



MODIFICATION AND FIELD TESTING OF THE PROTOTYPE HYPERBARIC TOXIC GAS MONITOR (SUBTOX) FOR DISABLED SUBMARINES

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Current Funding: NAVSEA

PROJECT GOAL

- **GOAL:** Develop procedures using portable analyzers for monitoring the eight toxic gases on DISSUBs for which submarine escape action levels (“SEALs”) have been defined
 - Allow escape / rescue decisions
- **WHY:** Current procedures rely on chemical detector tubes
 - Inaccurate, costly, limited storage times, time consuming and cumbersome to use, unknown pressure effect
 - National Academy of Sciences recommendation

BACKGROUND

- Over the last 6 years, developed with ENMET prototype DISSUB gas analyzer – “SubTox”
- Based on Navy requirements – “built from the ground up” with special hyperbaric sensors
- Working with ENMET via iterative process of modifying/retesting - all pressure testing at NEDU
- Field testing ongoing on submarines during the last year

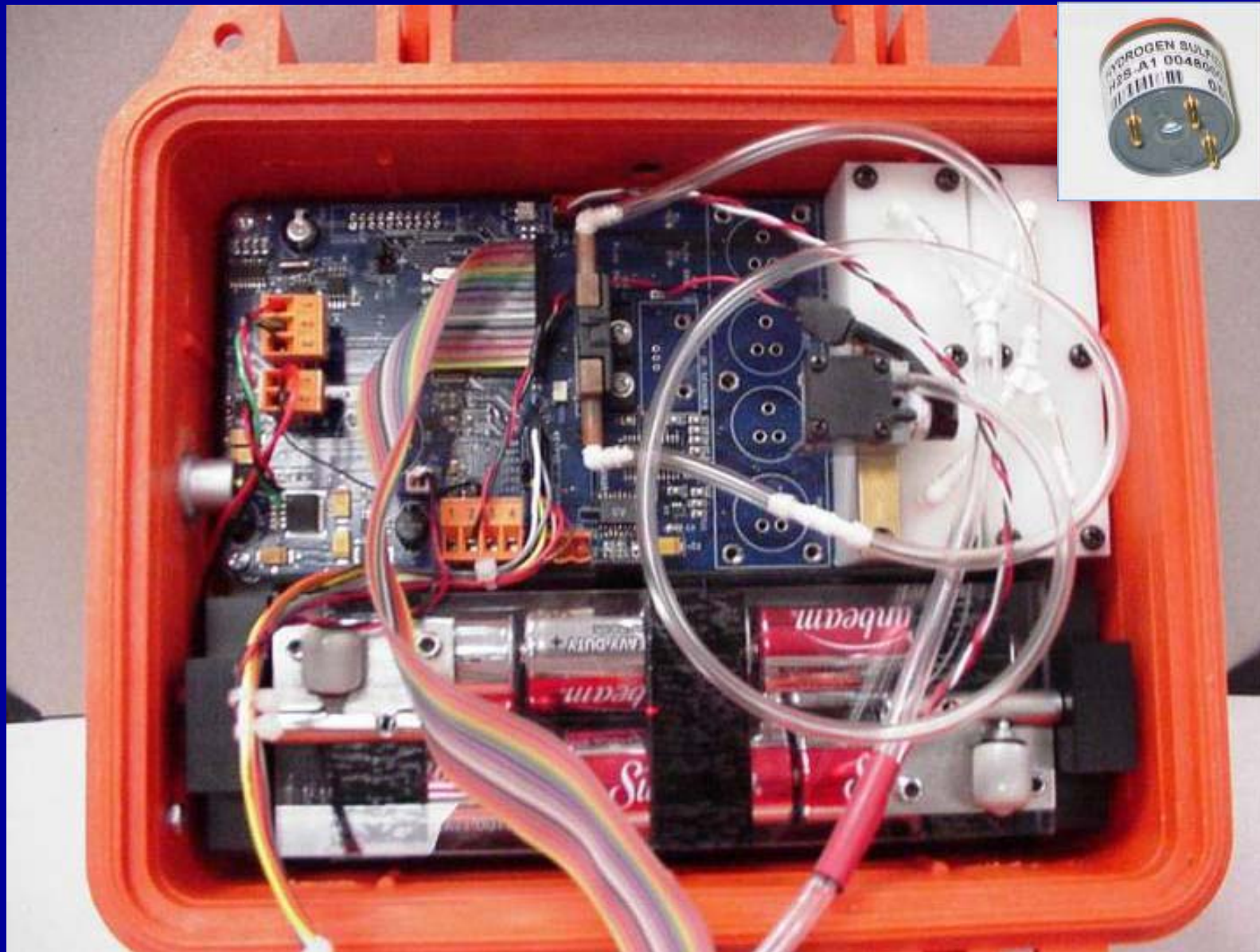
SUBTOX



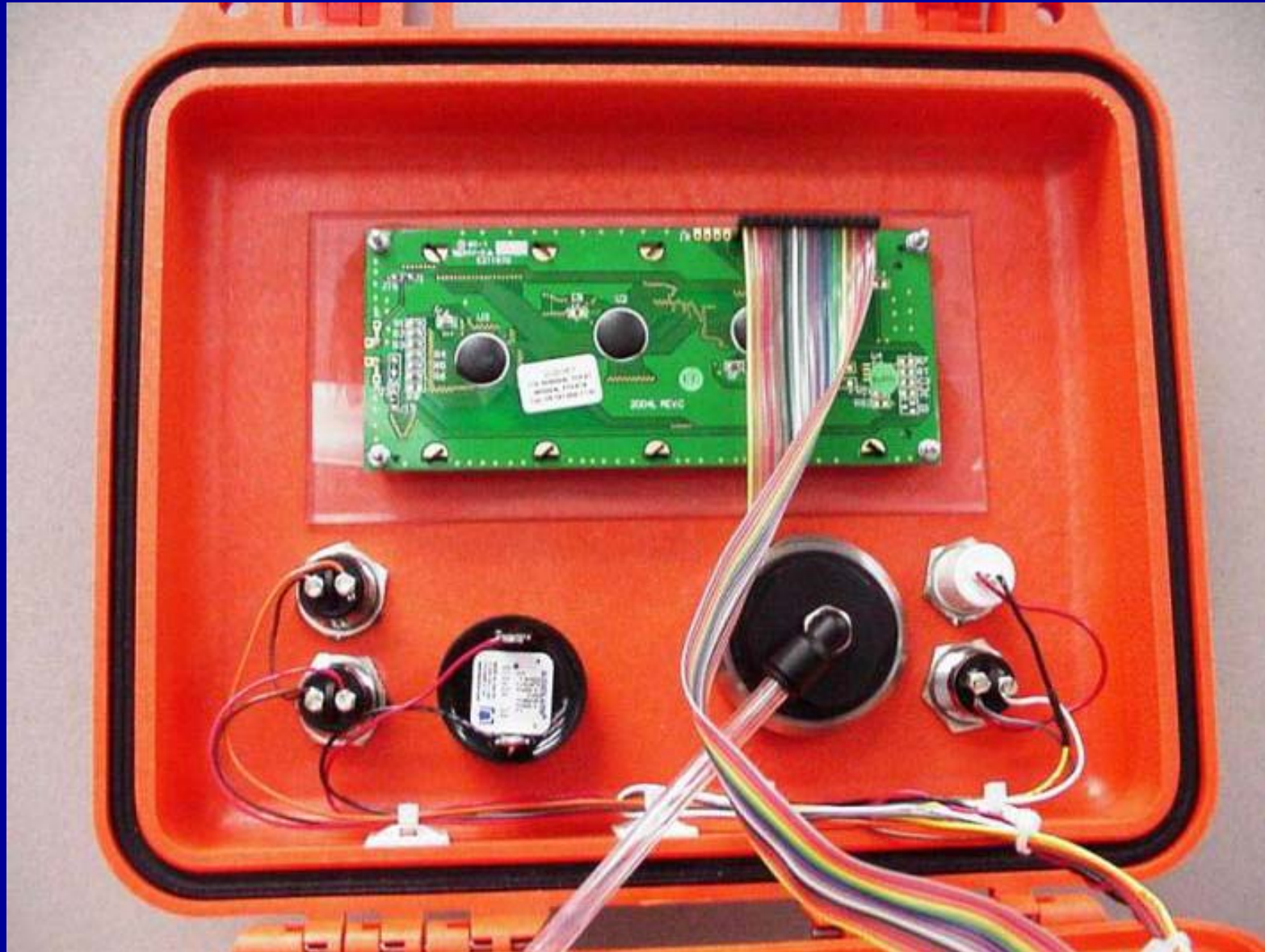
SUBTOX



SUBTOX



SUBTOX



SUBTOX FEATURES (1)

- **Twelve+ gas sensors / NEDU sensor manifold**
- **Currently monitors the following SEAL gases:**
 - **CO, H₂S, HCl, SO₂, Cl₂, HCN, NO₂; as well as H₂**
 - **Other gases? O₂, CO₂...**
- **Pressure range: 1 to 5 ATA**
- **Concentration ranges: 2 times SEAL2 levels**
- **Powered by 6 D cell alkaline batteries**
 - **Goal: > 3 days continuous operation per set of batteries**

SUBTOX FEATURES (2)

- **Custom circuit board**
- **Mass flow and pressure sensors, datalogger, LCD with backlight, computer interface, brushless sample pump**
- **LCD display:**
 - **Uncorrected and SEV values of all SEAL gases**
 - **Sample pump flow, pressure (ATA), inlet temperature, battery voltage, H₂**
 - **Status screen: battery life, date, time, pump mode**
 - **Information screen**
 - **Logger menu**

SUBTOX FEATURES (3)

- **Software for Navy application, passcode protections**
 - Visual Basic and SubTox code – many capabilities
 - Compensation for pressure, temperature, cross sensitivities among gases
 - Load test data for calibration and compensation workup
- **Visual/audio alarms, adjustable duty cycle**
- **Waterproof inlet**

NEW / UPCOMING FEATURES

- **Data log reviewer allowing users to scroll down the display screen to view past logged gas readings**
- **Peak display function allowing users to display maximum gas readings during a previous time period**
- **Alternative backlighting to maintain "night vision"**

SUBTOX DISPLAY SCREENS

CO	0	C12	0.0
H2S	0	HCN	0
HCl	0	NH3	0
SO2	0	NO2	0

FLO	0.5	H2	0
PRS	1.0		
TMP	68		
UBT	7.3		

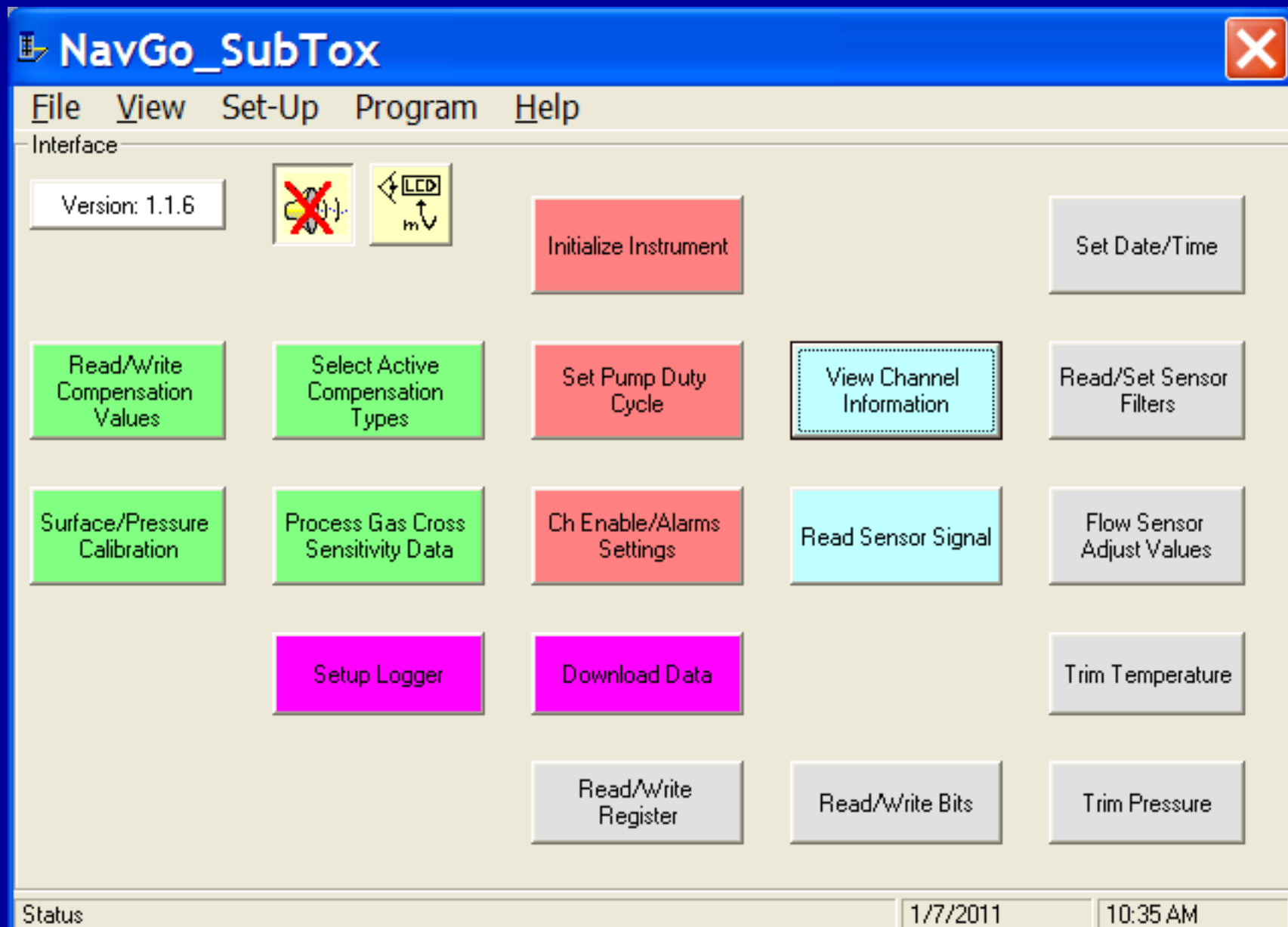
CO	0	S	C12	0.0
H2S	0	E	HCN	0
HCl	0	U	NH3	0
SO2	0		NO2	0

Battery: 47.3 %
Date: 05/16/11
Time: 10:34:45
Continuous Mode

ENTER LOGGER MENU
Menu = Exit
Select = Enter

11/05/16	07:58:04	
CO	H2S	HCl
SO2	C12	HCN
NH3	NO2	FLO

SUBTOX VB



CURRENT STATUS

- **Current SubTox prototype now undergoing final refinements and lab testing**
- **Field testing continues**
 - Much interest from submarine crews
 - INSURV support
- **NEDU and funding sponsor believe SubTox ready for “limited transition”**

THE WAY FORWARD

- **Need to identify “advocate” to support next steps**
 - **Procure small number of first production monitors**
 - **Verify ENMET can acquire hyperbaric capability and “successfully” assume entire production and testing process**
- **Briefed SERRG**
- **Briefed Submarine Atmosphere group**
- **Upcoming SUBMOD conference – INSURV support**