Performance

THROUGH LEADERSHIP

Transocean

Mark I / II upgrade

March 18, 2009

Houston, Texas

Comparison
Legacy Mark I & II MUX System to New Mark III System

Contents

- Transocean install Base
- Mark III System Overview – New Features

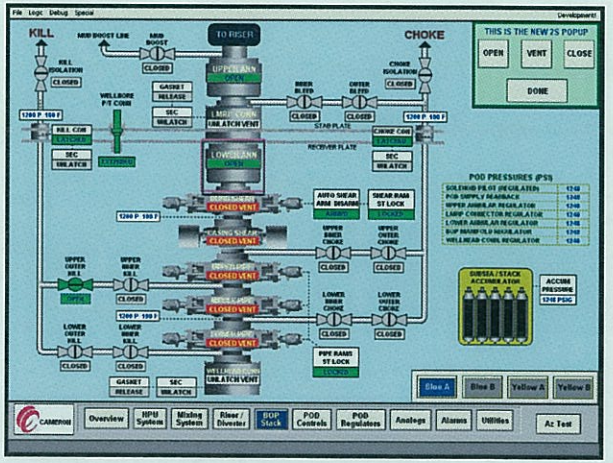
Cameron Mux Systems

Leader	Mark 1
Celtic Sea	Mark 1
Explorer	Mark 1
Express	Mark 1
Energy	Mark 1
Cajun	Mark 1
Sovereign Explorer	Mark 1
Discoverer Enterprise	Mark II
Nautilus	Mark II
CR Luigs	Mark II
Jack Ryan	Mark II
Horizon	Mark II

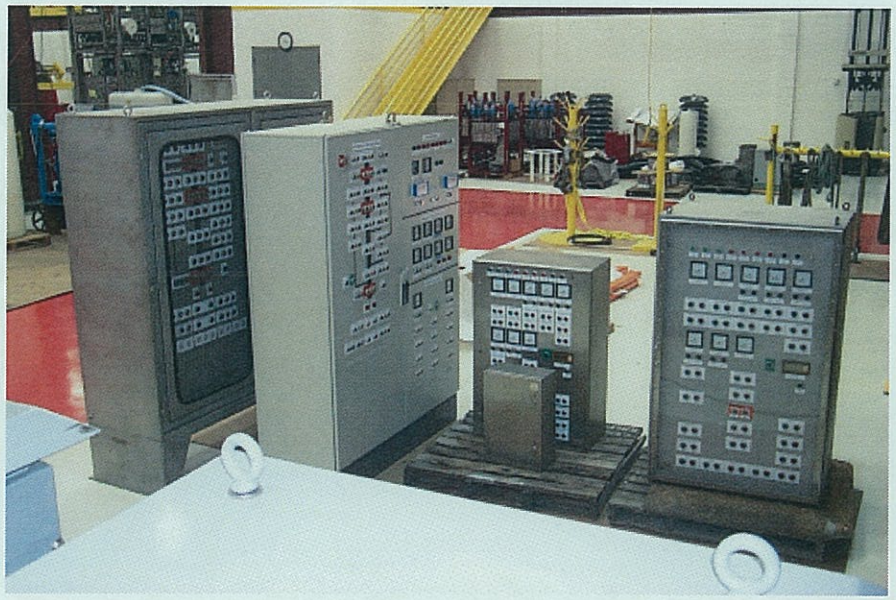
12 Systems

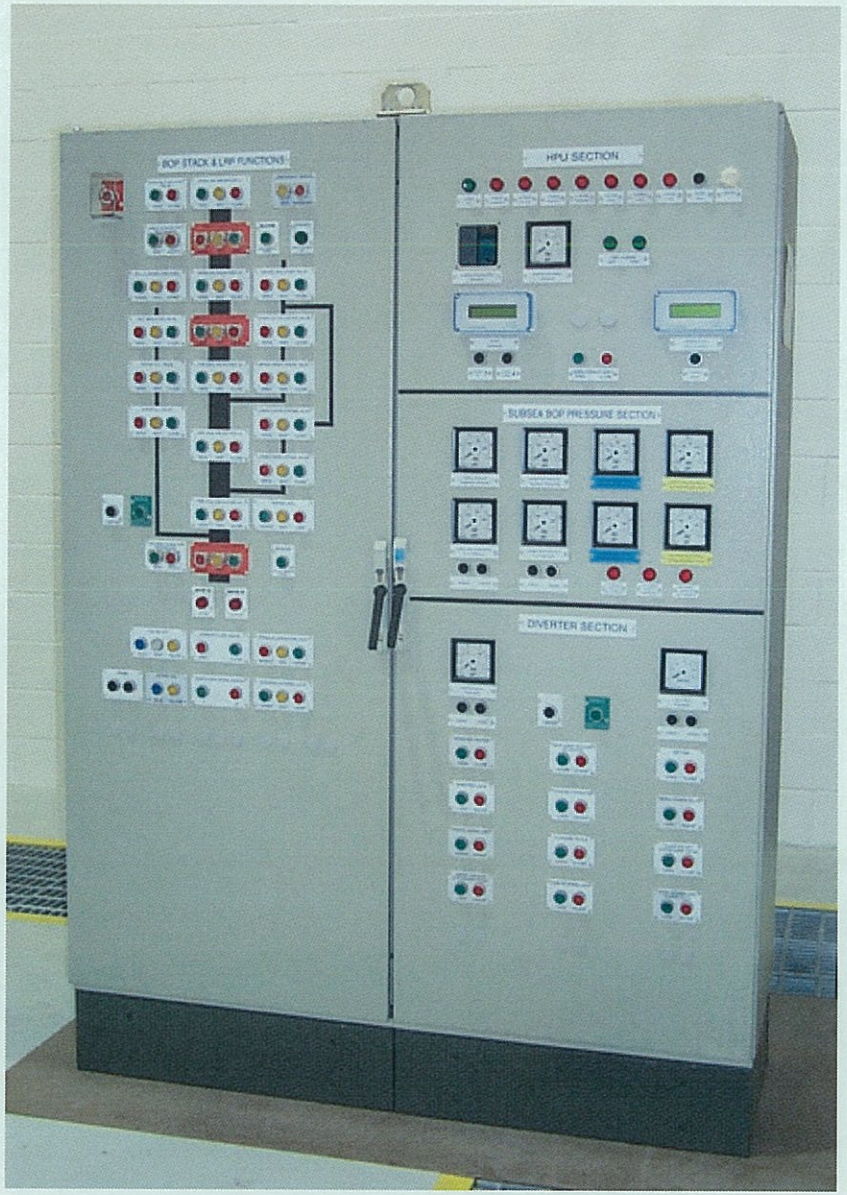
Surface Changes

- **Surface Communications**
  - **Legacy used Profibus via Fiber Optics with OLM's**
    (Star type network with poor diagnostic capabilities)
  - **Mark III utilizes Ethernet technology via Fiber Optics with field proven Siemens Fiber Converters/Switches**
    (robust network management for increased uptime with enhanced diagnostics)
- **Touch Screen Panels have been developed to replace hardwire push-button panels**
- **Wonderware HMI Software utilized for enhanced graphics and ease of use**
- **Field proven Siemens S7 PLC's utilizing Step 7 software**



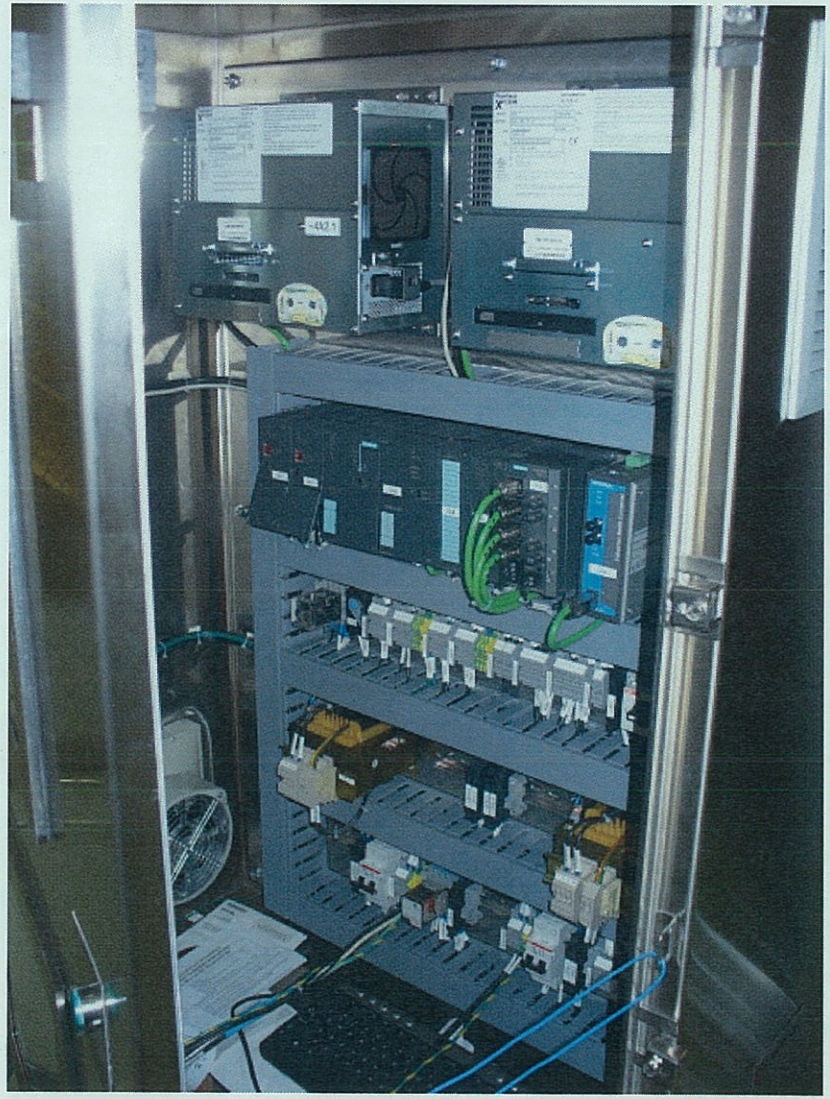
Legacy Hardwire Push-button Panels

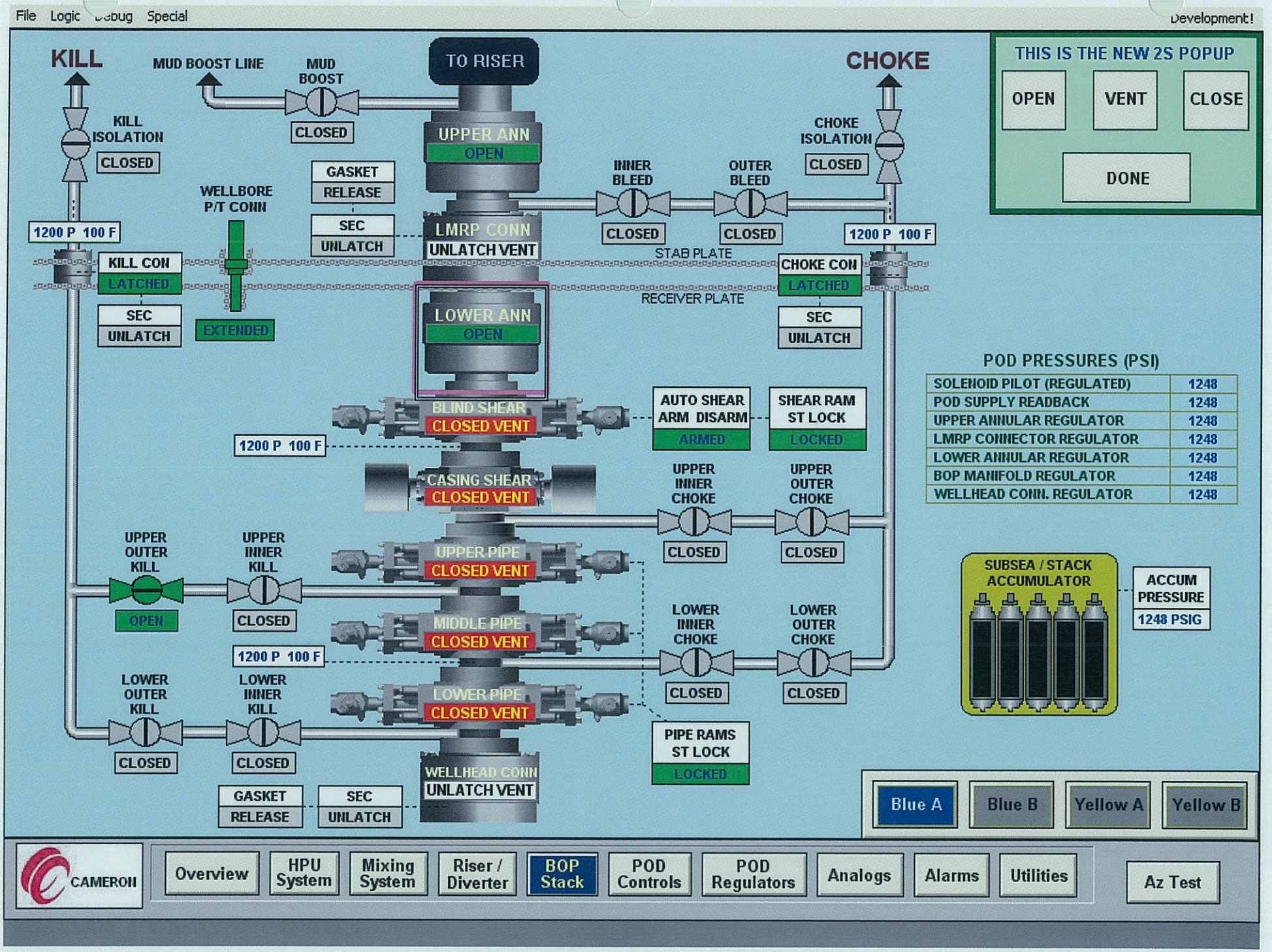


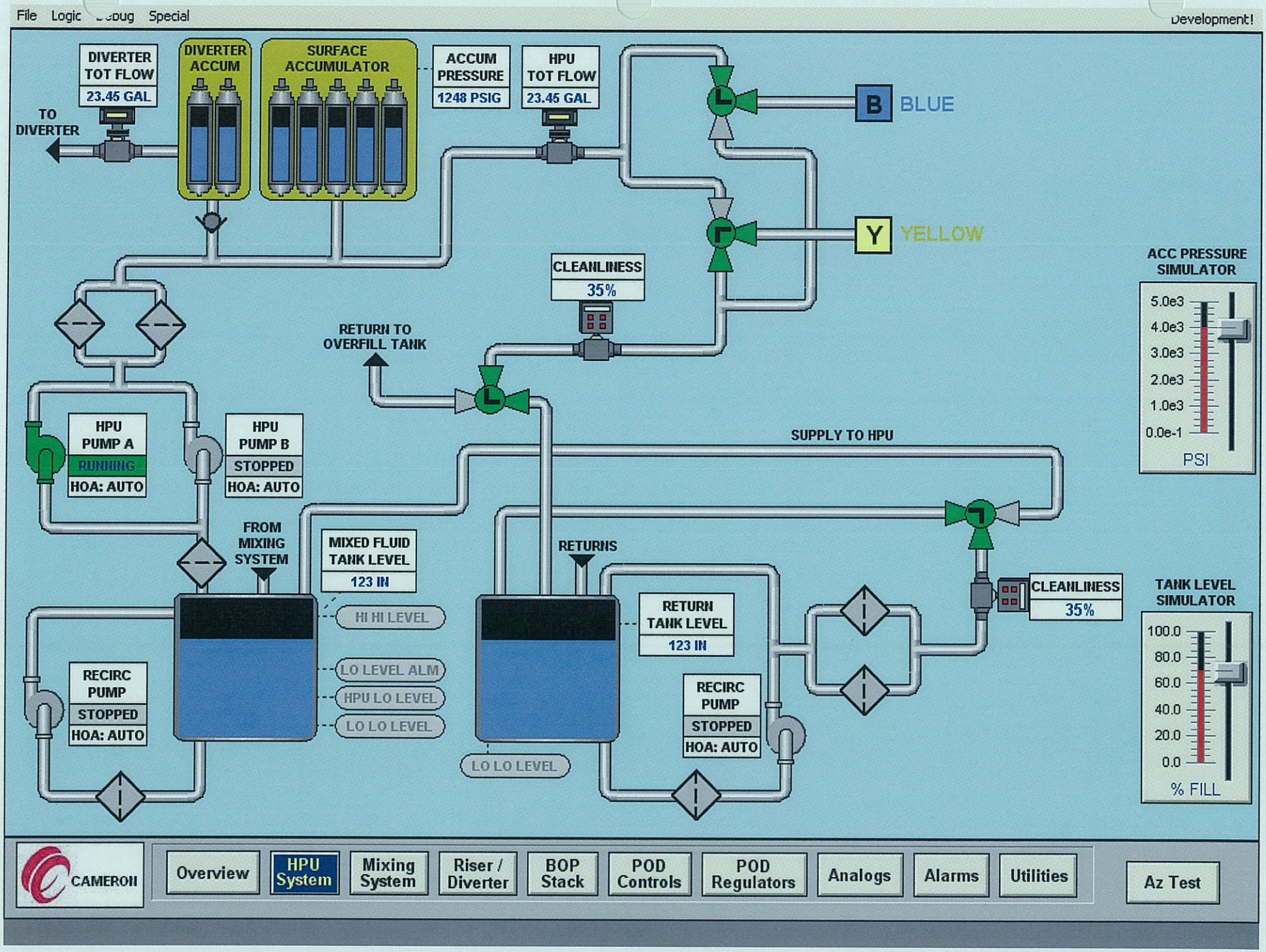


Touch Screen Panels

Touch Screen Panels




File Logic Debug Special
Development!
KILL
CHOKE
MUD BOOST LINE
MUD BOOST
CLOSED
TO RISER
KILL ISOLATION
CLOSED
CHOKE ISOLATION
CLOSED
UPPER ANN
OPEN
GASKET
RELEASE
INNER BLEED
OUTER BLEED
CLOSED
CLOSED
WELLBORE P/T CONN
SEC
UNLATCH
LMRP CONN
UNLATCH VENT
1200 P 100 F
1200 P 100 F
STAB PLATE
KILL CON
LATCHED
CHOKE CON
LATCHED
RECEIVER PLATE
SEC
UNLATCH
EXTENDED
LOWER ANN
OPEN
SEC
UNLATCH
BLIND SHEAR
CLOSED VENT
AUTO SHEAR ARM DISARM
ARMED
SHEAR RAM ST LOCK
LOCKED
1200 P 100 F
CASING SHEAR
CLOSED VENT
UPPER INNER CHOKE
UPPER OUTER CHOKE
CLOSED
CLOSED
UPPER OUTER KILL
UPPER INNER KILL
UPPER PIPE
CLOSED VENT
OPEN
CLOSED
MIDDLE PIPE
CLOSED VENT
LOWER INNER CHOKE
LOWER OUTER CHOKE
1200 P 100 F
CLOSED
CLOSED
LOWER OUTER KILL
LOWER INNER KILL
LOWER PIPE
CLOSED VENT
CLOSED
CLOSED
PIPE RAMS ST LOCK
LOCKED
WELLHEAD CONN
UNLATCH VENT
GASKET
RELEASE
SEC
UNLATCH
THIS IS THE NEW 2S POPUP
OPEN
VENT
CLOSE
DONE
POD PRESSURES (PSI)
SOLENOID PILOT (REGULATED) 1248
POD SUPPLY READBACK 1248
UPPER ANNULAR REGULATOR 1248
LMRP CONNECTOR REGULATOR 1248
LOWER ANNULAR REGULATOR 1248
BOP MANIFOLD REGULATOR 1248
WELLHEAD CONN. REGULATOR 1248
SUBSEA / STACK ACCUMULATOR
ACCUM PRESSURE
1248 PSIG
Blue A
Blue B
Yellow A
Yellow B
CAMERON
Overview
HPU System
Mixing System
Riser / Diverter
BOP Stack
POD Controls
POD Regulators
Analogs
Alarms
Utilities
Az Test


File Logic Debug Special
Development!
DIVERTER TOT FLOW
23.45 GAL
TO DIVERTER
DIVERTER ACCUM
SURFACE ACCUMULATOR
ACCUM PRESSURE
1248 PSIG
HPU TOT FLOW
23.45 GAL
B BLUE
Y YELLOW
CLEANLINESS
35%
RETURN TO OVERFILL TANK
ACC PRESSURE SIMULATOR
5.0e3
4.0e3
3.0e3
2.0e3
1.0e3
0.0e-1
PSI
HPU PUMP A
RUNNING
HOA: AUTO
HPU PUMP B
STOPPED
HOA: AUTO
SUPPLY TO HPU
FROM MIXING SYSTEM
MIXED FLUID TANK LEVEL
123 IN
HI HI LEVEL
LO LEVEL ALM
HPU LO LEVEL
LO LO LEVEL
RETURNS
RETURN TANK LEVEL
123 IN
LO LO LEVEL
RECIRC PUMP
STOPPED
HOA: AUTO
RECIRC PUMP
STOPPED
HOA: AUTO
CLEANLINESS
35%
TANK LEVEL SIMULATOR
100.0
80.0
60.0
40.0
20.0
0.0
% FILL
CAMERON
Overview
HPU System
Mixing System
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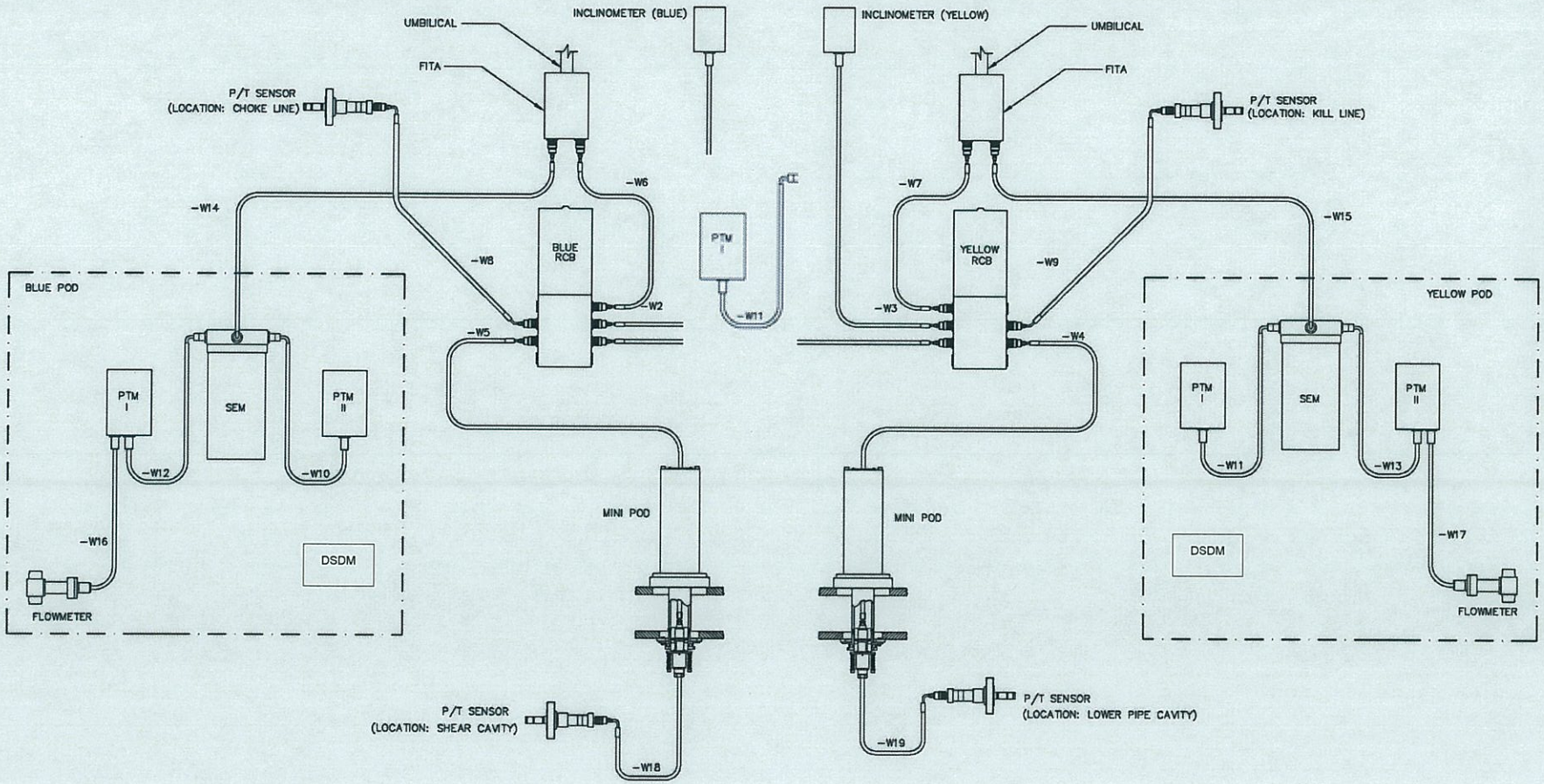
Subsea Changes

- Number of 1atm chambers reduced
- Power and signal go directly to SEM
- RCB has separate power and signal
- All interconnection cabling is Version 2 PBOF with testable connections and field repairability

PBOF Interconnection Diagram



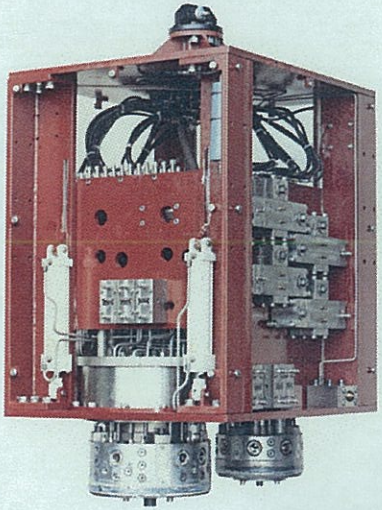
PODS

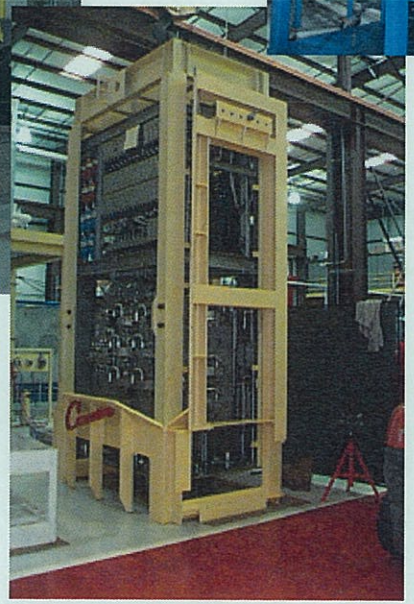
- Ben Ocean Lancer – 1st Gen MUX circa 1976
- Mark I – 2nd Gen 77 Functions circa 1995
  - Used Direct Hyd Mod Section developed in the
- Mark II – 2nd Gen Extended 107 functions circa 1998
  - Larger rectagular footprint

Current Generation (began development 2004)

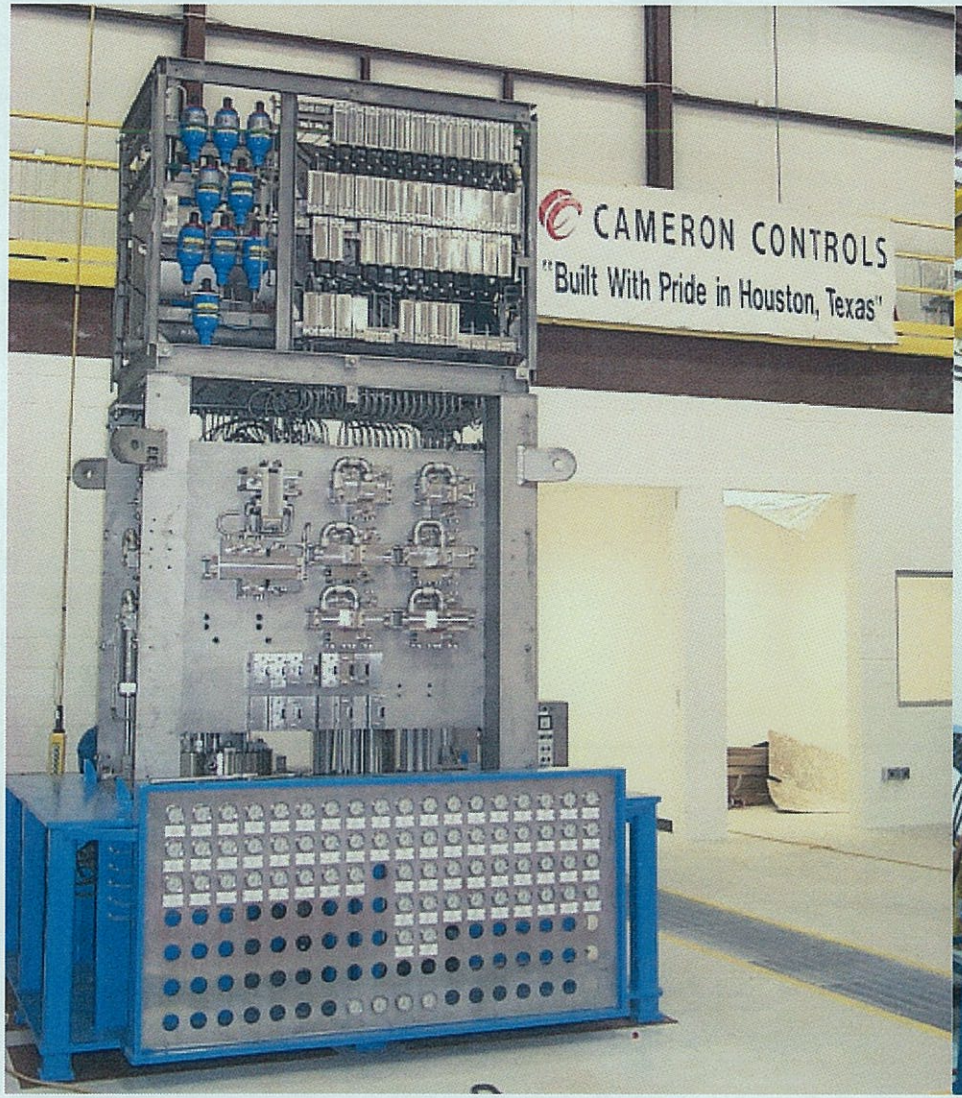
- Mark III Model 80 (80 functions, base footprint)
- Mark III Model 120 (120 functions, rectagular footprint)

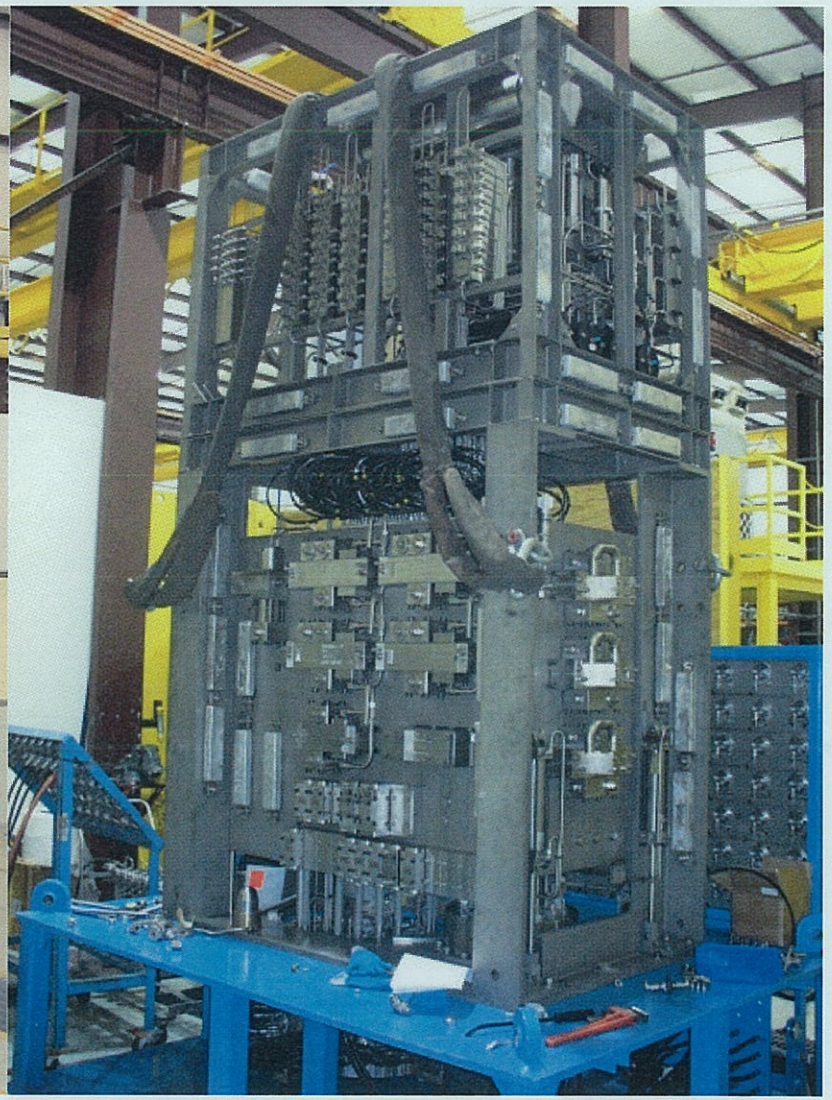
PODS





Mark II & Mark III Model 120 Pods





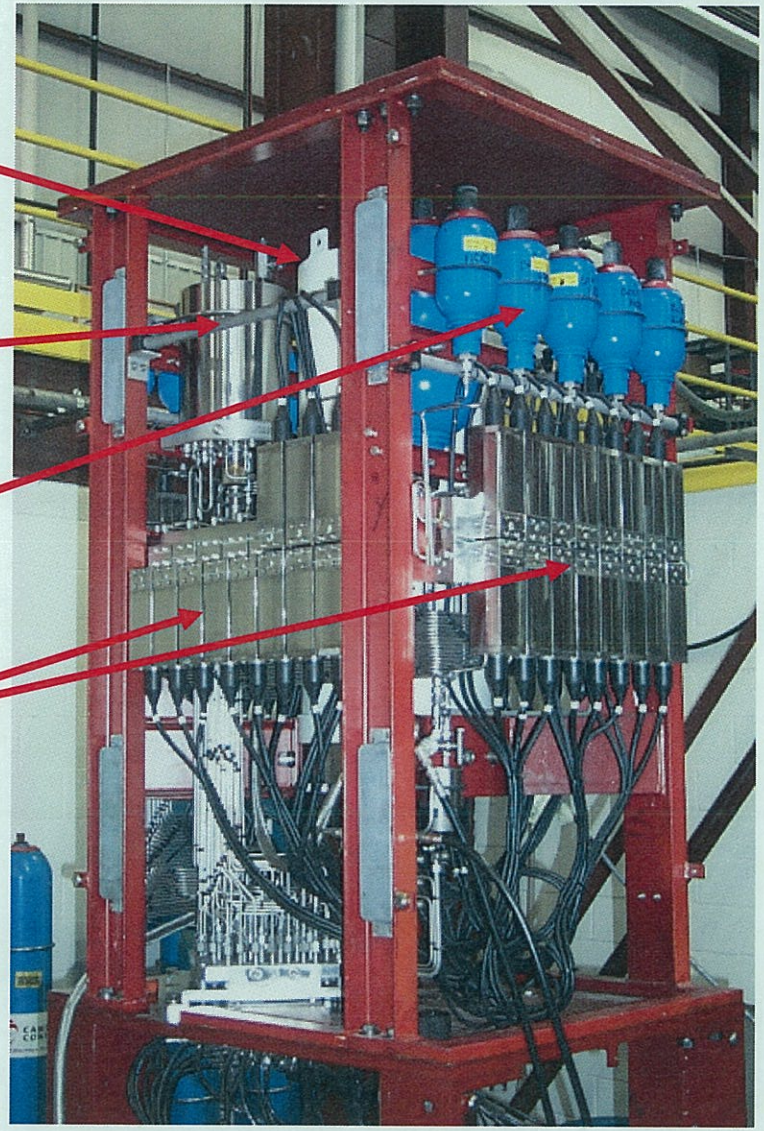
Mark I MUX Package

Subsea Electronics Module

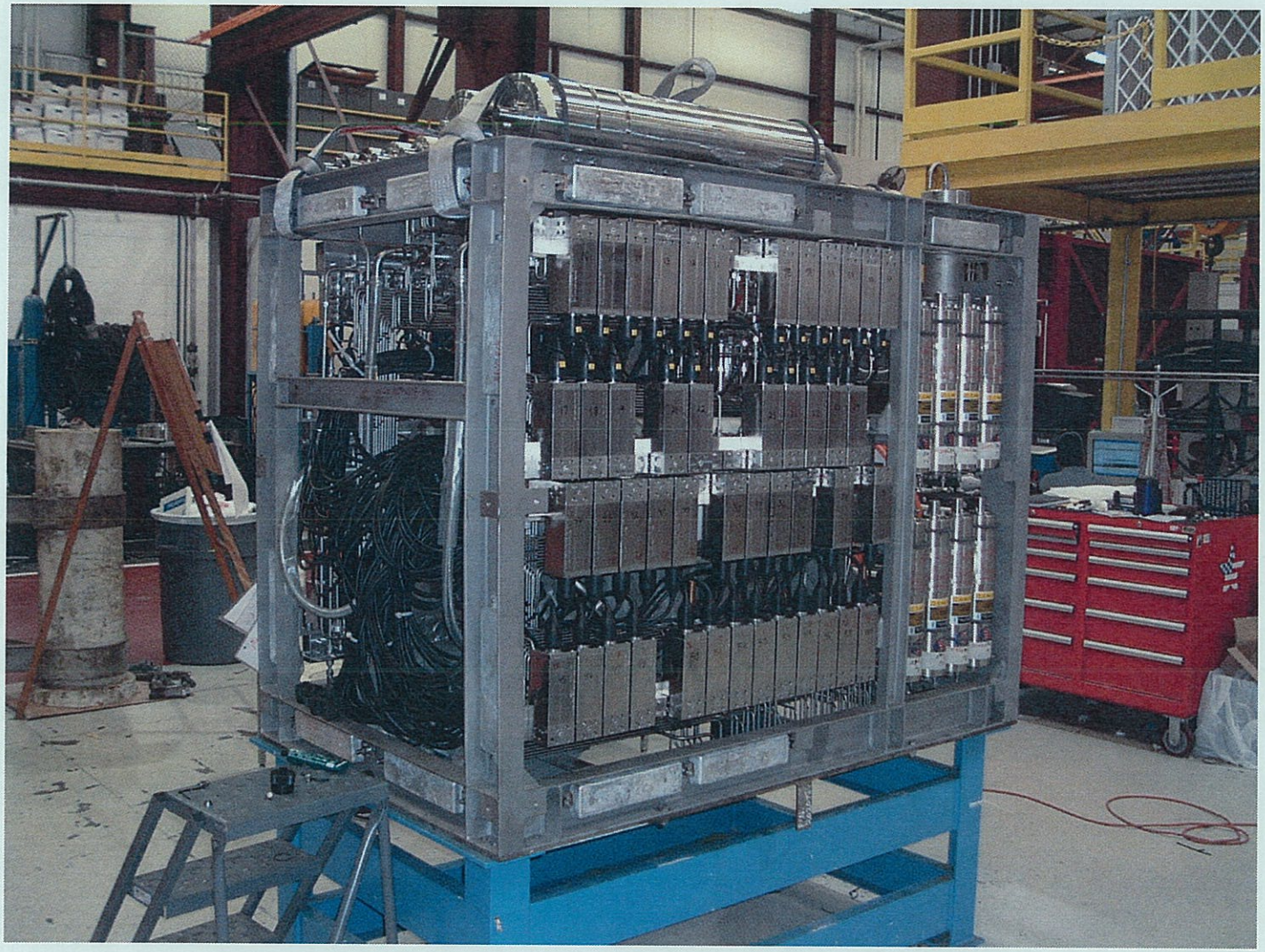
Subsea Transmitter Module

Accumulators

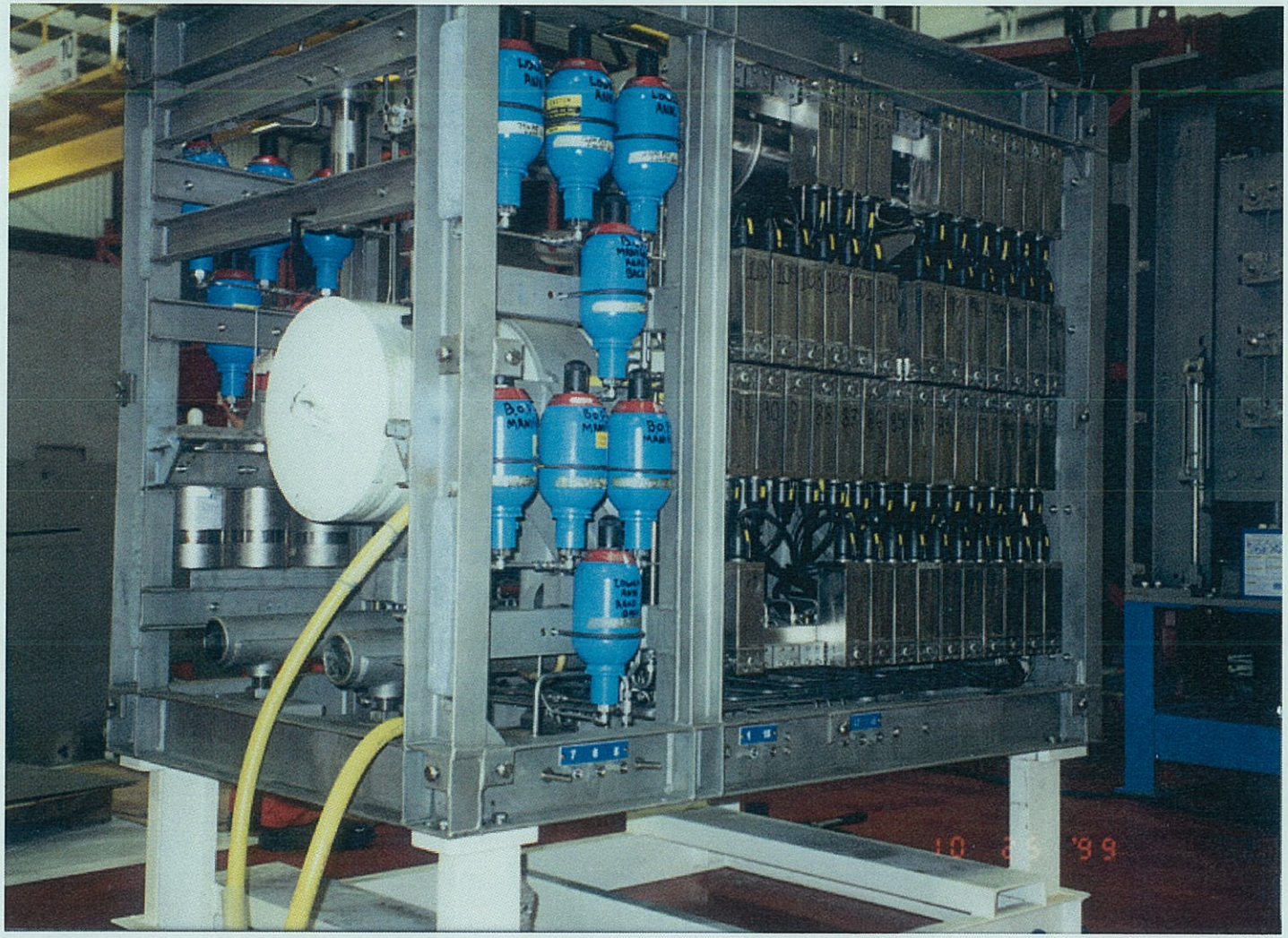
Solenoid Valves



Mark II MUX Package



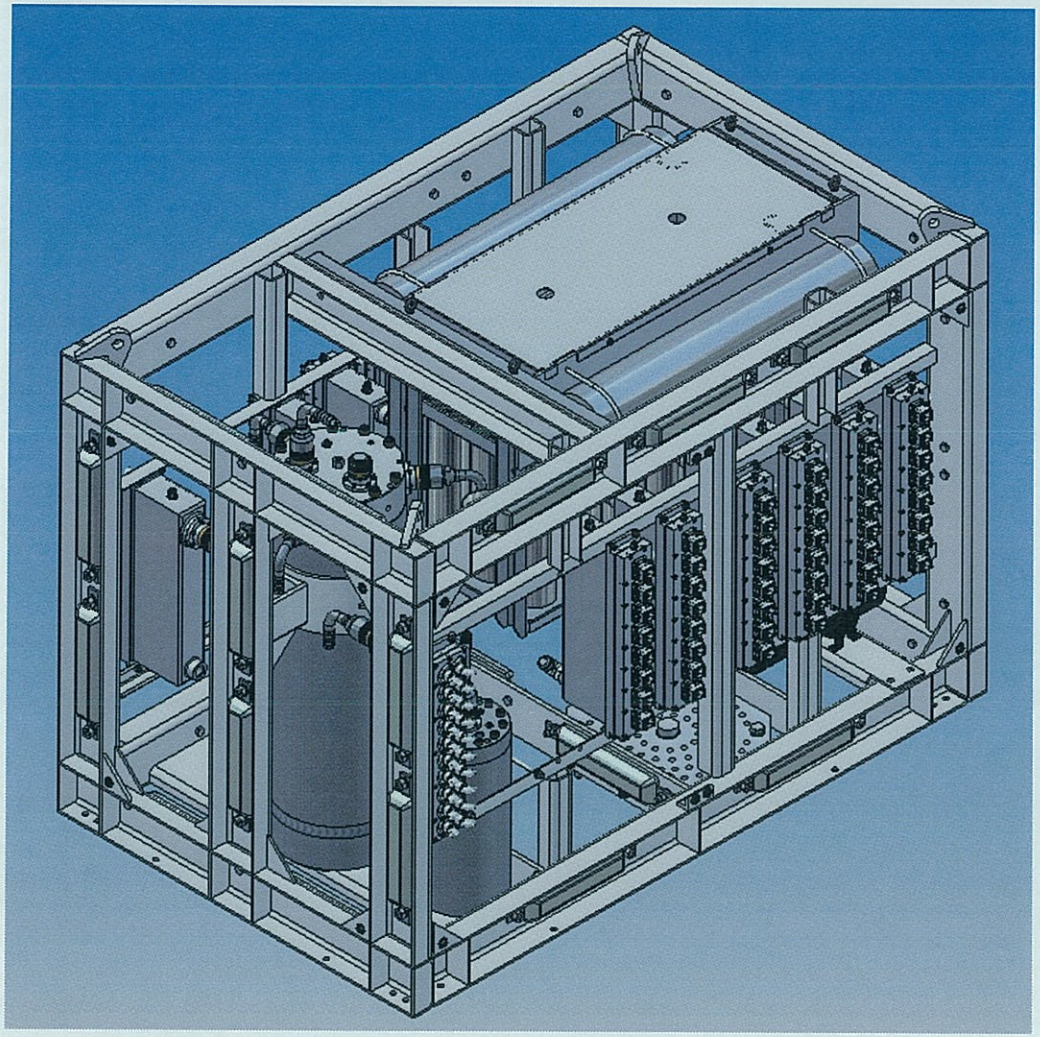
Mark II MUX Package



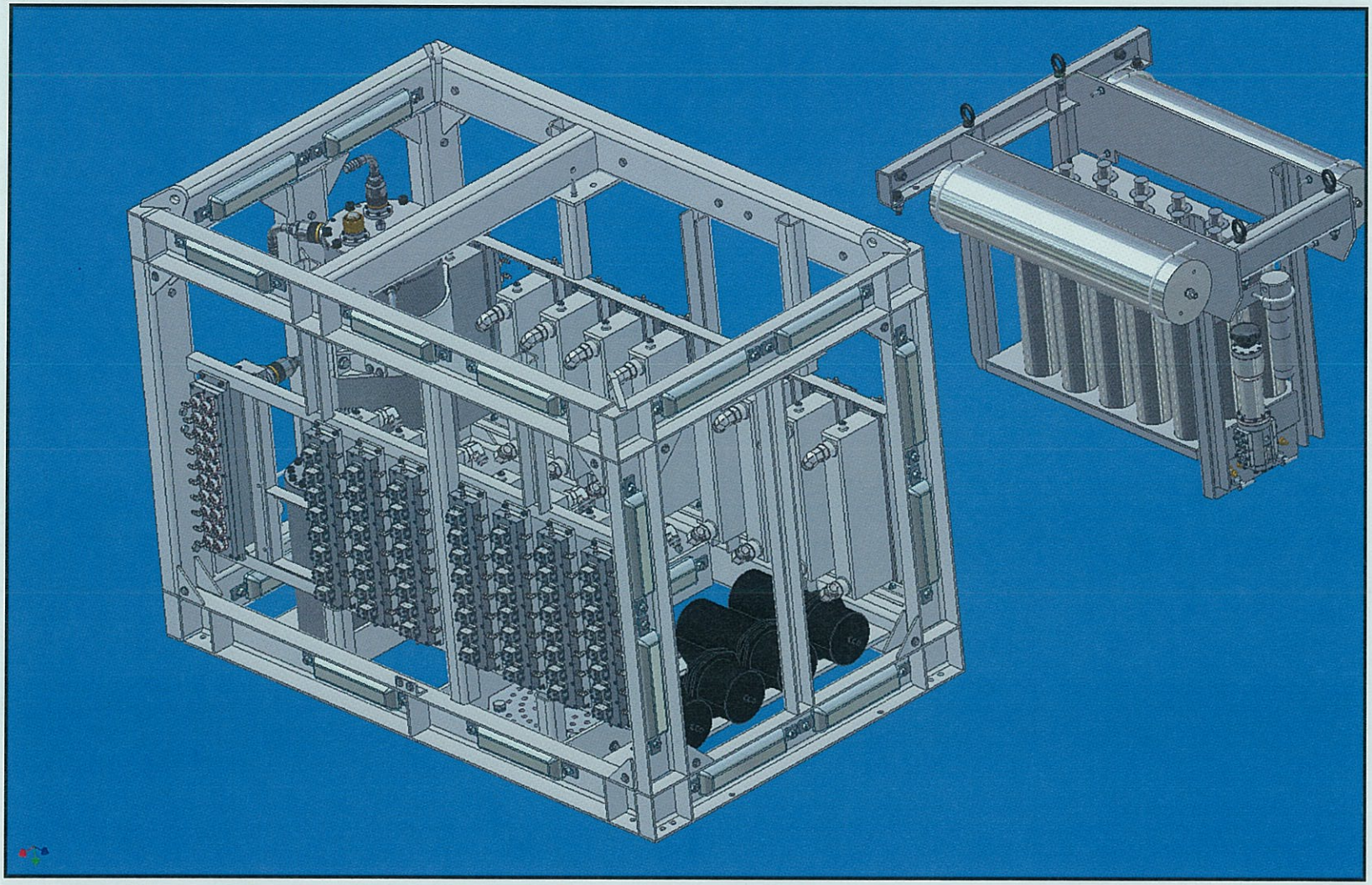
Mark III MUX Section

- Completely Repackaged for ease of maintenance
- Pressure compensated dielectric filled chambers
  - Solenoids
  - Transducers
- Modular construction
  - Solenoid chambers
  - Transducer chambers
  - Pilot Accumulator, Regulator & Filter rack
- Junction Plate for hydraulic interface between MUX / Mod
- New compact SEM design with next-gen electronics
- Rechargeable batteries for AMF/Deadman System

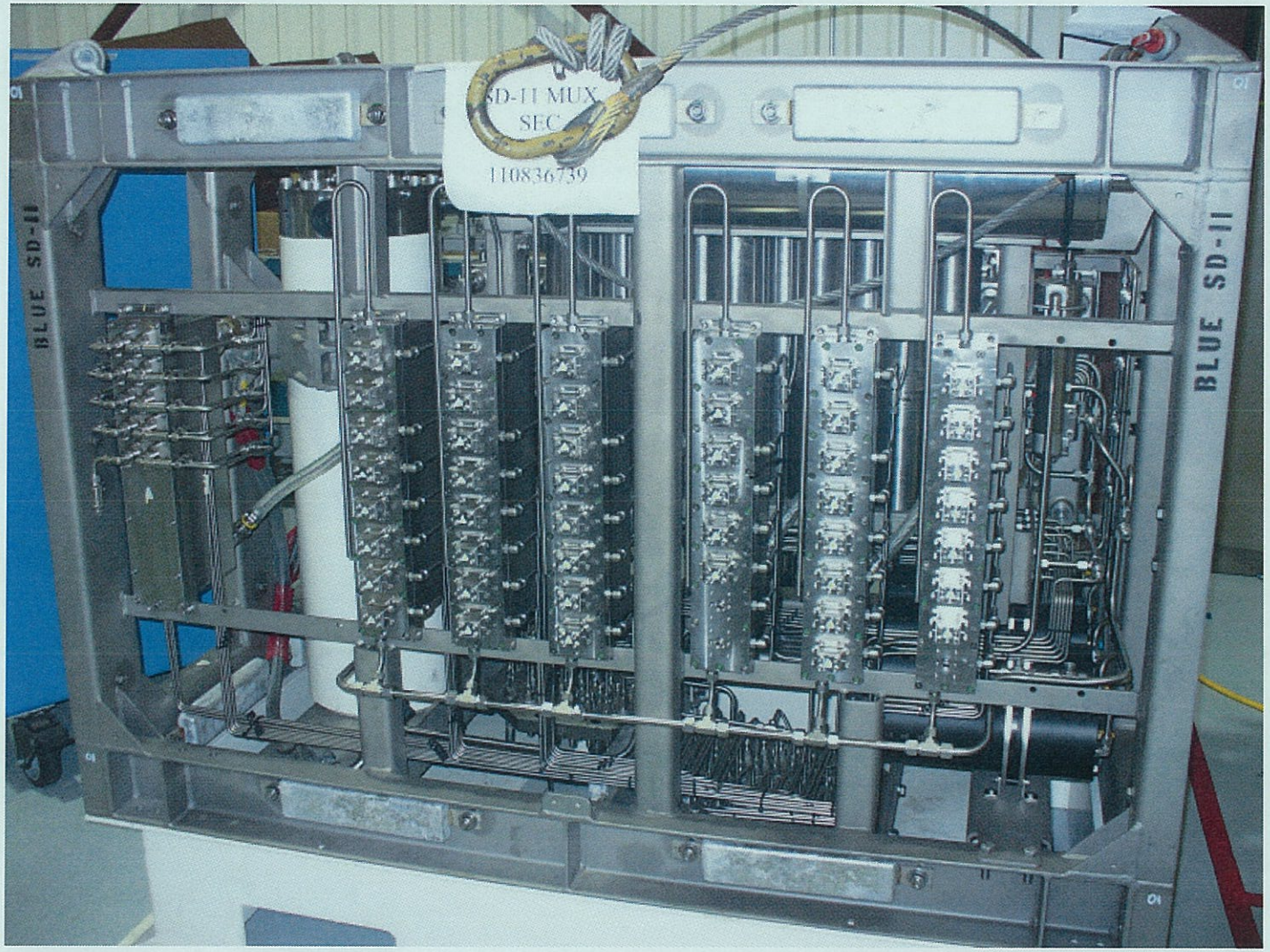
Mark III Model 120 MUX Section



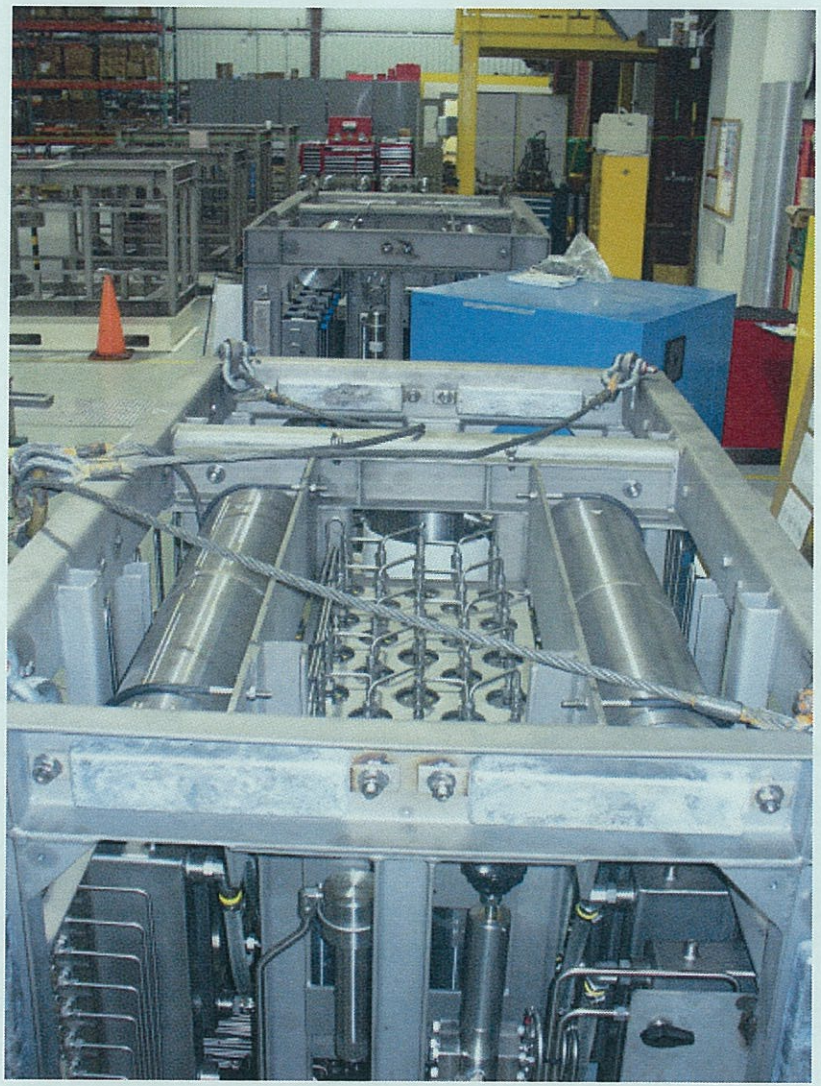
Mark III Model 120 MUX Section



Mark III Model 120 MUX Section



Mark III Model 120 MUX Section



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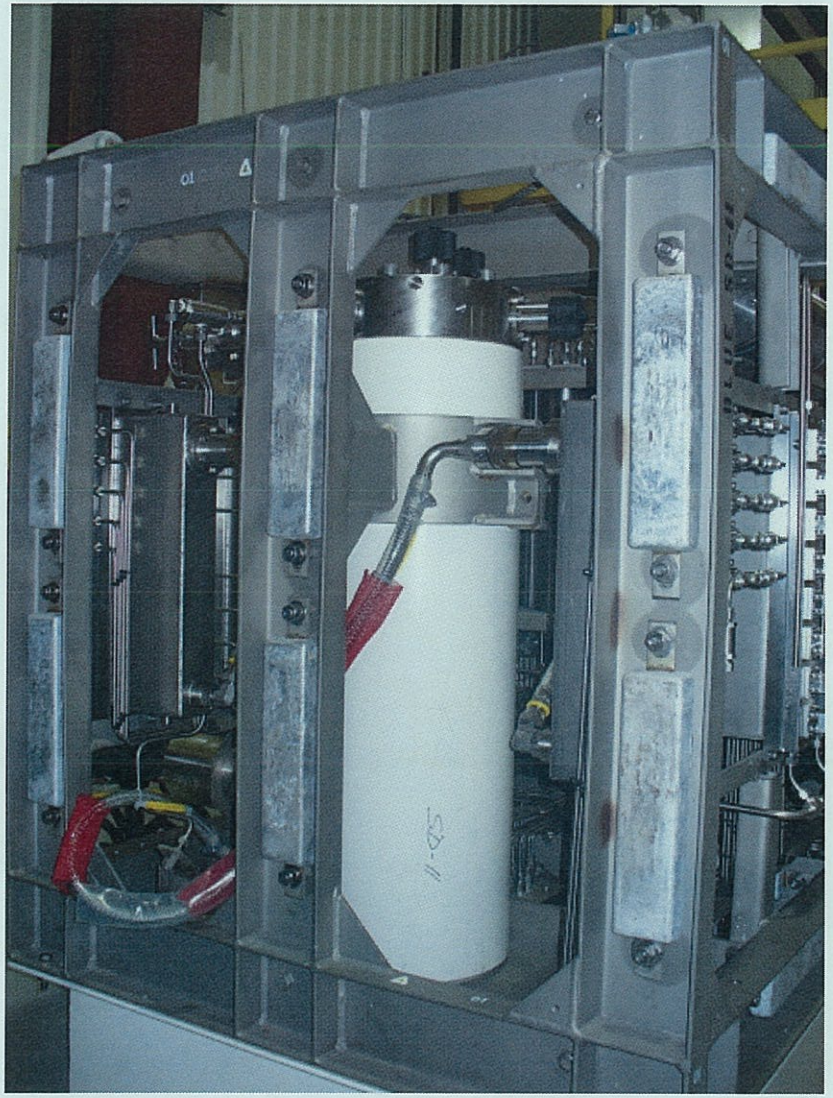
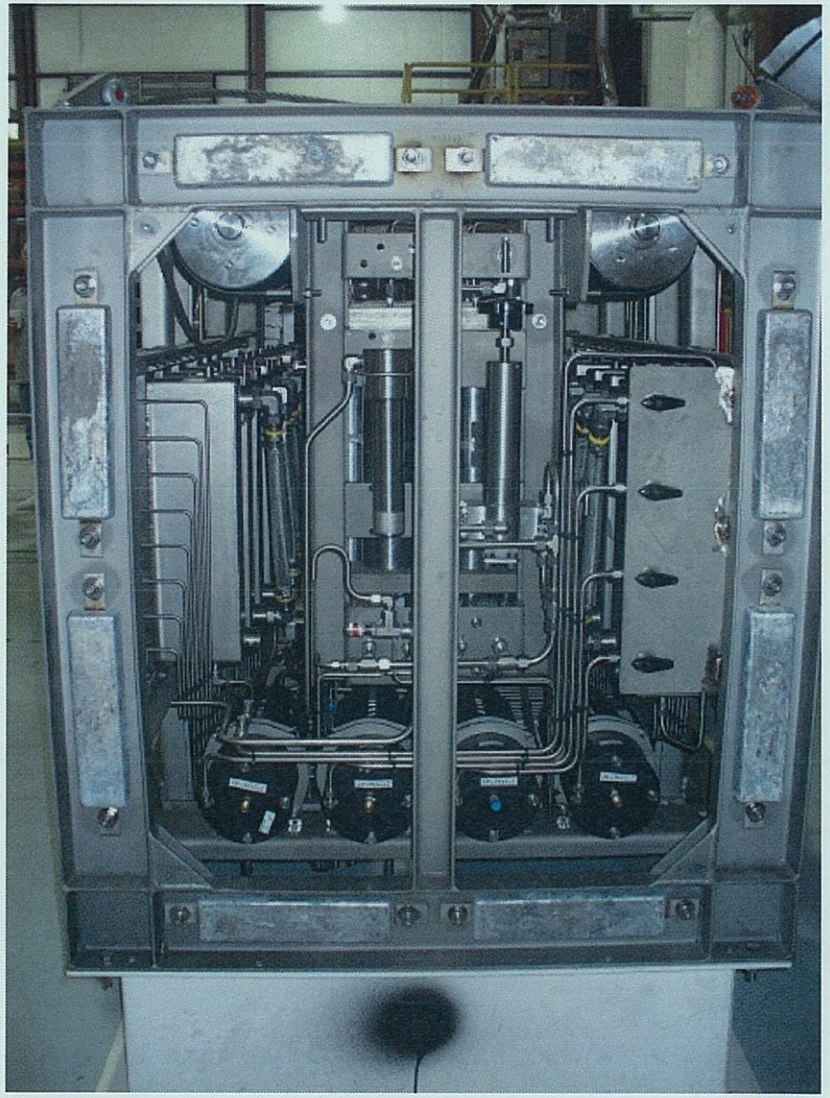
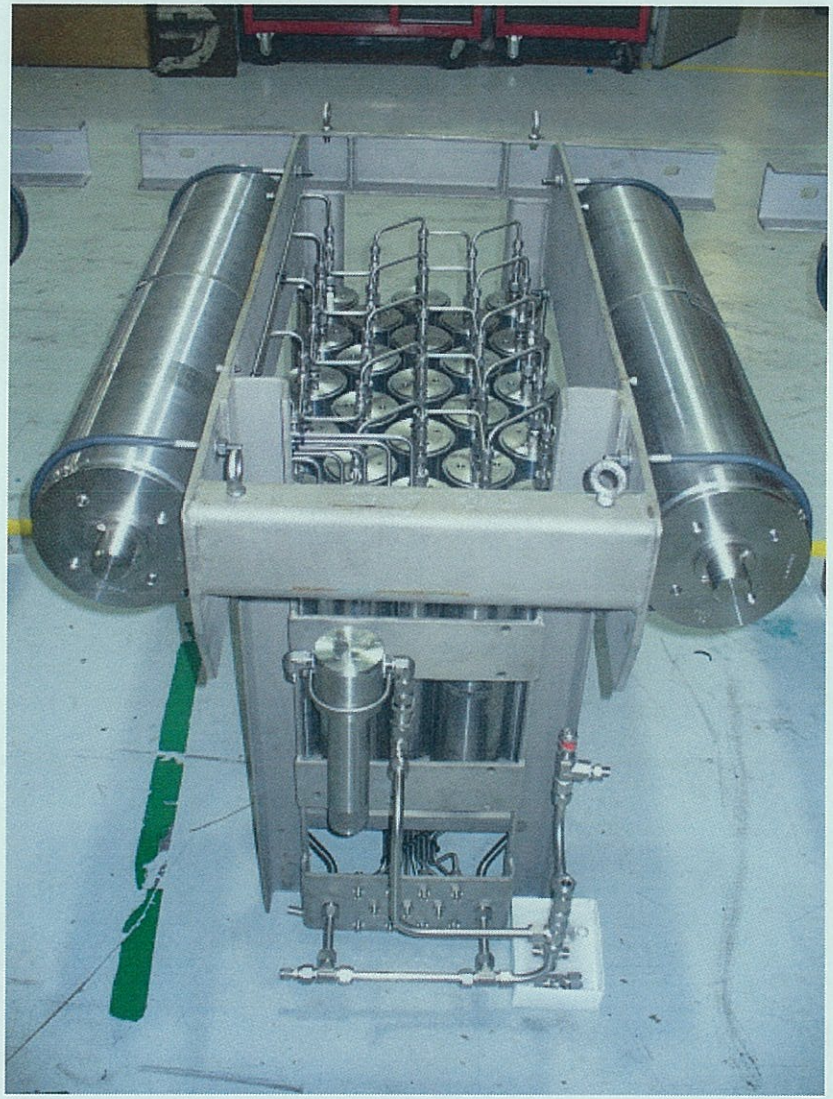
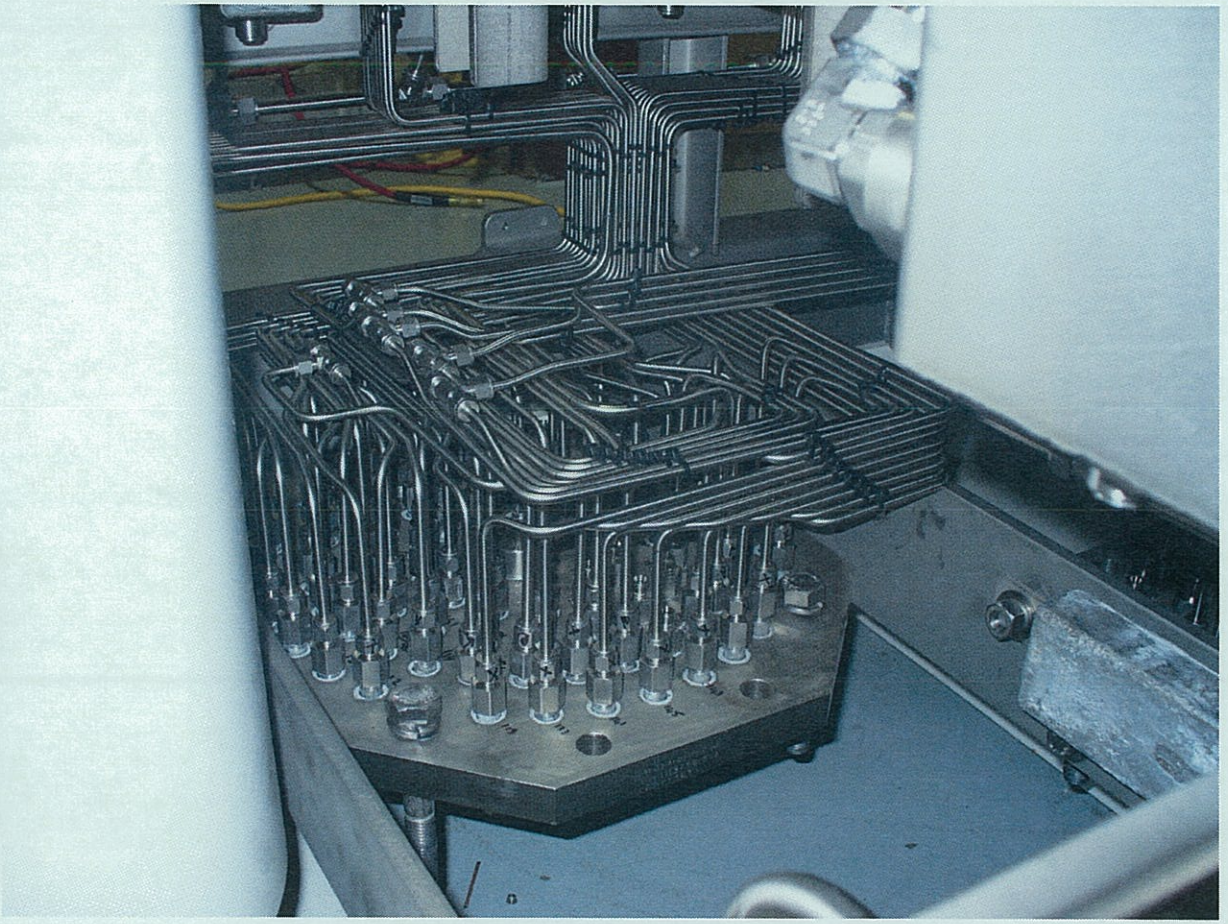




Mark III Model 120 Pilot Accumulator Rack



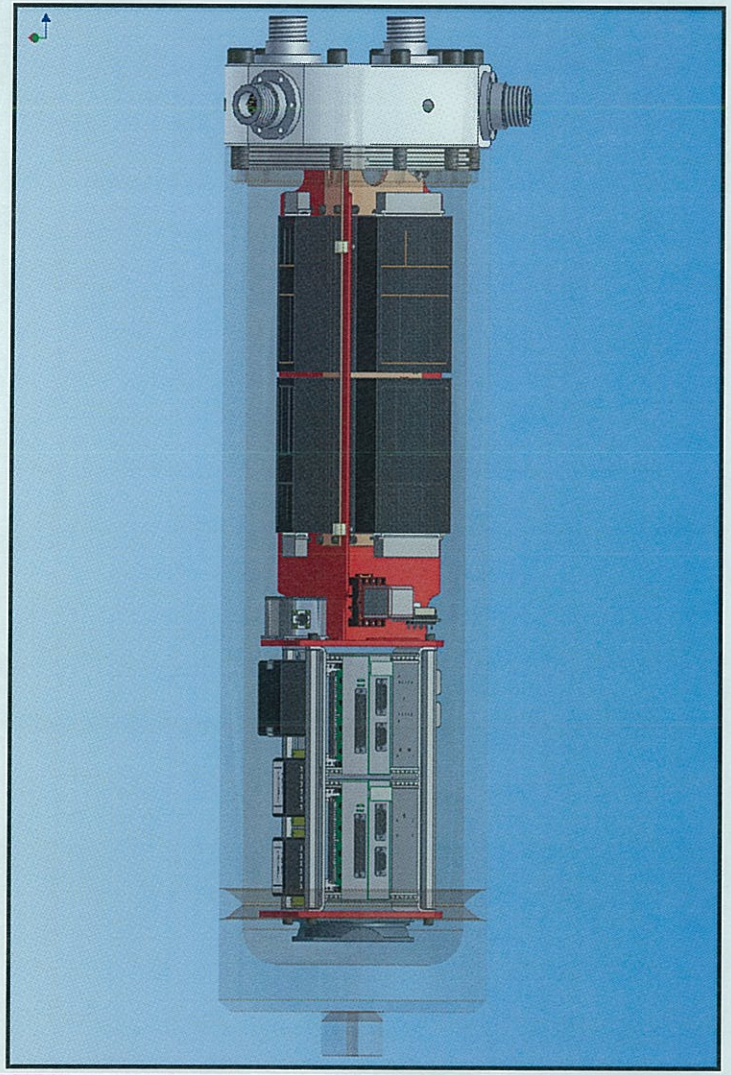
Mark III Model 120 Junction Plates

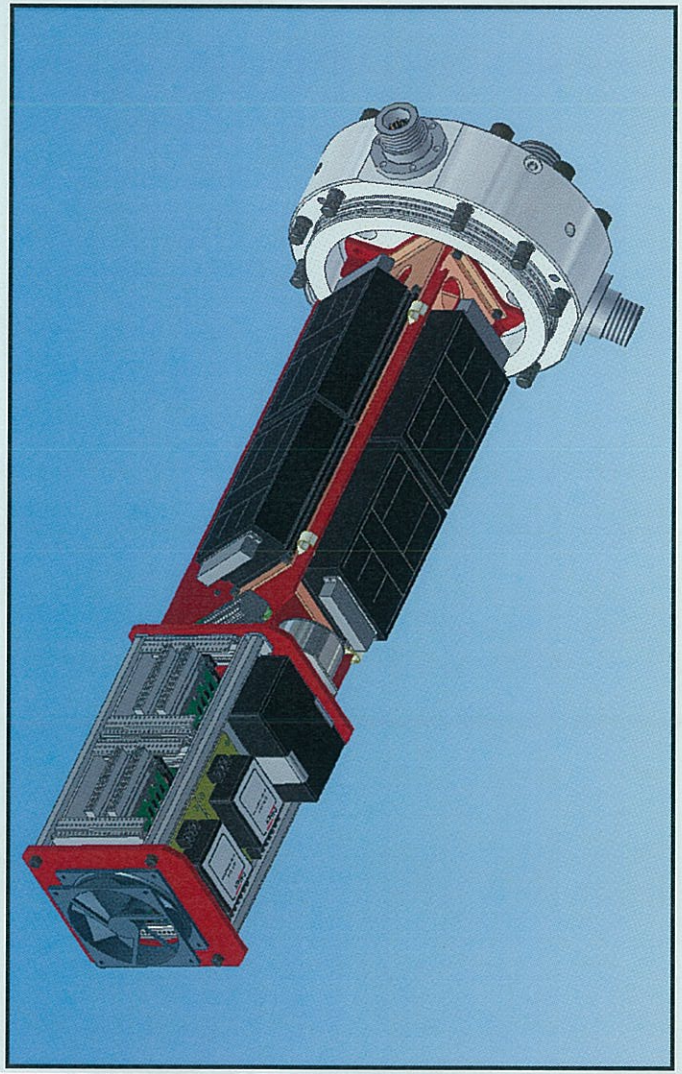


Mark III SEM Features

- **Major SEM Electronics, SEM Controller I\O Board, Solenoid Drivers & Pressure Transducers are derivatives of the field proven CamTrol technology and are Proprietary to Cameron**
- **Electronics packaged to increase efficiency of heat dissipation**
- **Solenoid driver modules removed from SEM**
- **Mark III SEM is smaller than Mark I & Mark II**
- **1 SEM for both the Model 80 or 120**
- **Pie connectors eliminated**

Mark III SEM (Subsea Electronics Module)





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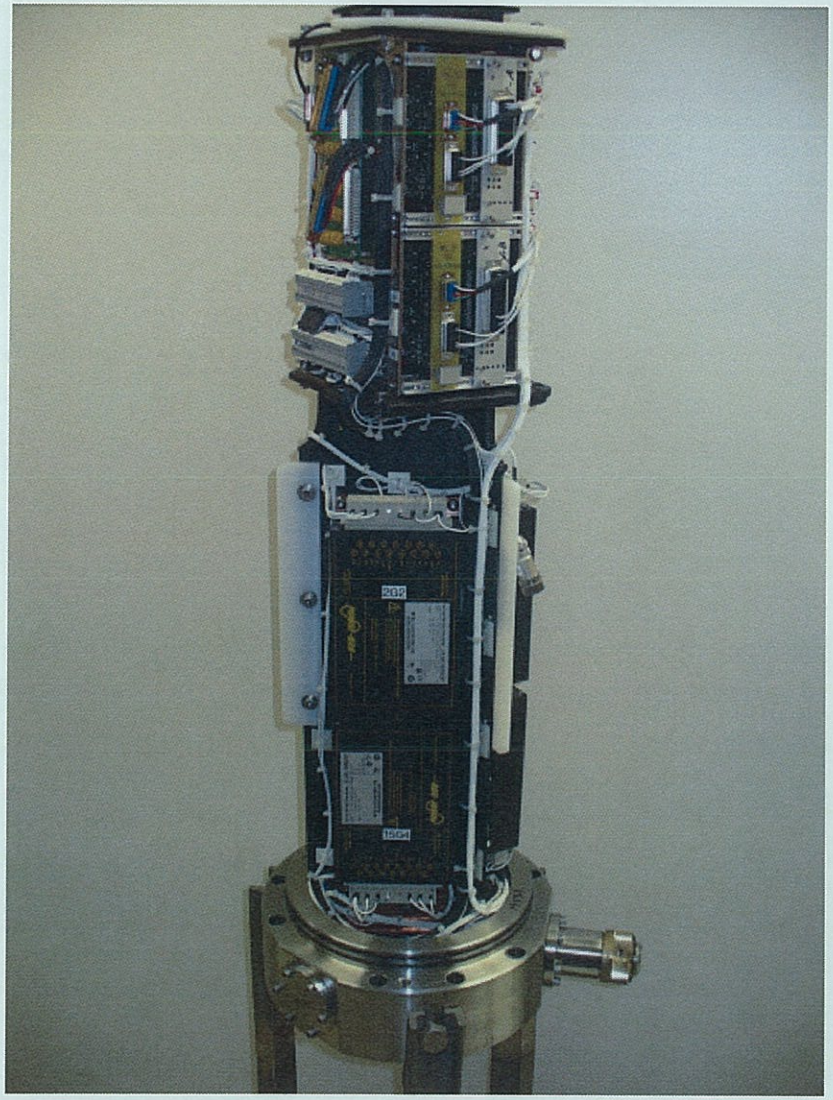
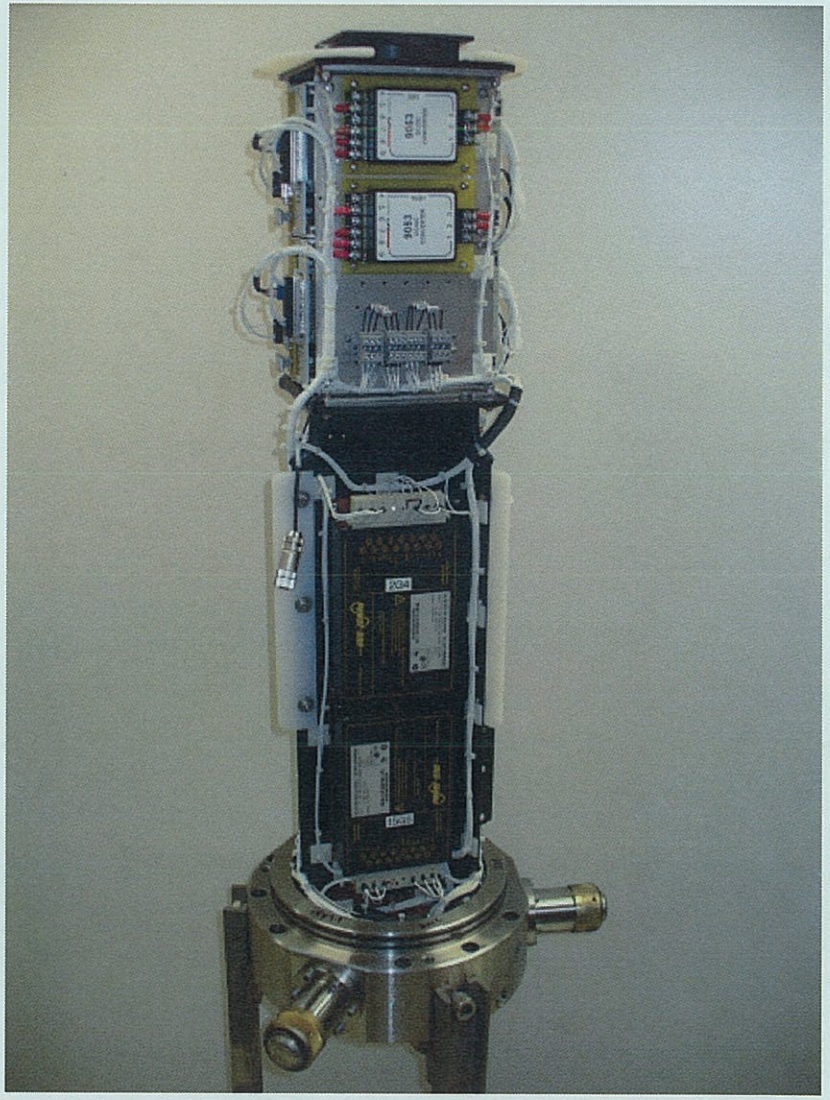
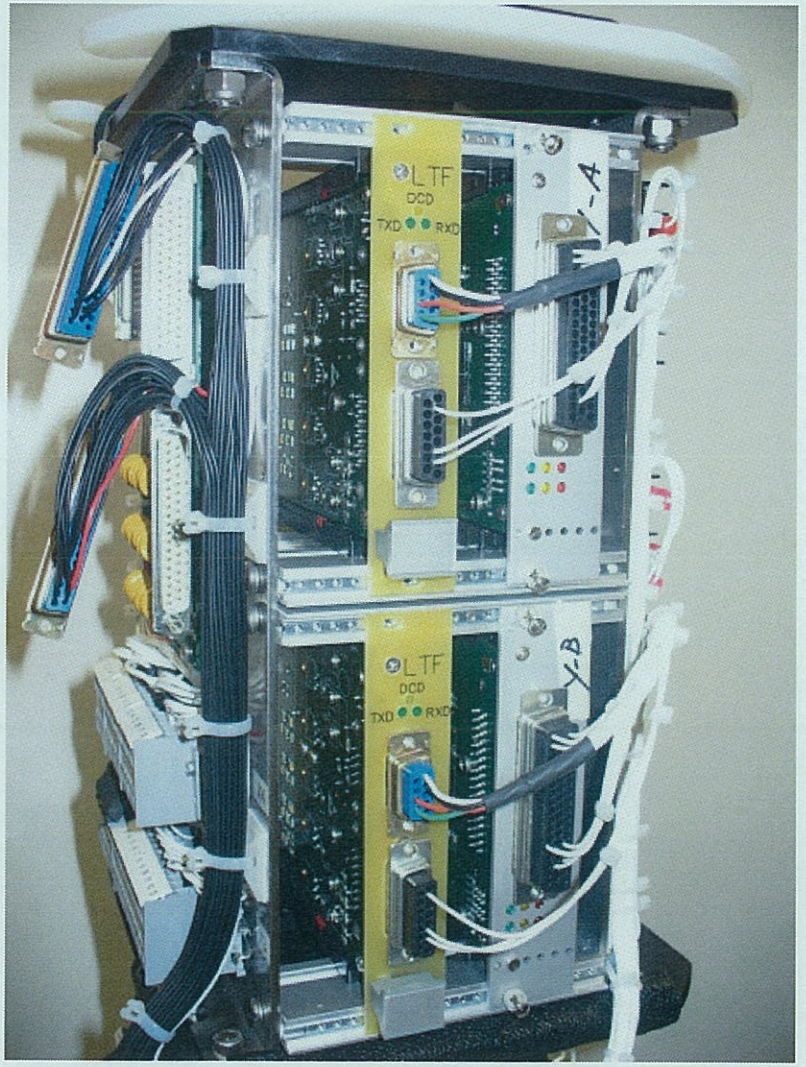




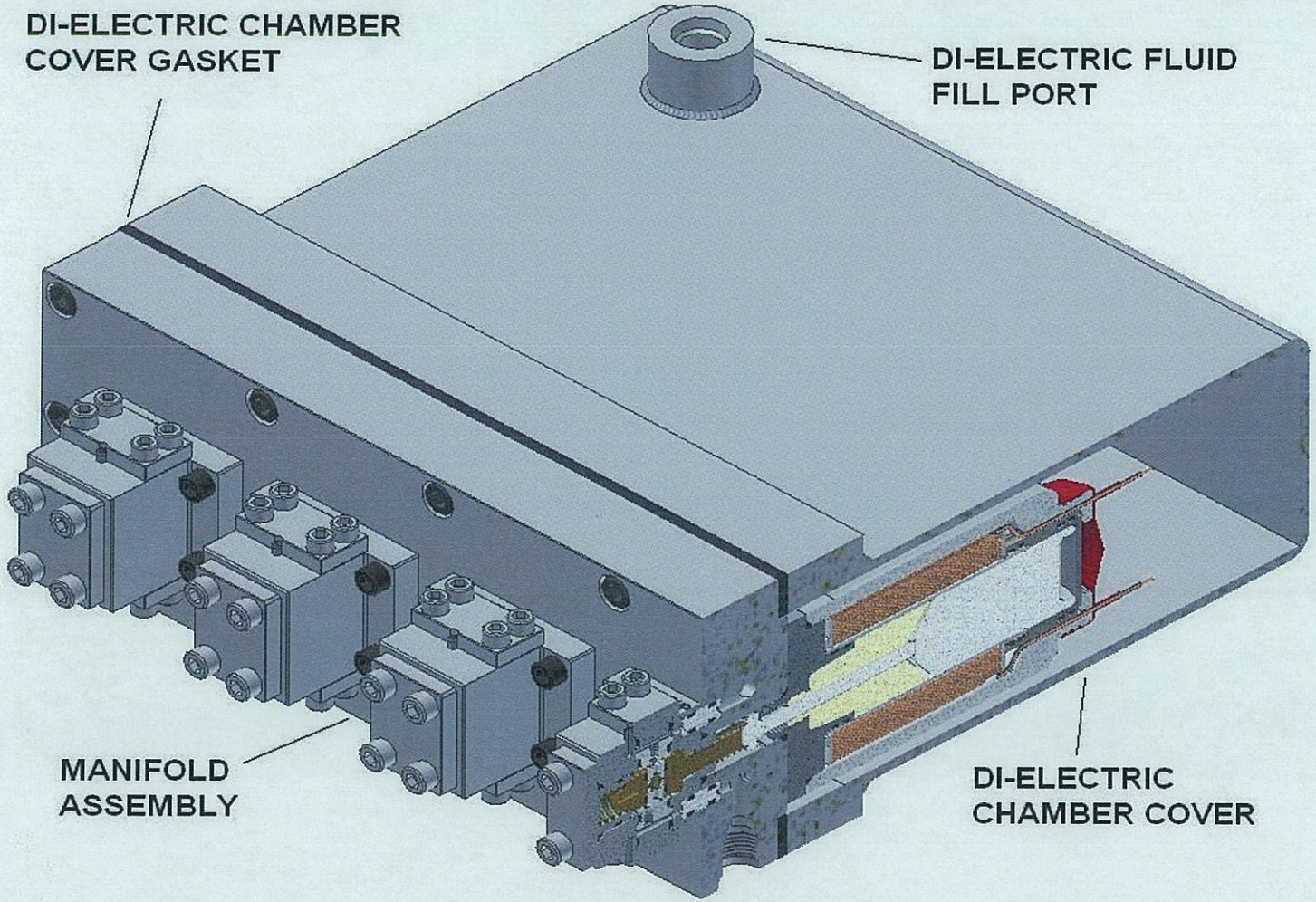
Mark III SEM (Subsea Electronics Module)



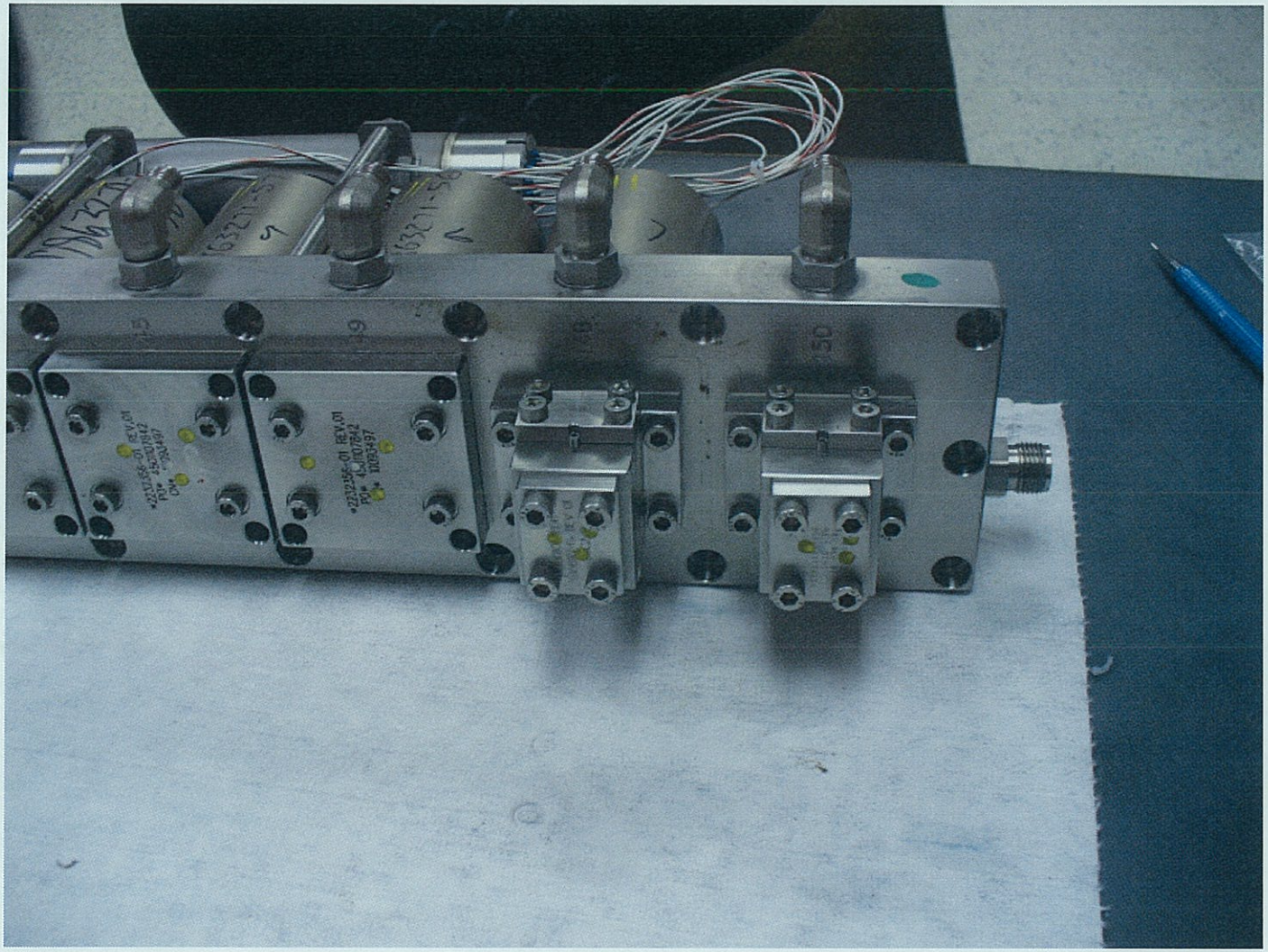
SVM (Solenoid Valve Module)

- **SDM (Solenoid Driver Module) included in each SVM**
- **Module is dielectrically compensated**
- **Wires between SDM and coils are booted**
- **PBOF hose for SVM interconnect**
- **CANBUS communication to SEM**

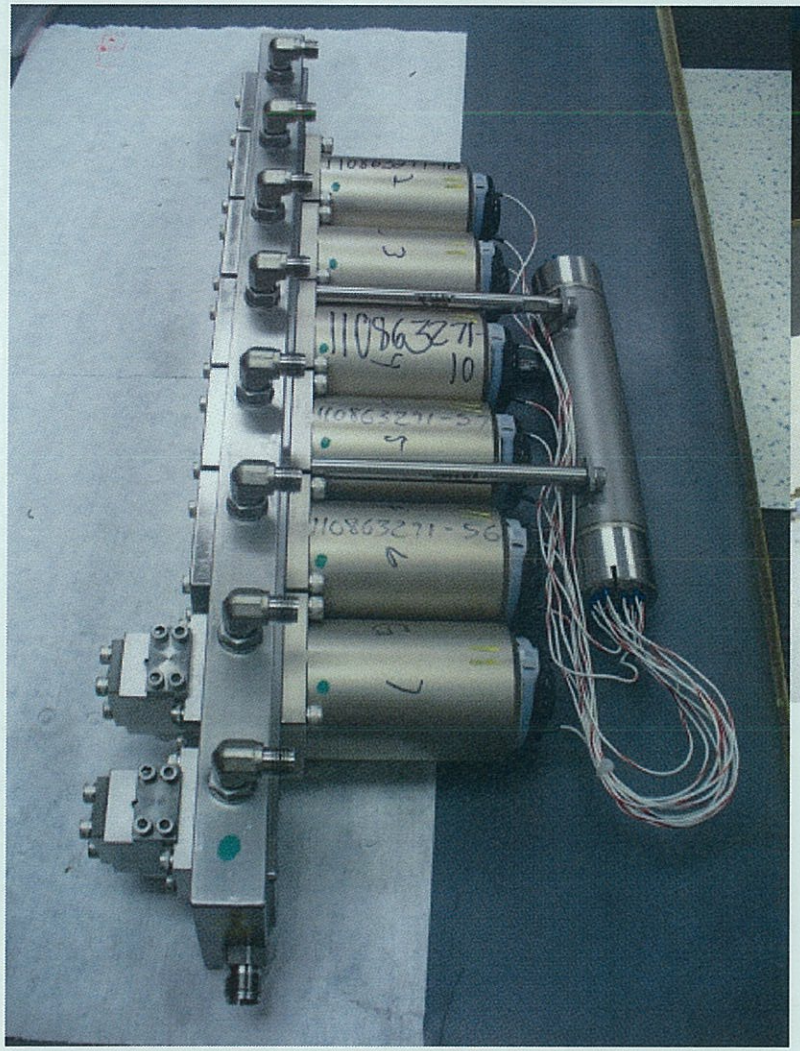
Solenoid Valve Module

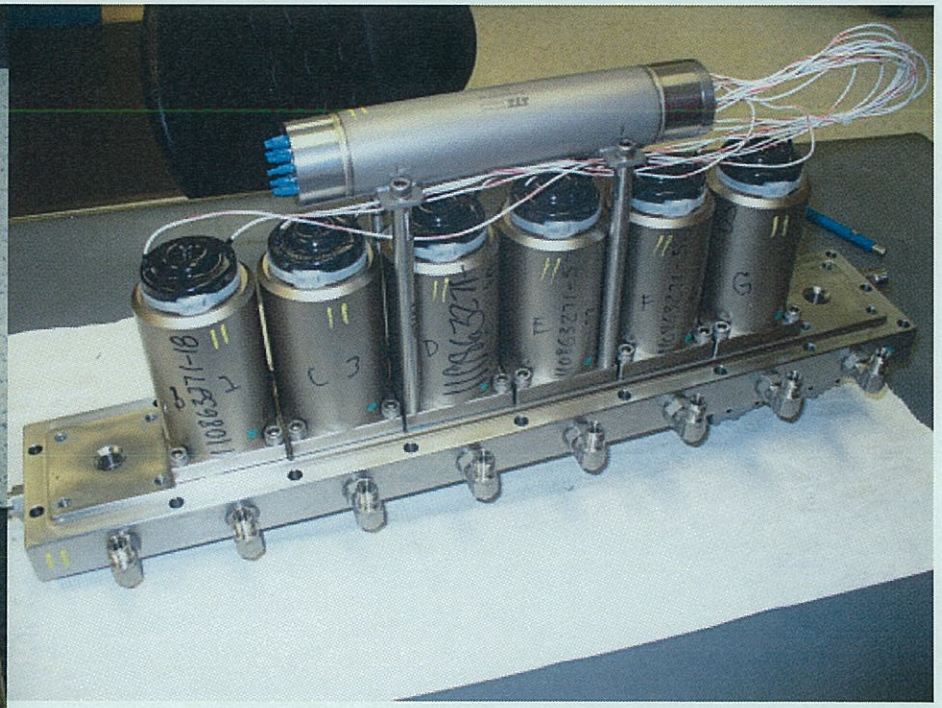


Solenoid Valve Module



Solenoid Valve Module

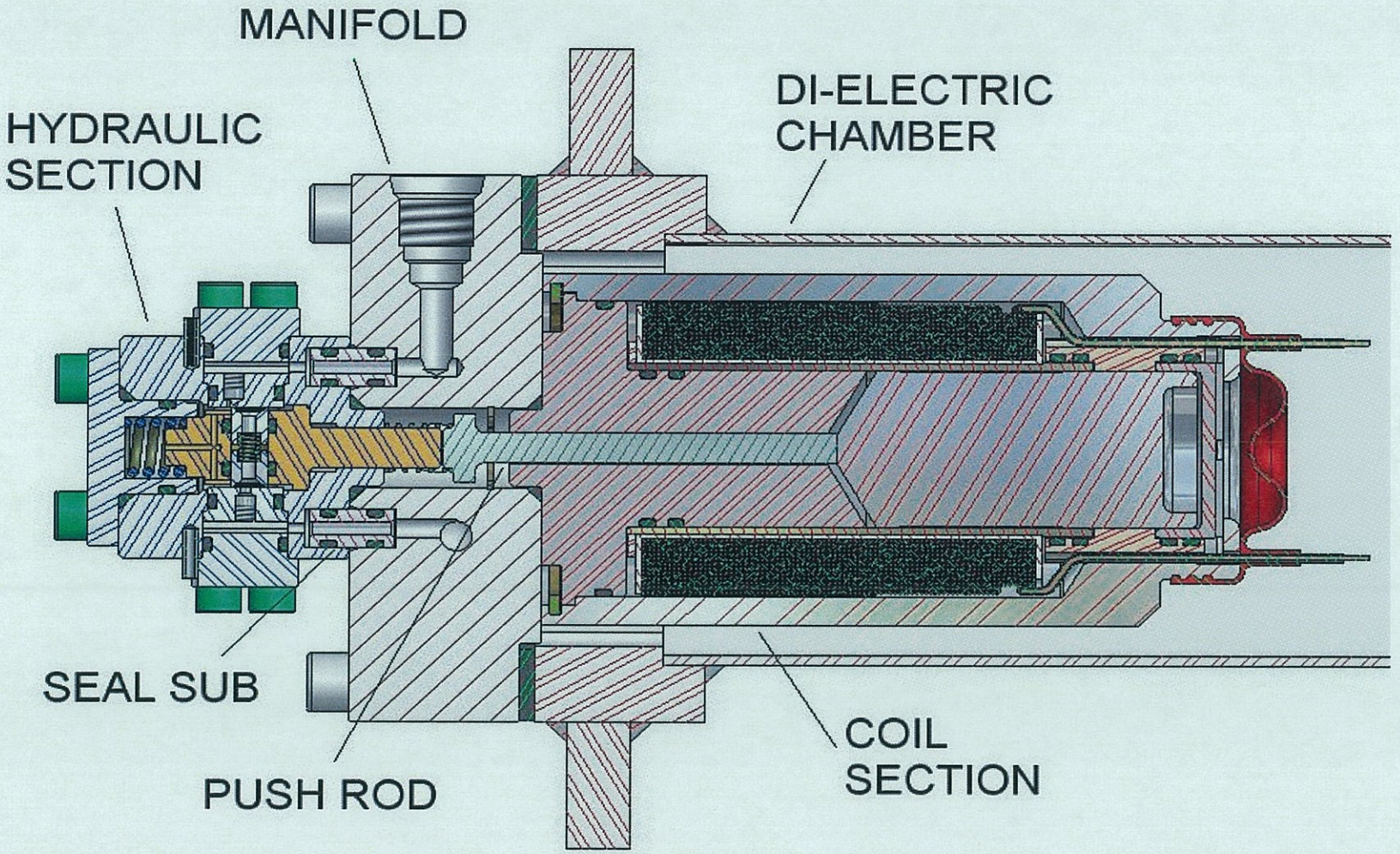




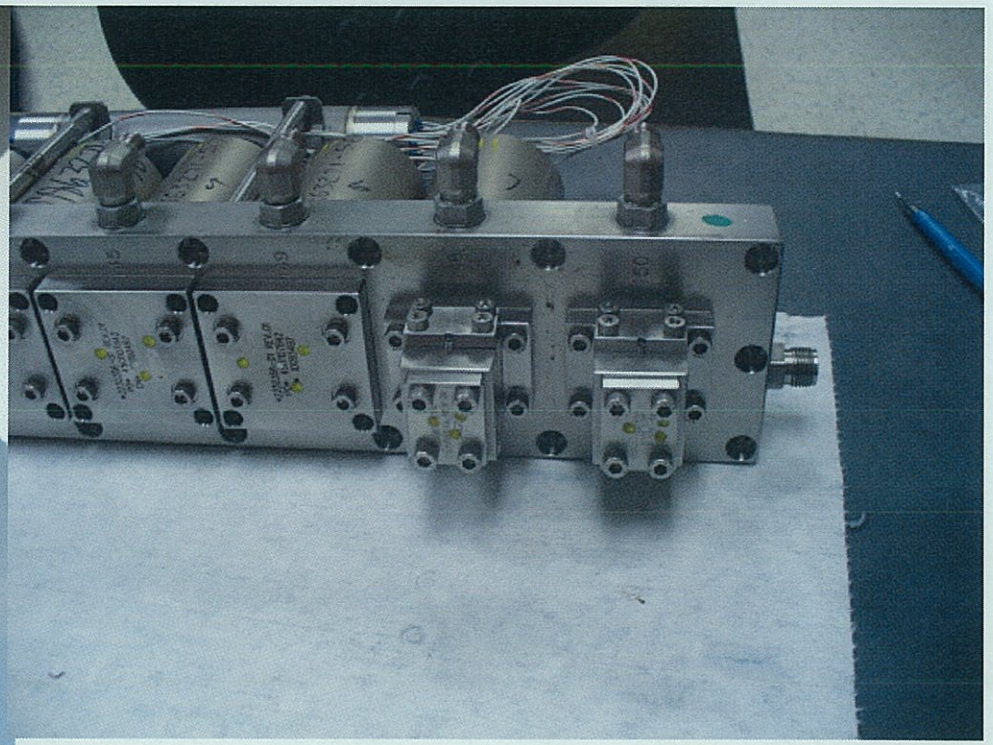
Solenoid Valve Features

- **Hydraulic section is divorce mounted**
- **Coil section is compensated with dielectric**
- **Single coil design with higher pull-in force**
- **Premium seal plates and seal ring materials**

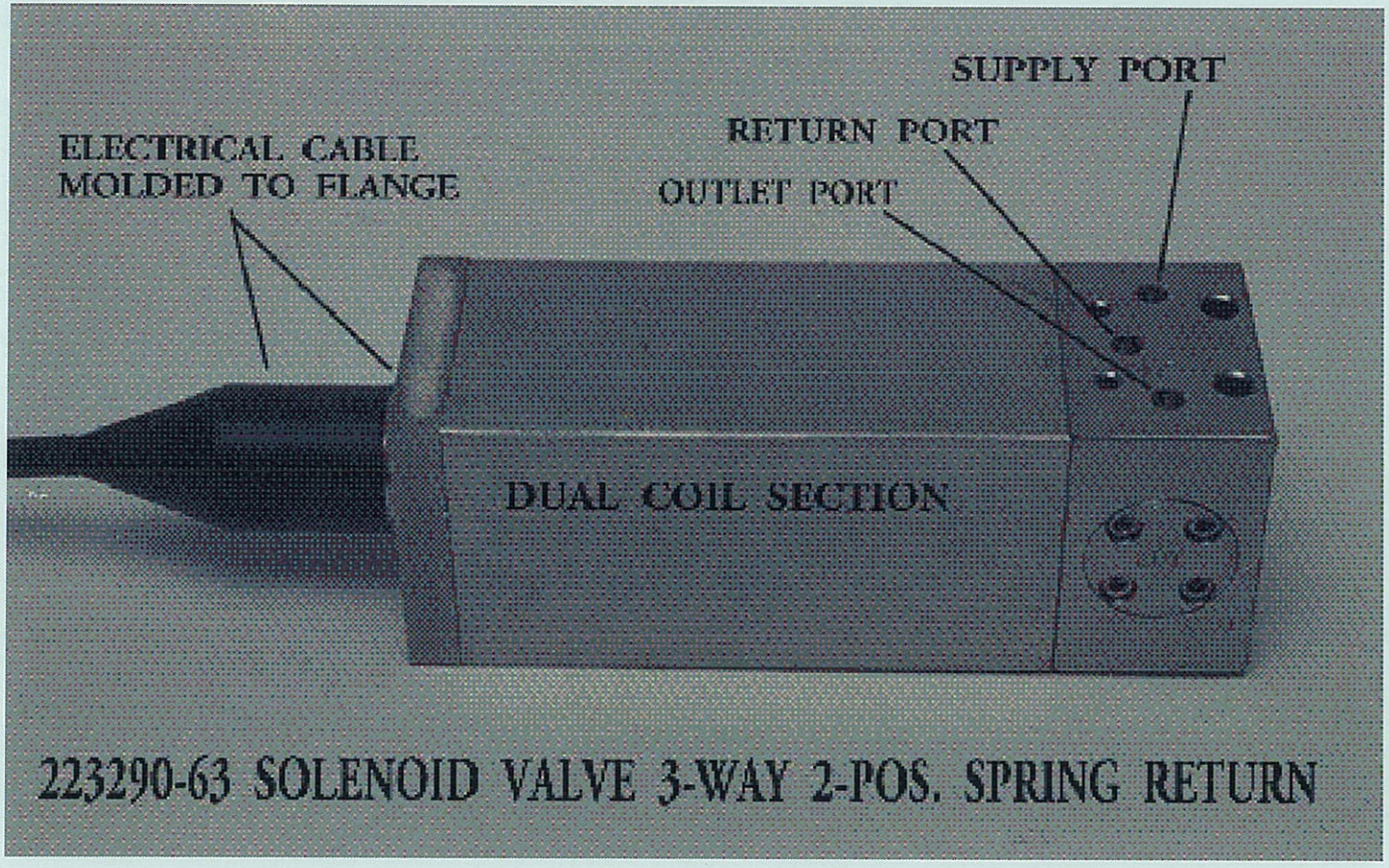
Solenoid Valve Assembly



Solenoid Valve Assembly

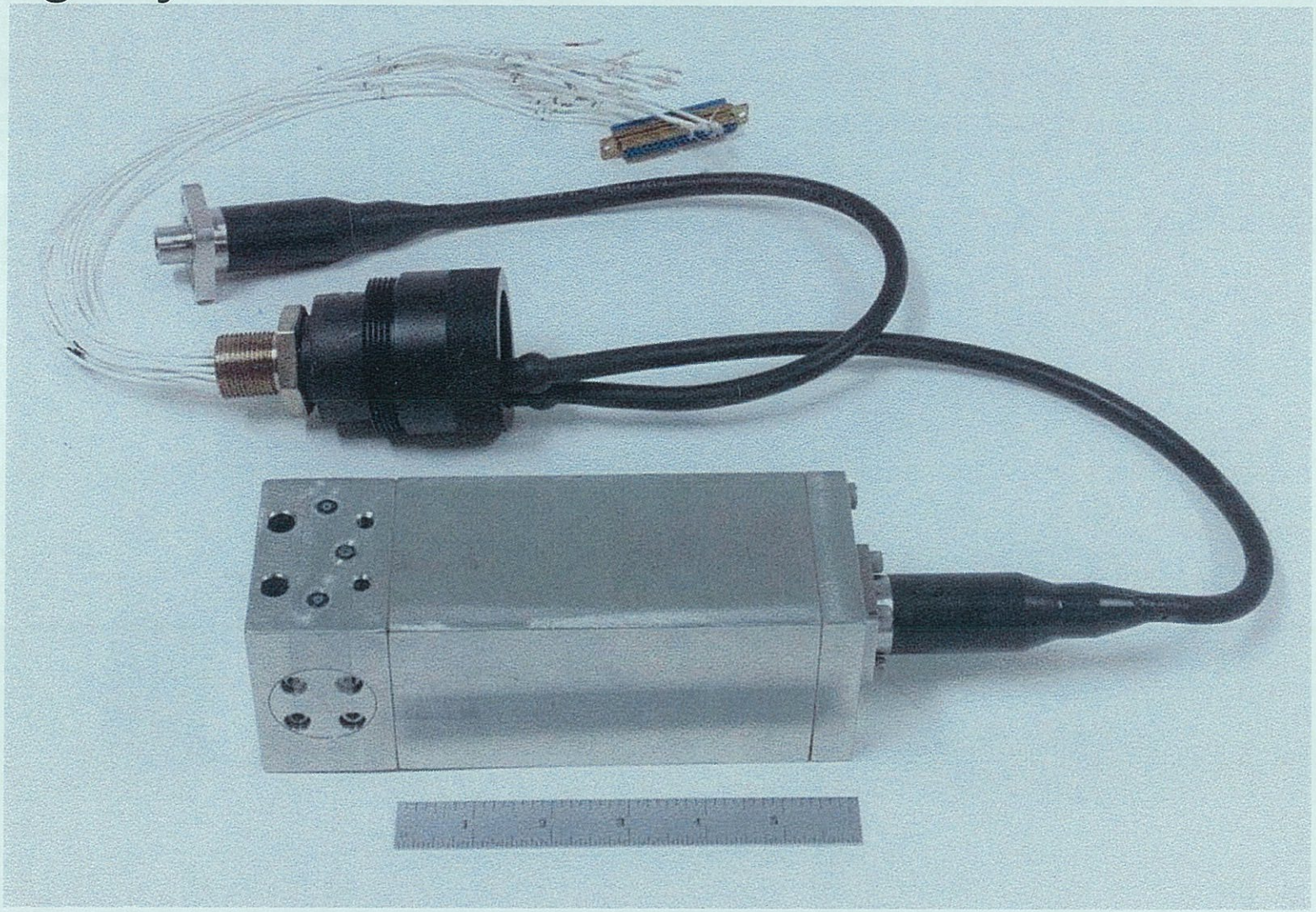


Legacy -63 Solenoid Valve



With the -63 you get 77 to 107 1 ATM Chambers per POD

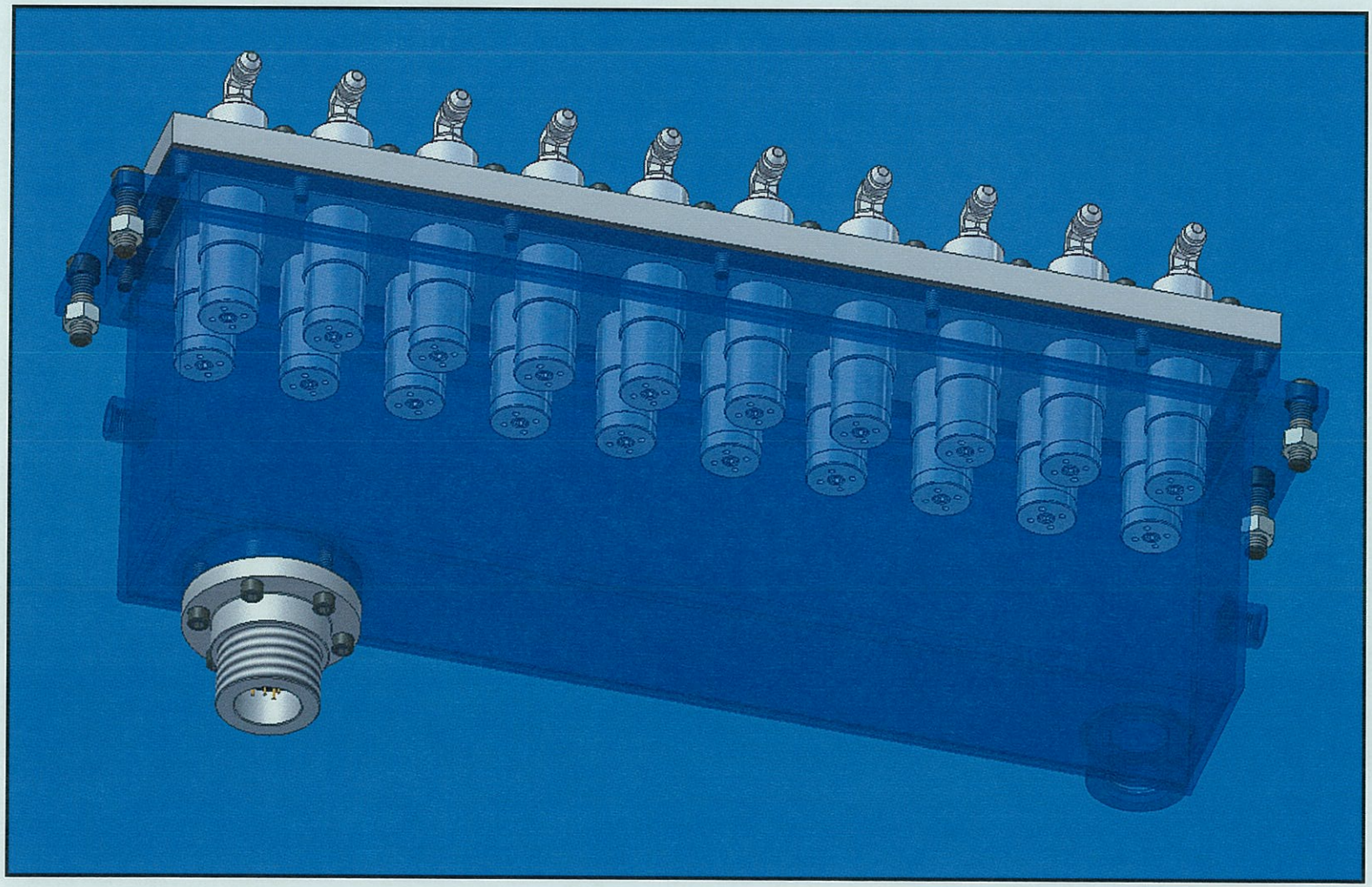
Legacy -63 Solenoid Valve & Pie Connector



PTM (Pressure Transducer Module)

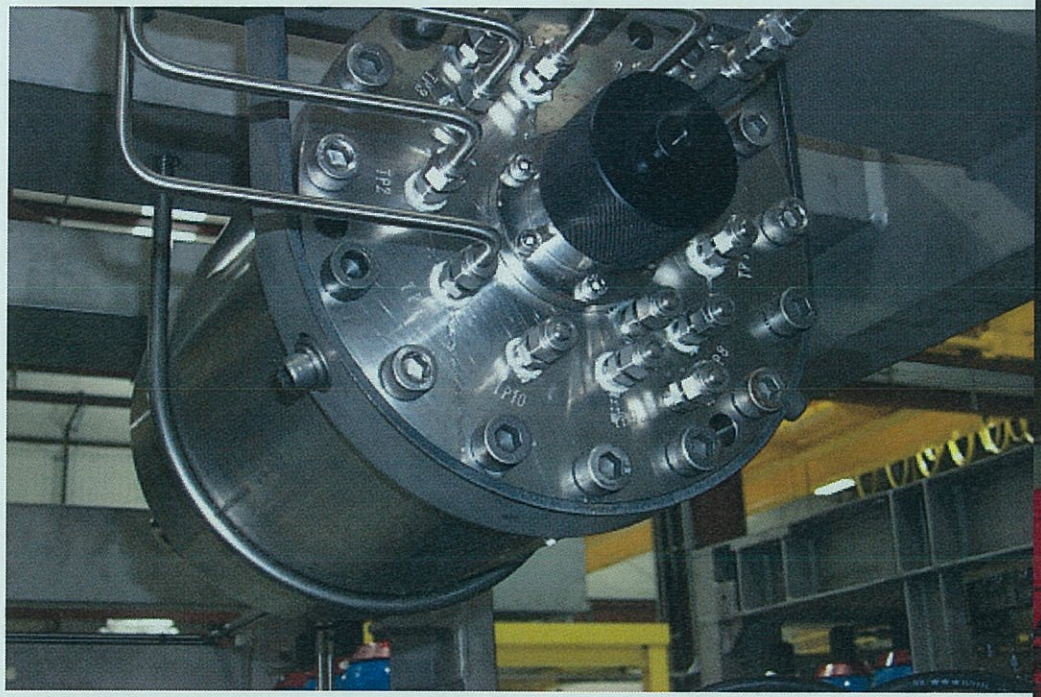
- **Compensated Dielectric chamber**
- **External mounting**
- **Wires between Transducers are booted**
- **CANBUS communication to SEM**
- **Eliminates 1 ATM chambers**

Pressure Transducer Module



Pressure Transducer Module

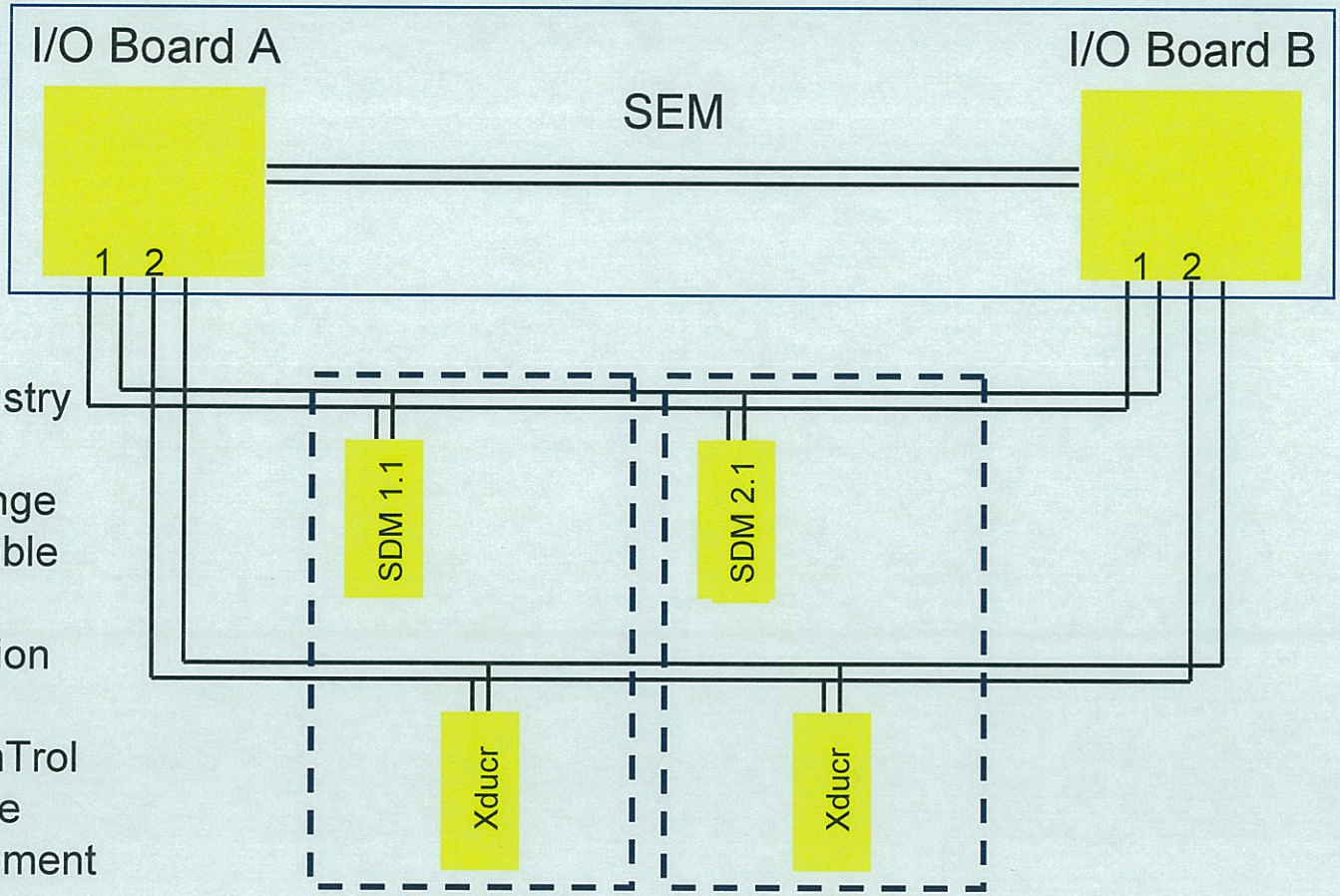
Legacy Pressure Transducer Module



MUX System Architecture

Why CAN?

- used in the auto industry
- fault tolerant
- wide temperature range
- compact chips available
- cost effective
- low power consumption
- industry standard
- used in the new CamTrol SEM, as well as in the Electric Tree development

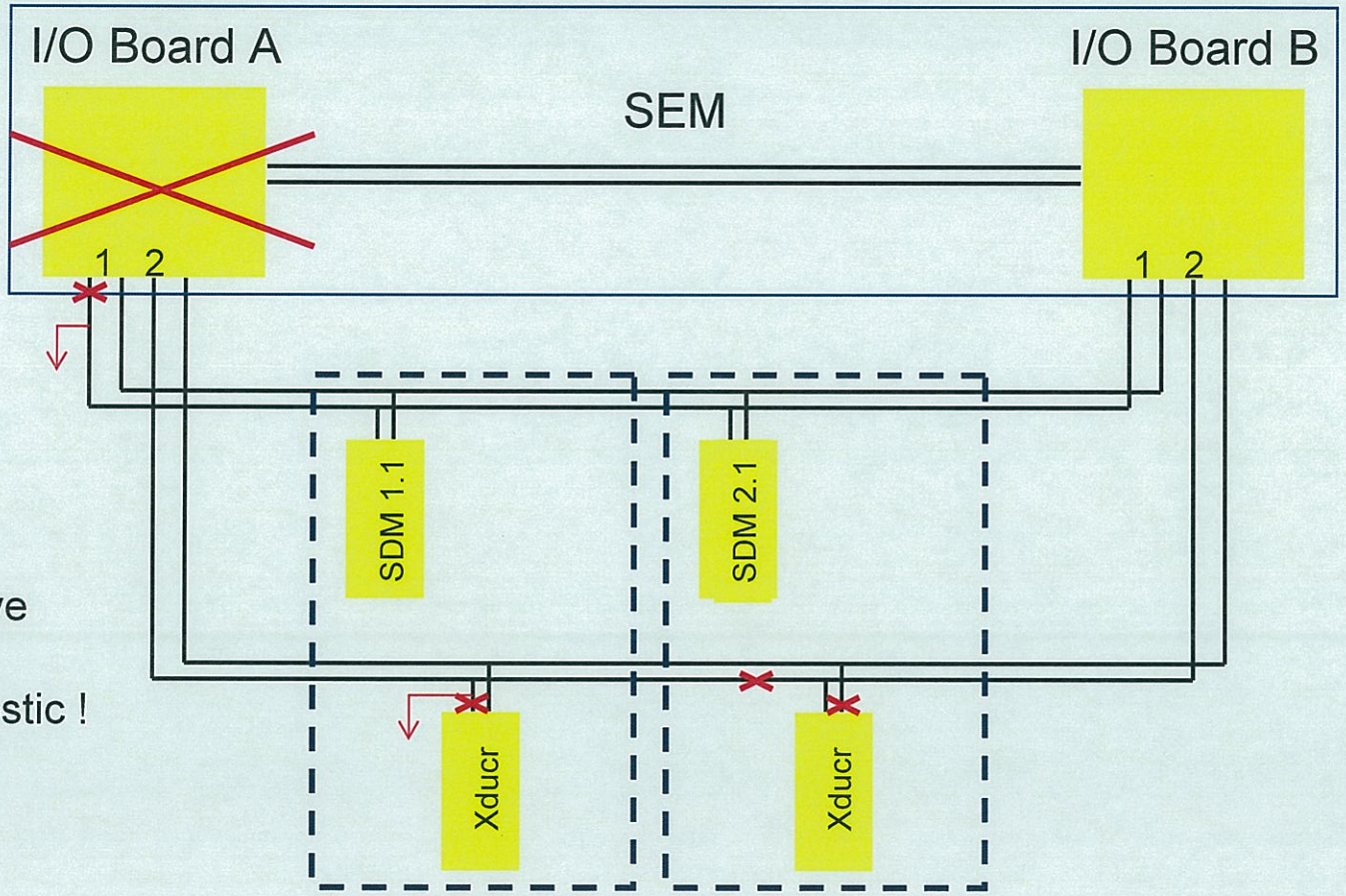


MUX System Architecture

Fault Tolerant against:

Wire breaks
Connector problems
Seawater ingress
Electronic faults
Combinations of above

Detectable via diagnostic !



the Industry Leader in MUX Control Systems