limited Diver Range
  - Diver Range = Umbilical Length – Depth
  - Diver Range = 40’ = 150’ – 110’
  - With 150’ Umbilical in 110’ feet of water
Resources for Scientific Diving Using Surface Supplied Air

• U.S. EPA Dive Units
  • Environmental Response Team (ERT)
    • Alan Humphrey (Humphrey.Alan@epa.gov)
    • Scott Grossman (Scott.C.Grossman@lmco.com)
  • Region 10
    • Sean Sheldrake (Sheldrake.Sean@epa.gov)
    • www.epa.gov/region10/dive
• EPA Standard Operating Procedures