# MECHANICAL SYSTEMS

WBS 1.1 – Bubble Chamber

WBS 1.2 – High Purity Fluid Handling

WBS 1.7 – Commissioning (as related to mechanical systems)

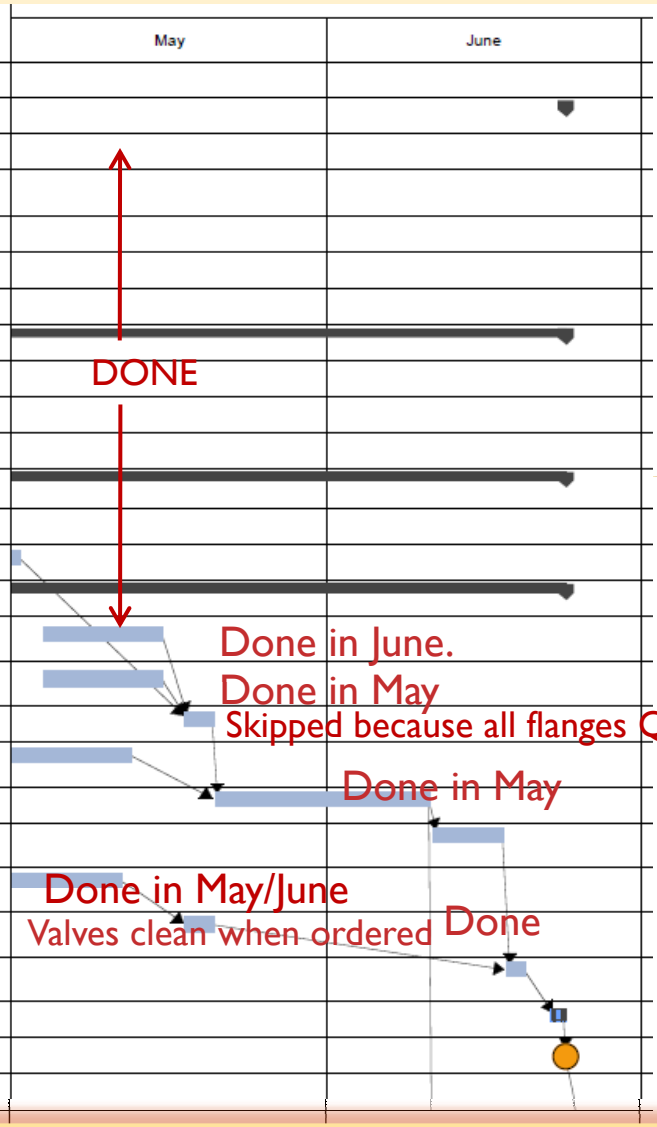
SAFETY READINESS

# Outline

- I will go over the Status as overlaid on the Schedule that was presented in May 2009 review.
- I will then go into more detail
  - WBS 1.1 Bubble Chamber
  - WBS 1.2 High Purity Fluid Handling
  - Safety Readiness for NUMI
- My goal is to leave you with an understanding of what's left to do before NUMI commissioning run.
- I will identify for you what technical issues/challenges are embedded in that work.
- I will also try to estimate the resources necessary to complete the remaining mechanical tasks.

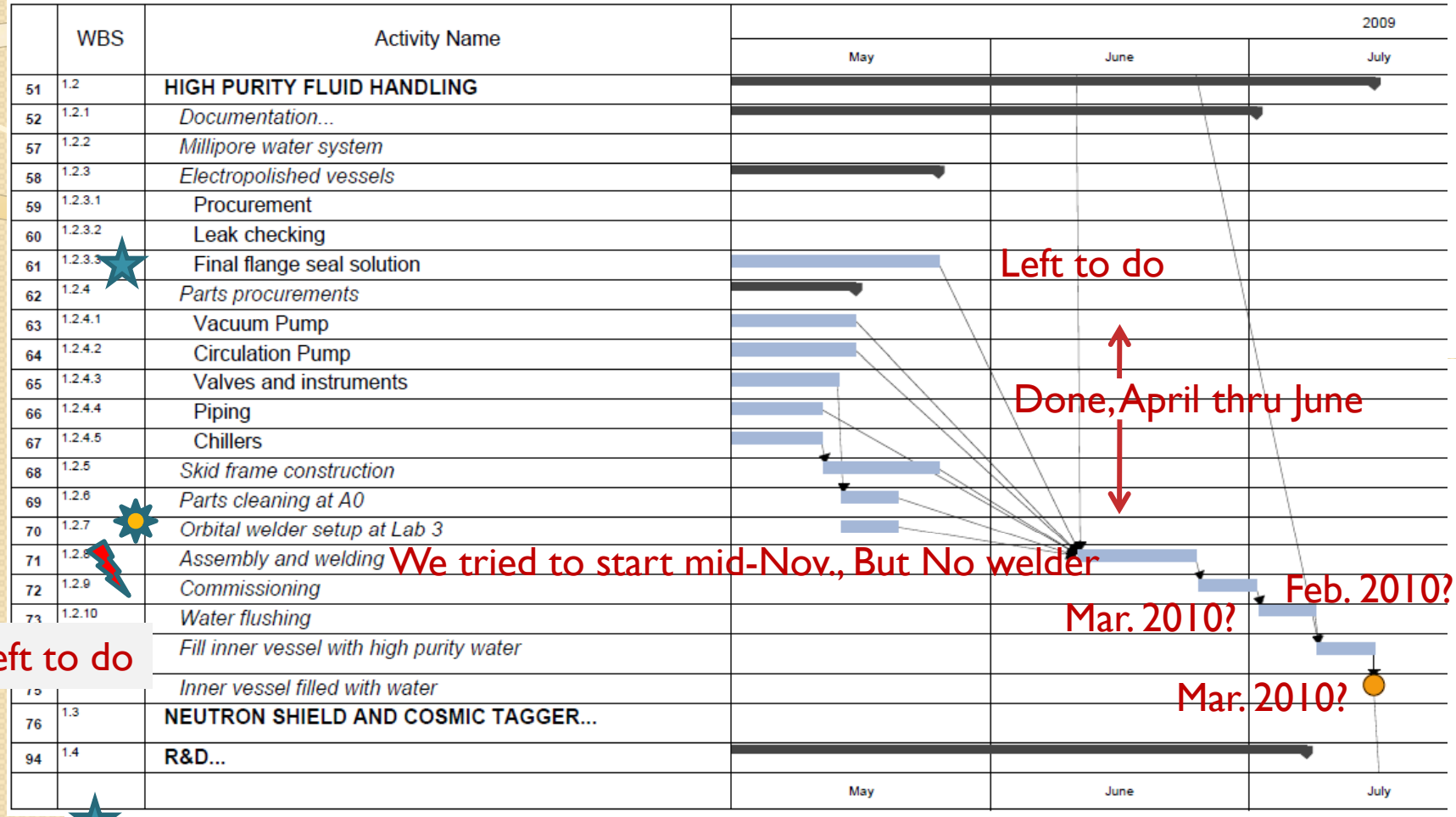
# Status as overlaid on schedule

| | WBS | Activity Name |
|---|---|---|
| 1 | 1 | **COUPP-60 KG** |
| 2 | 1.1 | **BUBBLE CHAMBER** |
| 3 | 1.1.1 | *Pressure vessel...* |
| 11 | 1.1.2 | *Quartz to metal seal development...* |
| 14 | 1.1.3 | *Control system...* |
| 22 | 1.1.4 | *Hydraulics and piping...* |
| 27 | 1.1.5 | *Quartz vessel...* |
| 31 | 1.1.6 | *Expansion chamber* |
| 32 | 1.1.6.1 | Specifications |
| 33 | 1.1.6.2 | Design |
| 34 | 1.1.6.3 | Prototype |
| 35 | 1.1.6.4 | High Purity Chamber |
| 36 | 1.1.6.4.1 | *Parts preparation* |
| 37 | 1.1.6.4.2 | *welding and leak check* |
| 38 | 1.1.6.4.3 | *Assembly* |
| 39 | 1.1.6.4.3.1 | Make fixture to hold jar during assembly |
| 40 | 1.1.6.4.3.2 | Make restraint for bellows under vacuum and cleaning |
| 41 | 1.1.6.4.3.3 | Test assembly to prototype quartz |
| 42 | 1.1.6.4.3.4 | Packaging for shipment to Astropak |
| 43 | 1.1.6.4.3.5 | Cleaning at Astropak |
| 44 | 1.1.6.4.3.6 | Assemble Quartz to expansion chamber |
| 45 | 1.1.6.4.3.7 | Procure valves and instruments for HP inner vessel |
| 46 | 1.1.6.4.3.8 | Clean valves and instruments at A0 |
| 47 | 1.1.6.4.3.9 | Assemble valves and instruments onto chamber |
| 48 | 1.1.6.4.3.10 | Leak check vessel assembly |
| 49 | 1.1.6.4.3.11 | Inner Vessel Assembly Complete |
| 50 | 1.1.7 | *System Level Documentation* |




Left to do, expected to be easy, < 1 week, Ruschman & Rucinski

# Status as overlaid on schedule




| | WBS | Activity Name |
|---|---|---|
| 51 | 1.2 | **HIGH PURITY FLUID HANDLING** |
| 52 | 1.2.1 | *Documentation...* |
| 57 | 1.2.2 | *Millipore water system* |
| 58 | 1.2.3 | *Electropolished vessels* |
| 59 | 1.2.3.1 | Procurement |
| 60 | 1.2.3.2 | Leak checking |
| 61 | 1.2.3.3 | Final flange seal solution |
| 62 | 1.2.4 | *Parts procurements* |
| 63 | 1.2.4.1 | Vacuum Pump |
| 64 | 1.2.4.2 | Circulation Pump |
| 65 | 1.2.4.3 | Valves and instruments |
| 66 | 1.2.4.4 | Piping |
| 67 | 1.2.4.5 | Chillers |
| 68 | 1.2.5 | *Skid frame construction* |
| 69 | 1.2.6 | *Parts cleaning at A0* |
| 70 | 1.2.7 | *Orbital welder setup at Lab 3* |
| 71 | 1.2.8 | *Assembly and welding* |
| 72 | 1.2.9 | *Commissioning* |
| 73 | 1.2.10 | *Water flushing* |
| | | *Fill inner vessel with high purity water* |
| | | *Inner vessel filled with water* |
| 76 | 1.3 | **NEUTRON SHIELD AND COSMIC TAGGER...** |
| 94 | 1.4 | **R&D...** |

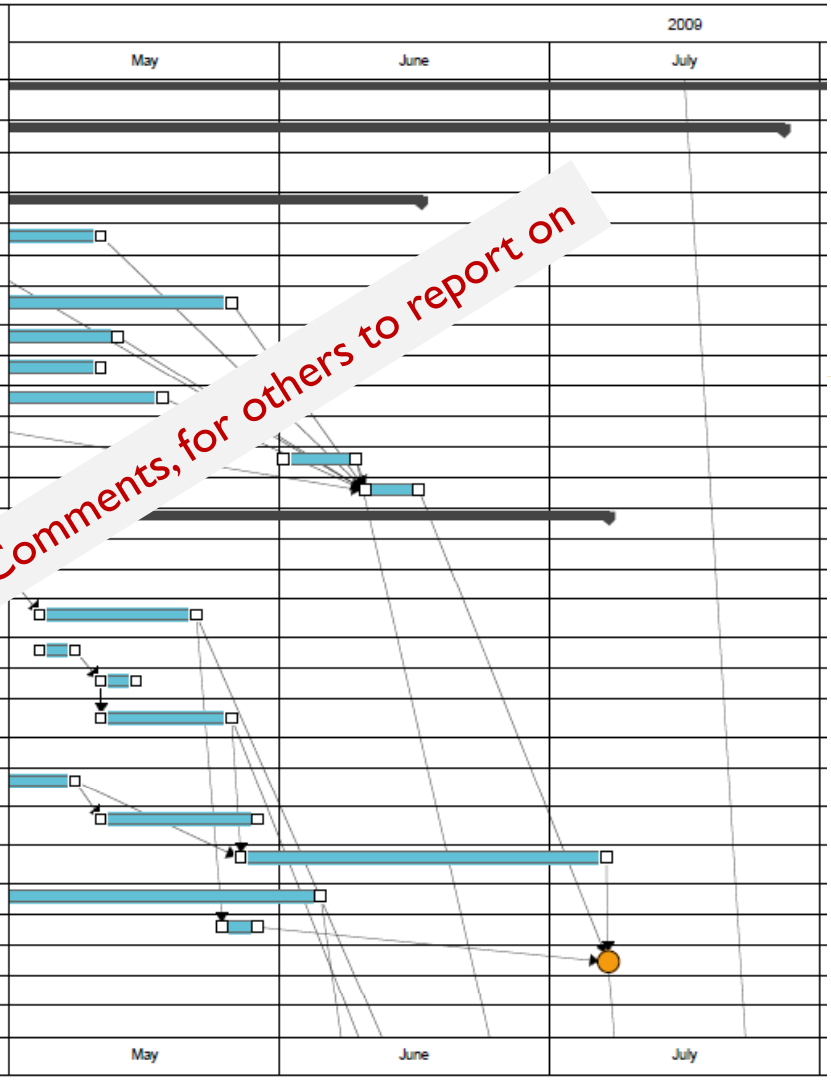
Still need to do this, 1 day + procurement time.

¼" tube formula done, ground work done, NEED WELDER TIME.

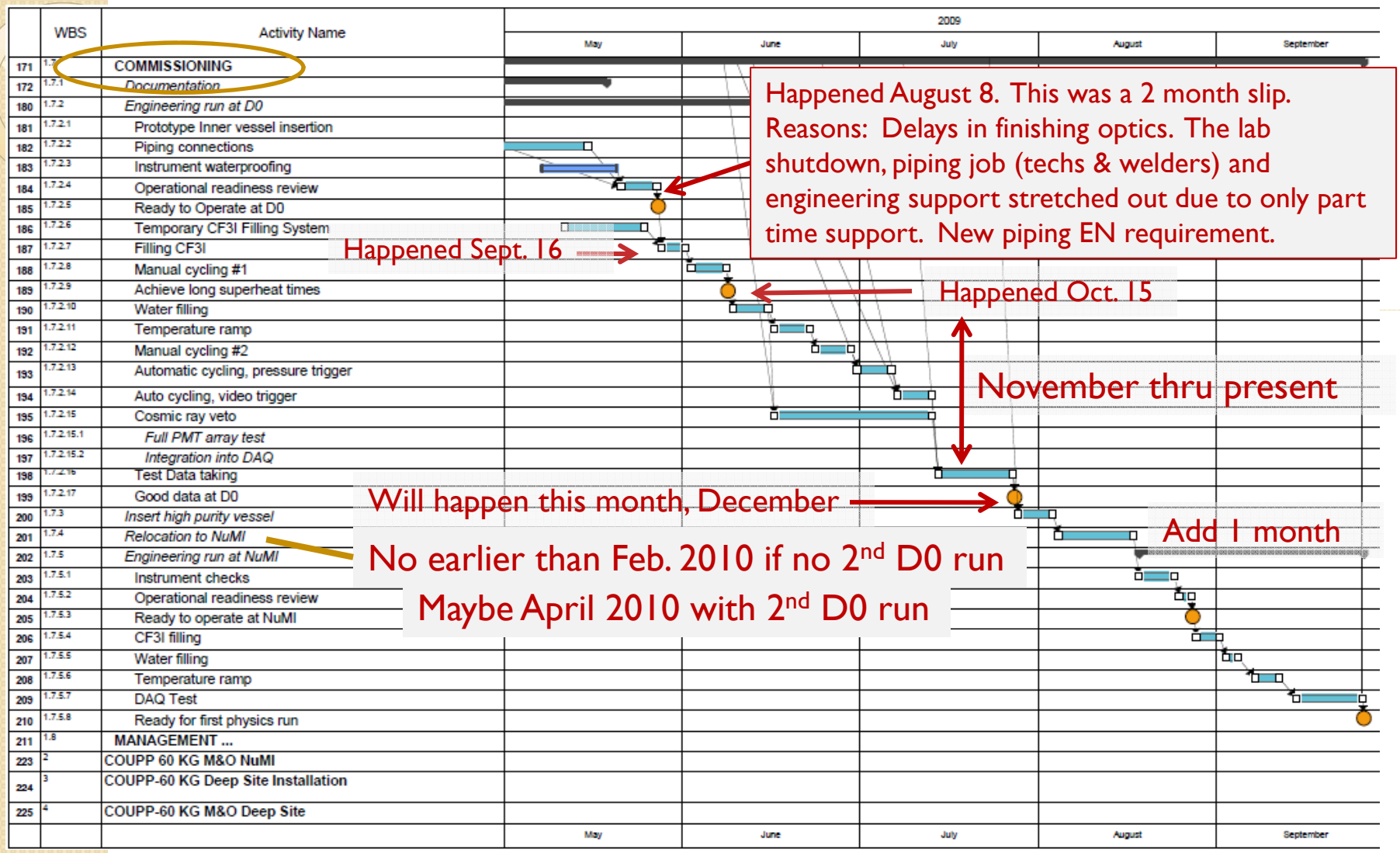
Delayed due to PID and layout delays (RAR), Estimate 3 weeks, If we have WELDER

# Status as overlaid on schedule

| | WBS | Activity Name |
|---|---|---|
| 105 | 1.5 | **DATA ACQUISITION AND HANDLING** |
| 106 | 1.5.1 | *Documentation...* |
| 111 | 1.5.2 | *VIDEO AND ILLUMINATION HARDWARE...* |
| 126 | 1.5.3 | *DAQ Hardware* |
| 127 | 1.5.3.1 | Trigger Box (CTIC) |
| 128 | 1.5.3.2 | PXI Crate and NI interface |
| 129 | 1.5.3.3 | Fast digitizers for acoustic sensors and breakouts |
| 130 | 1.5.3.4 | Slow digitizer |
| 131 | 1.5.3.5 | Signal conditioning box |
| 132 | 1.5.3.6 | CTIC interface board |
| 133 | 1.5.3.7 | COUPP30L |
| 134 | 1.5.3.8 | Private camera network |
| 135 | 1.5.3.9 | Integration |
| 136 | 1.5.4 | *DAQ Software* |
| 137 | 1.5.4.1 | Camera test software |
| 138 | 1.5.4.2 | Develop on-camera code |
| 139 | 1.5.4.3 | Test on-camera code with trigger board and ca |
| 140 | 1.5.4.4 | OPC server |
| 141 | 1.5.4.5 | Interface to PLC |
| 142 | 1.5.4.6 | Labview program for monitor and control |
| 143 | 1.5.4.7 | Install working Linux NI platform |
| 144 | 1.5.4.8 | Hardware configuration of Linux Labview system |
| 145 | 1.5.4.9 | Interface camera software to NI platform (Plan B) |
| 146 | 1.5.4.10 | Labview program for event handling |
| 147 | 1.5.4.11 | Smart PMT base Labview code |
| 148 | 1.5.5 | *DAQ system bench test* |
| 149 | 1.5.6 | *Full DAQ System at D0* |
| 150 | 1.5.7 | *Data Archiving* |
| 151 | 1.6 | **SITE INFRASTRUCTURE...** |



# Status as overlaid on schedule




| | WBS | Activity Name |
|---|---|---|
| 171 | 1.7 | COMMISSIONING |
| 172 | 1.7.1 | *Documentation* |
| 180 | 1.7.2 | *Engineering run at D0* |
| 181 | 1.7.2.1 | Prototype Inner vessel insertion |
| 182 | 1.7.2.2 | Piping connections |
| 183 | 1.7.2.3 | Instrument waterproofing |
| 184 | 1.7.2.4 | Operational readiness review |
| 185 | 1.7.2.5 | Ready to Operate at D0 |
| 186 | 1.7.2.6 | Temporary CF3I Filling System |
| 187 | 1.7.2.7 | Filling CF3I |
| 188 | 1.7.2.8 | Manual cycling #1 |
| 189 | 1.7.2.9 | Achieve long superheat times |
| 190 | 1.7.2.10 | Water filling |
| 191 | 1.7.2.11 | Temperature ramp |
| 192 | 1.7.2.12 | Manual cycling #2 |
| 193 | 1.7.2.13 | Automatic cycling, pressure trigger |
| 194 | 1.7.2.14 | Auto cycling, video trigger |
| 195 | 1.7.2.15 | Cosmic ray veto |
| 196 | 1.7.2.15.1 | *Full PMT array test* |
| 197 | 1.7.2.15.2 | *Integration into DAQ* |
| 198 | 1.7.2.16 | Test Data taking |
| 199 | 1.7.2.17 | Good data at D0 |
| 200 | 1.7.3 | *Insert high purity vessel* |
| 201 | 1.7.4 | *Relocation to NuMI* |
| 202 | 1.7.5 | *Engineering run at NuMI* |
| 203 | 1.7.5.1 | Instrument checks |
| 204 | 1.7.5.2 | Operational readiness review |
| 205 | 1.7.5.3 | Ready to operate at NuMI |
| 206 | 1.7.5.4 | CF3I filling |
| 207 | 1.7.5.5 | Water filling |
| 208 | 1.7.5.6 | Temperature ramp |
| 209 | 1.7.5.7 | DAQ Test |
| 210 | 1.7.5.8 | Ready for first physics run |
| 211 | 1.8 | **MANAGEMENT ...** |
| 223 | 2 | **COUPP 60 KG M&O NuMI** |
| 224 | 3 | **COUPP-60 KG Deep Site Installation** |
| 225 | 4 | **COUPP-60 KG M&O Deep Site** |

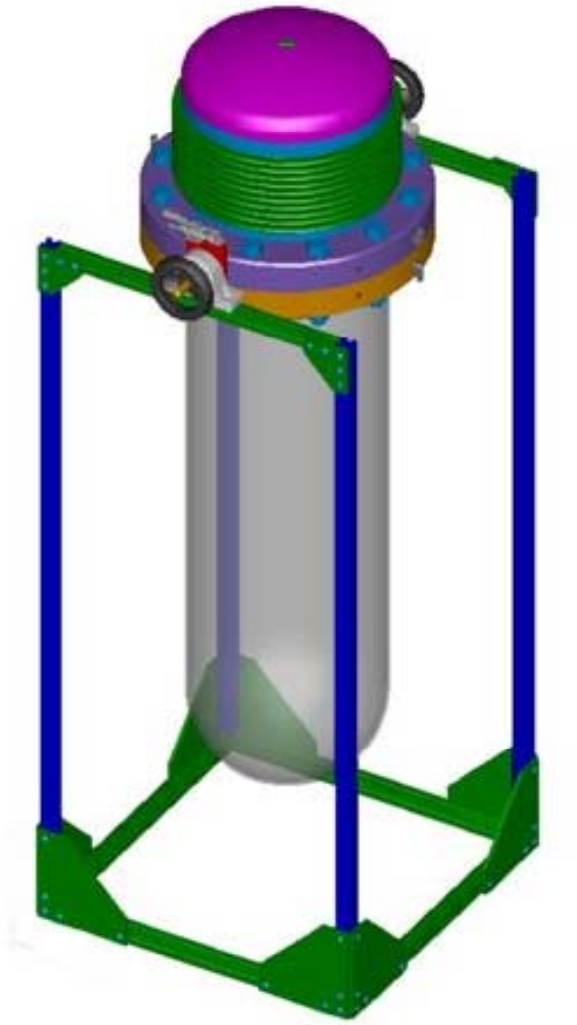
# *Now in more detail….*

Now I will go into more detail on
1.) the High Purity final Bubble chamber,
2.) Plans with the mechanical prototype BC at DZERO, and
3.) the High Purity Fluid Handling Cart.

# High Purity Bubble Chamber

- **STATUS**
  - The Synthetic quartz Jar is in virgin condition in sealed metal bags.
  - The Expansion chamber was cleaned by Astro-Pak and is in sealed metal bag.
  - Seals, bolts, hardware all were cleaned at A0 and are in sealed purged bags.
  - These parts are in the Lab 3 cleanroom.

# This is the Assembly & Rotation fixture.

# High Purity Bubble Chamber

- What's LEFT to complete it?
  - Assembling in the class 10 cleanroom.
    - It has been ready to assemble for months, just hasn't been a priority. Should be a few days work. We will do this very soon.
    - The assembly is the same as mechanical prototype and should go smoothly.
  - PT83 modification, metal seal. Make small tube ass'ys
  - Leak checking. Need $10^{-6}$ mbar-L/sec. We will leave it under vacuum.
  - When fluid handling cart is completed, rinse down internal surfaces with water and then condense BC full with water.
  - Estimated resources is one week of Mark Ruschman's time and some of Rucinski.

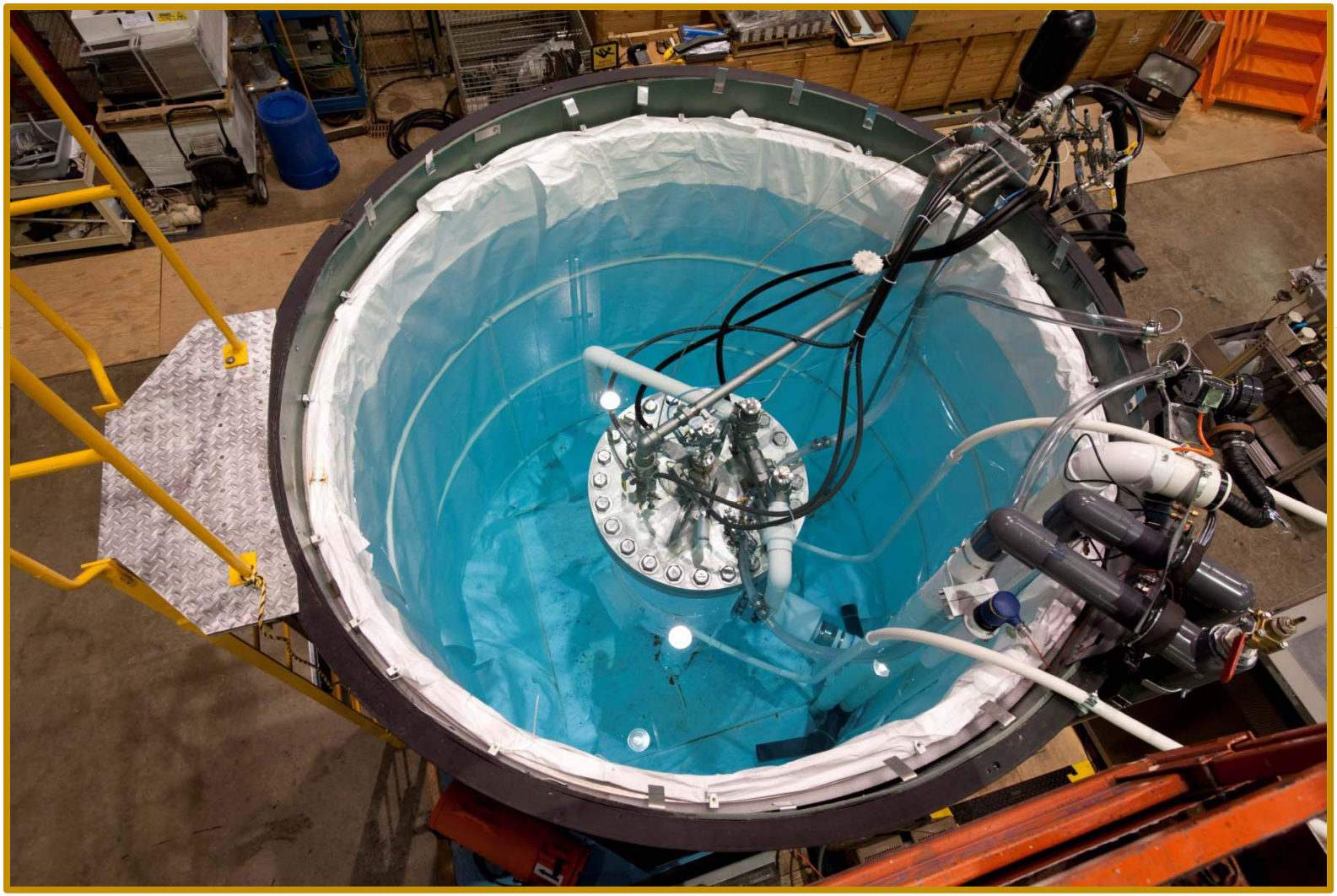
# COUPP 60 run at DZERO

Mechanical Prototype is currently in operation at DZERO.

We need to do automated data taking. (1-2 weeks, Eric Dahl)

Would like to do some control system improvements (2 man-days)

# COUPP 60 run at DZERO



# Mechanical Prototype BC

# Bubble Chamber – What's left to do:

When integration run is ended…(estimated Dec. 18)

- Remove the Lid & light tight covering.
- Remove the PMT raft.
- Drain 4000 gallon water tank.
- Recapture CF3I from BC.
- Transfer glycol hydraulic fluid out of PV.
- Remove process & instrumentation connections from lid.
- Unbolt the lid.
- Put the lid & BC on work stand.
- Remove the LED light grid & Diffuser.

The above work would take about 2+ weeks using 2 D0 mech. techs. This puts us into January 2009 for the next step.

No technical challenges here, just work.

# Bubble Chamber – What's left to do:

Originally as envisioned in May 2009…

Swap out Mechanical prototype with High Purity BC

Re-attach LED grid & diffuser

Move lid back onto PV and bolt up for move.

} (2 FTEs x 1 week)

Transport all equipment to MINOS (3.5 FTEs about 1week effort)

What changed?

1. LED lighting started failing. Better lighting system developed in 4 kg.

We want to line inside of the pressure vessel with retro-reflective material.

Remove camera enclosure, re-vamp with fiber optic light sources.

2. Camera lenses used were not ideal. We need to replace these lenses.

3. Acoustic sensors now a must. The attachment method, decision on number and spacing of sensors present some risk. What spacing is needed? Will sensors interfere with line of sight? Would repositioning of sensors damage quartz?

# Bubble Chamber – What's left to do: Starts in January

Proposed 2nd run @ DZero with mechanical prototype…

- Change out camera lenses on viewport.
- Attach new fiber optic light source to viewport.
- Attach reflective lighting sheet inside vessel.
- Implement a plan to calibrate image reconstruction.
- Attach acoustic sensors to mechanical prototype.
- Replace instrumentation feed through as necessary.
- Re-attach lid to pressure vessel.
- Reconnect lines. {Resource 15 man-days?, A. Sonnenschein+D0 techs }

New Run starts - February 2010?

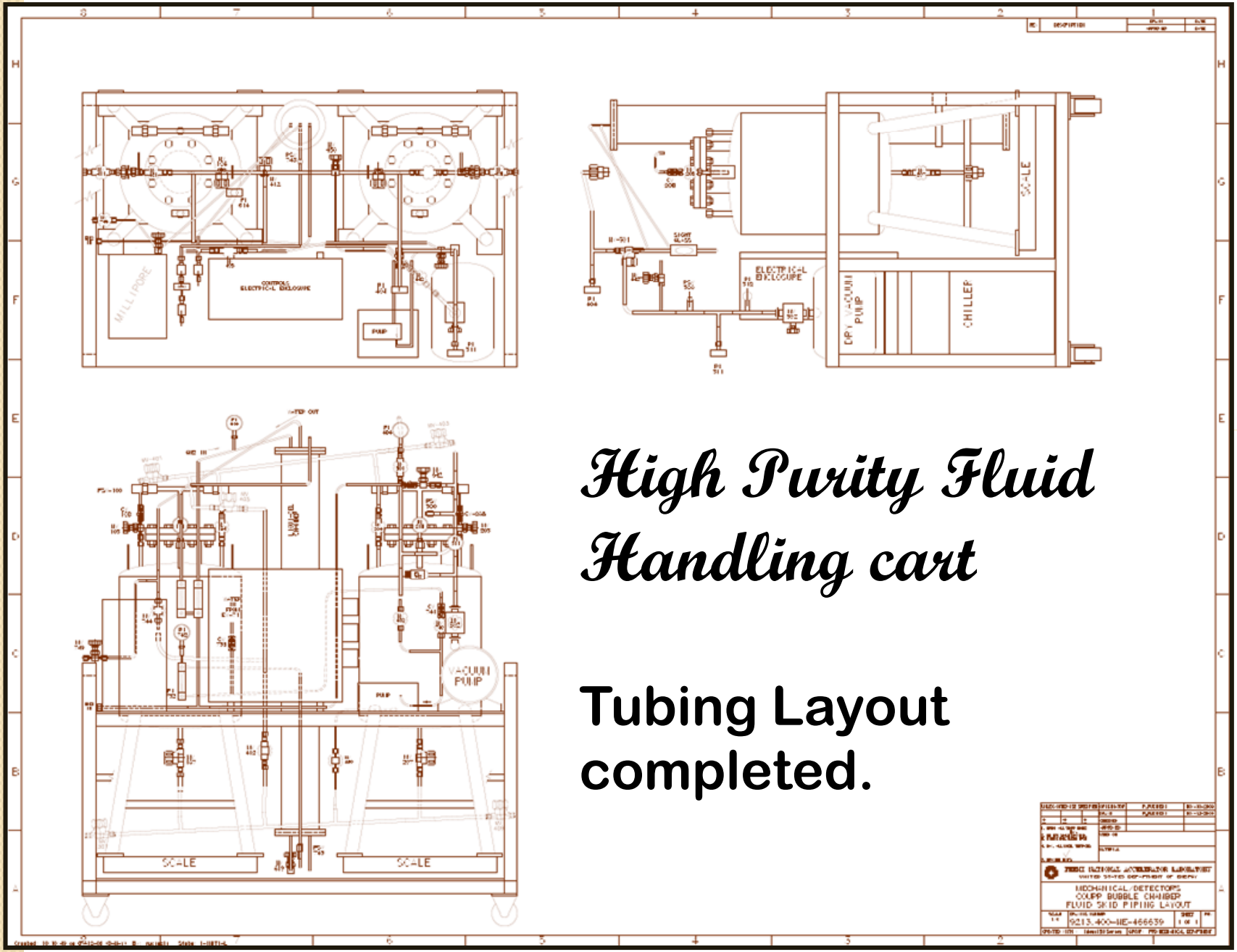
- Refill PV with glycol, condense CF3I into BC. Fill water tank.
- Install PMT raft. Attach lid and make light tight.
- Take good data. End run.

Change out with HP BC, move underground – April 2010?

# High Purity Fluid Handling cart

# High Purity Fluid Handling cart

**Status –** Design done. The Major Pieces are in place, mounted on a cart. Almost all components here. The Flow Diagram and Process Layout finalized. No high purity tubing runs have been welded yet.




# *High Purity Fluid Handling cart*

**Tubing Layout completed.**

# High Purity Fluid Handling cart

- What's left to do:
  - Buy filters, sight glass, bubbler, small stuff.
  - Complete the Technical Specification and performance document. (a draft exists)
  - Documentation
    - (Piping EN, Procedures, pORC)
  - Have a peer review.
  - Construction. (in II w/above)
  - Commissioning.
  - Validation.

Resources:

Rucinski + Ruschman, 4 weeks

(Assuming we can get a welder. Realistically we can't get a welder so I can't make any realistic estimate.)

# High Purity Fluid Handling cart

Process Description:

Distilled water is pumped, filtered and de-ionized (nuclear grade resin) as part of the Lab 3 cleanroom water supply. This source is supplied to a Milli Q Element commercial purification system. The water product is then stripped of radon and other gasses by a series of three Liqui-Cel membrane filters. The water with dissolved GN2 is deposited in a 100 liter vessel.

The water can be de-gassed by a dry vacuum pump.

Water can be distilled back and forth between vessels multiple times.

A high purity diaphragm pump with a filter on it's discharge can circulate product back through the radon stripping filters, or back to the vessels, or piping to continuously clean the flow paths and water product.

Some Technical Information

- Project goal # 1: Alpha emitters at less than $10^{-16}$ g/g of Uranium to reduce alpha induced background rate in the experiment to ~ 1 event /year = $7x10^{-5}$ events/kg-day.
- Project goal # 2: Decay rate less than 1 decay/Liter-day of Radon and less than 0.1 decays/Liter-day of Uranium, Polonium, Radium and Thorium combined.

Source water (Distilled and de-ionized water) expected to have:

$10^5$ decays/Liter-day Rn-222

$10^3$ decays/Liter-day of U-238 & Po-210

$10^2$ decays/Liter-day Th-232

MilliQ produces water with $<1.8x10^{-14}$ g/g Uranium & $10^{-13}$ Thorium per liter.

Liqui-Cel radon stripping train will reduce radon by at least 1000 for each pass.

Document #: Projects-doc-793-v1

# SAFETY READINESS

- COUPP 60 at DZERO moving to NUMI
  - Pressure vessel and Piping engineering notes done and approved.
  - Safety Review and Operations document completed.
  - CF3I release analysis (includes ODH) done and easy to adapt to NUMI.
  - pORC for Operations at DZERO, July 30, 2009, is an excellent basis for pORC at NUMI.

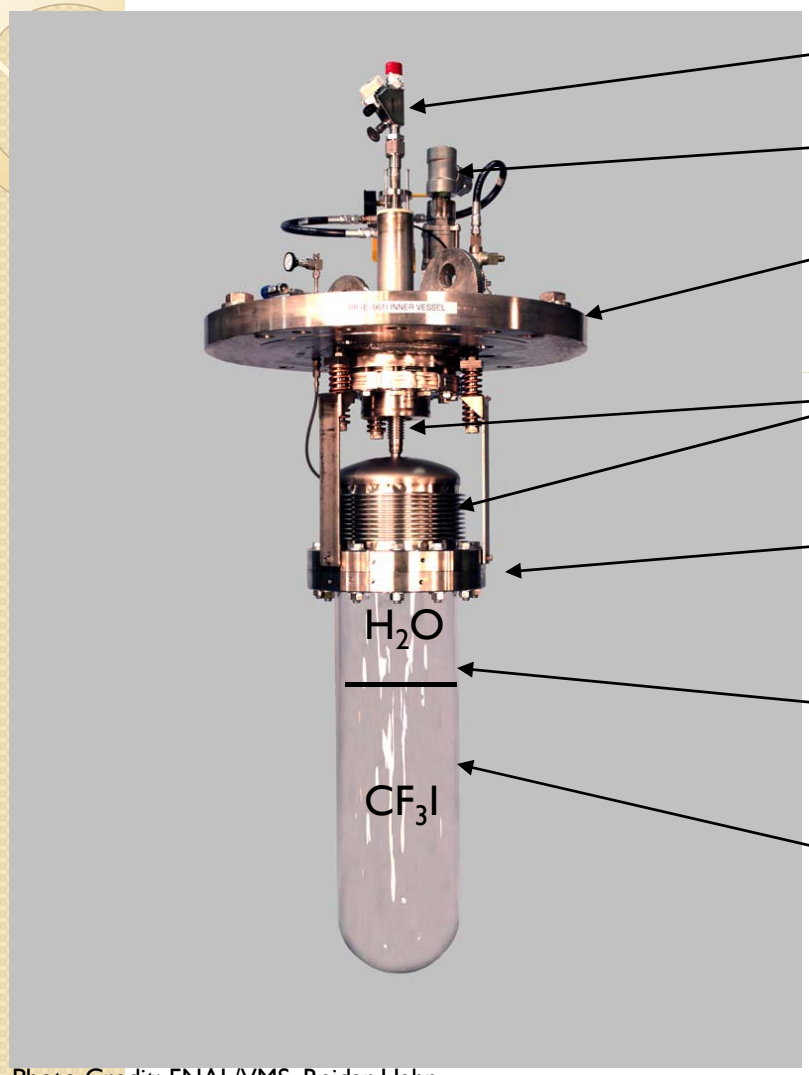
# SUMMARY

- The High Purity bubble chamber can be assembled and ready (sans acoustic sensors) with about 1 week of effort.
- A second run at DZERO with the mechanical prototype will reduce some risk associated with the acoustic sensors. It delays the final move to NUMI by roughly 6 weeks, April 2010?
- The fluid handling cart may run into construction delays due to lack of a welder. If that was solved, it will be ready for the NUMI Run.
- The current level of Engineering support is needed for at least a few more months. (0.75 FTE)
- The current level of technician resources (Ruschman, D0 Technicians, Voirin for move) is needed until the experiment is hooked up in NUMI. (2 FTEs)

# Supplementary Slides

- Bubble chamber design features
- Flow schematic of COUPP 60 at DZERO
- Draft technical specification for HP fluid handling cart.
- Flow schematic of HP fluid handling cart
- Components list for HP fluid handling cart
- Rucinski's itemized work list for COUPP 60

# COUPP - 60 Kg Bubble Chamber, Mechanical Design




High purity valve seals volume

2" port for fast glycol pressurization

Lid of glycol vessel

Set of bellows for volume change
& expansion/compression of fluid

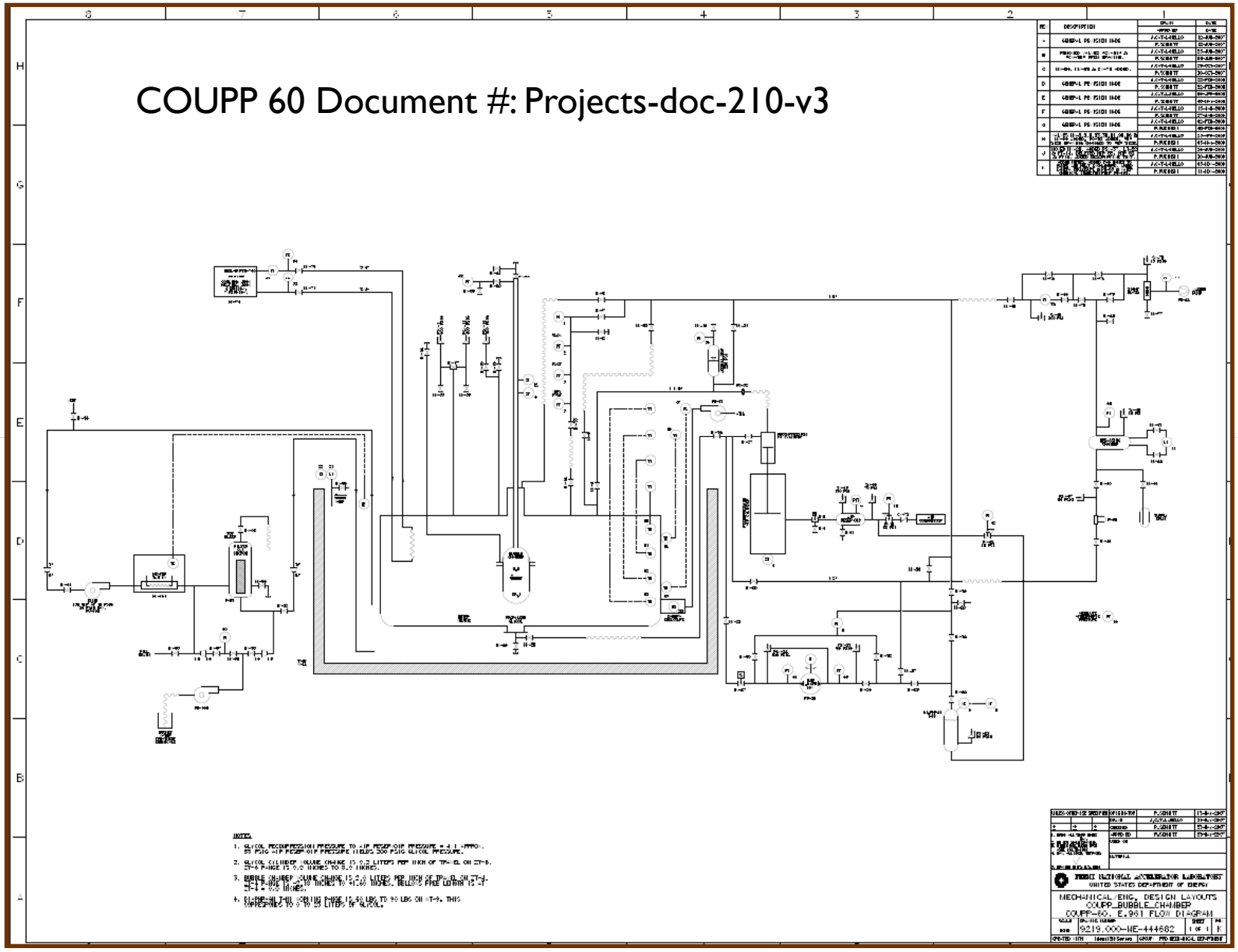
Quartz to Metal seal by gold wire + oring

Jar is stationary

Jar will contain ~ 80 kg (40 L) of CF3I
~ 40 kg (40 L) of H2O

Photo Credit: FNAL/VMS, Reidar Hahn

# COUPP 60 Document #: Projects-doc-210-v3

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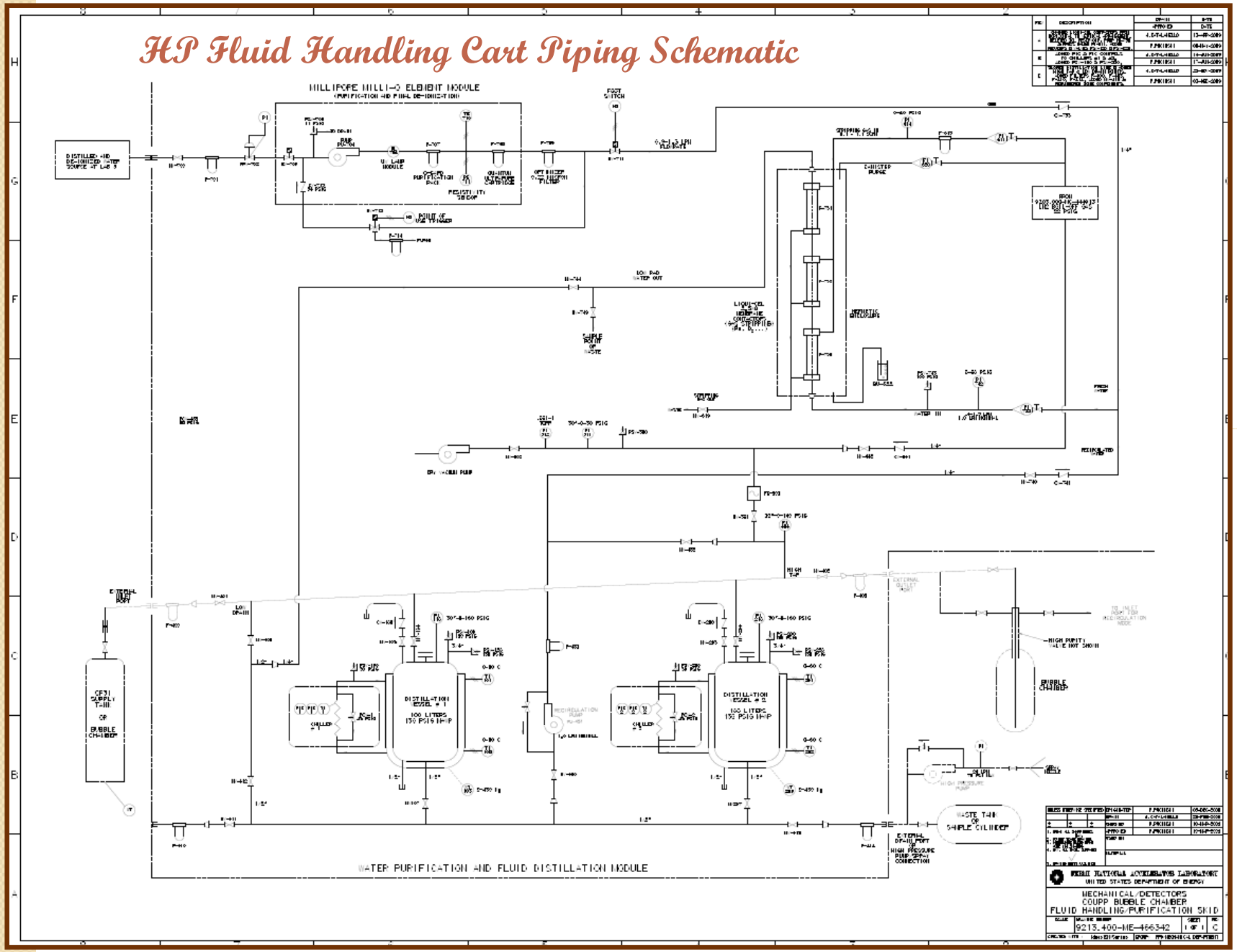
# HP Fluid Handling Cart Piping Schematic



# HP Fluid Handling Cart – Component list. Work with ME-466342

Sheet 1 of 2

| Type | Num | Description | Manufacturer | Model | Size | Rating | Capacity | Here? |
|---|---|---|---|---|---|---|---|---|
| BU | 622 | Bubbler | none | jar | 1/8" FPT | 30 psig | | No |
| CV | 108 | Check valve, high purity, vessel vapor vent | Swagelok | 6L-CW4VR4-EP | 1/4" male VCR | 3000 psig | | Yes |
| CV | 208 | Check valve, high purity, vessel vapor vent | Swagelok | 6L-CW4VR4-EP | 1/4" male VCR | 3000 psig | | Yes |
| CV | 641 | Check valve, gas nitrogen back fill line | Swagelok | 6L-CW4S4 | 1/4" compression | 3000 psig | | Yes |
| CV | 713 | Millipore Recirculation valve and pressure limiter | Millipore | Milli-Q Element, ZMQS6VE01 | Internal | | | Yes |
| CV | 733 | Check valve after Millipore module | Swagelok | 6L-CW4S4 | 1/4" compression | 3000 psig | | Yes |
| CV | 741 | Check valve, high purity | Swagelok | 6L-CW4VR4-EP | 1/4" male VCR | 3000 psig | | Yes |
| EV | 703 | Millipore internal isolation valve | Millipore | Milli-Q Element, ZMQS6VE01 | Internal | | | Yes |
| EV | 711 | Millipore purified water discharge solenoid | Millipore/Oiral | made in Italy, supplied with Milli-Q | 1/8" NPT | | | Yes |
| EV | 712 | Point of use dispenser solenoid | Millipore | Milli-Q Element, ZMQS6VE01 | Internal | | | Yes |
| F | 613 | Filter on GN2 sweep gas | | | | | | No |
| F | 707 | Q-Guard purification pack | Millipore | QGARD00R1 | | | | Yes |
| F | 708 | Quantum Ultrapure cartridge | Millipore | QTUM00ICP | | | | Yes |
| F | 709 | Optimizer final filter | Millipore | MPEVICPKJ | | | 0.10 micron | Yes |
| F | 714 | Milllipak filter on point of use tap | Millipore | MPGL04SK2 | | | 0.22 micron | Yes |
| F | 751 | Membrane Contactors | Liqui-Cel | 2.5 x 8 | 3/8" Flaretek | 105 psig | 0.4 - 11 liters/min water | Yes |
| F | 752 | Membrane Contactors | Liqui-Cel | 2.5 x 8 | 3/8" Flaretek | 105 psig | 0.4 - 11 liters/min water | Yes |
| F | 753 | Membrane Contactors | Liqui-Cel | 2.5 x 8 | 3/8" Flaretek | 105 psig | 0.4 - 11 liters/min water | Yes |
| FI | 453 | Recirculation polishing filter | | | | | | No |
| FI | 611 | Stripping gas Flow Indicator | Brooks | 1510D-NB5-A-1-F | 1/4" FNPT | 200 psig | 3.6 - 36 scfh air | Yes |
| FI | 620 | Enclosure purge Flow Indicator | Brooks | 1510D-KB3-A-1-D | 1/4" FNPT | 200 psig | 0.08-0.8 scfh air | Yes |
| FI | 732 | Water into Liqui-Cel Flow Indicator | Brooks | 1510D-PB2-A-1-D | 1/4" FNPT | 200 psig | 10-100 liters/hr | Yes |
| MV | 104 | Diaphragm valve, vessel # 1 top port | Swagelok | 6L-ELD8-CCXX | 1/2" male VCR | 240 psig | Cv=2.8 | Yes |
| MV | 105 | Manual valve, top vent on vessel # 1 | Swagelok | SS-DSV51 | 1/4" female VCR | 1500 psig | Cv=0.3 | Yes |
| MV | 107 | Manual valve, bottom drain on vessel # 1 | Swagelok | 6L-ELD8-CCXX | 1/2" male VCR | 240 psig | Cv=2.8 | Yes |
| MV | 204 | Diaphragm valve, vessel # 2 top port | Swagelok | 6L-ELD8-CCXX | 1/2" male VCR | 240 psig | Cv=2.8 | Yes |
| MV | 205 | Manual valve, top vent on vessel # 2 | Swagelok | SS-DSV51 | 1/4" female VCR | 1500 psig | Cv=0.3 | Yes |
| MV | 207 | Manual valve, bottom drain on vessel # 1 | Swagelok | 6L-ELD8-CCXX | 1/2" male VCR | 240 psig | Cv=2.8 | Yes |
| MV | 401 | Manual valve, Gas inlet connection | Swagelok | 6L-ELD8-CCXX | 1/2" male VCR | 240 psig | Cv=2.8 | Yes |
| MV | 402 | Manual valve, Gas outlet connection | Swagelok | 6L-ELD8-CCXX | 1/2" male VCR | 240 psig | Cv=2.8 | Yes |
| MV | 411 | Manual valve, liquid inlet connection | Swagelok | 6L-ELD8-CCXX | 1/2" male VCR | 240 psig | Cv=2.8 | Yes |
| MV | 412 | Manual valve, liquid oulet connection | Swagelok | 6L-ELD8-CCXX | 1/2" male VCR | 240 psig | Cv=2.8 | Yes |
| MV | 412 | Manual valve, bottom liquid line isolation | Swagelok | 6L-ELD8-CCXX | 1/2" male VCR | 240 psig | Cv=2.8 | Yes |
| MV | 405 | Manual valve,top distillation line isolation | Swagelok | 6L-ELD8-CCXX | 1/2" male VCR | 240 psig | Cv=2.8 | Yes |
| MV | 450 | Manual valve, recirculation pump inlet | Swagelok | SS-DSV51 | 1/4" female VCR | 1500 psig | Cv=0.3 | Yes |
| MV | 501 | Manual valve, pump or backfill isolation | Swagelok | 6L-ELD8-CCXX | 1/2" male VCR | 240 psig | Cv=2.8 | Yes |
| MV | 502 | Vacuum pump manual isolation valve | | | | | | No |
| MV | 619 | GN2 Sweep gas discharge valve | | | | | | No |
| MV | 642 | Manual valve, gas nitrogen purge supply | Swagelok | SS-DSV51 | 1/4" female VCR | 1500 psig | Cv=0.3 | ? |
| MV | 700 | Isolation valve from house water supply | Banjo | UVL1000 | 1/2" FNPT | 100 psig | | Yes |
| MV | 740 | Water Recirculation block valve to Liqui-Cel train | Swagelok | SS-DSV51 | 1/4" female VCR | 1500 psig | Cv=0.3 | Yes |
| MV | 744 | Liqui-Cel output control valve | Swagelok | SS-DSV51 | 1/4" female VCR | 1500 psig | Cv=0.3 | Yes |
| MV | 749 | Valve, sample or purge Liqui-Cel output | Swagelok | SS-DSV51 | 1/4" female VCR | 1500 psig | Cv=0.3 | Yes |
| PCV | 455 | Pressure control valve, water recirc. Pump | KNF Neuberger, Inc. | internal | n/a | 22 psig | 22 psig relief | Yes |
| PI | 110 | Pressure Indicator, vessel # 1 pressure | Swagelok | PGU-50-PC160-L-4FSF | 1/4" female VCR | 30"vac-0-160 psig | lower mount | due 12/18 |
| PI | 210 | Pressure Indicator, vessel # 2 pressure | Swagelok | PGU-50-PC160-L-4FSF | 1/4" female VCR | 30"vac-0-160 psig | halocarbon filled | due 12/18 |
| PI | 404 | Pressure Indicator distillation line pressure | Swagelok | PGU-50-PC160-C-4FSF | 1/4" female VCR | 30"vac-0-160 psig | center back mount | due 12/18 |
| PI | 511 | Pressure Indicator vacuum pumping line | Swagelok | PGU-50-PC30-C-4FSF | 1/4" female VCR | 30"vac-0-30 psig | center back mount | due 12/18 |

# HP Fluid Handling Cart – Component list. Work with ME-466342

Sheet 2 of 2

| Type | Num | Description | Manufacturer | Model | Size | Rating | Capacity | Here? |
|---|---|---|---|---|---|---|---|---|
| PI | 110 | Pressure Indicator, vessel # 1 pressure | Swagelok | PGU-50-PC160-L-4FSF | 1/4" female VCR | 30"vac-0-160 psig | lower mount | due 12/18 |
| PI | 210 | Pressure Indicator, vessel # 2 pressure | Swagelok | PGU-50-PC160-L-4FSF | 1/4" female VCR | 30"vac-0-160 psig | halocarbon filled | due 12/18 |
| PI | 404 | Pressure Indicator distillation line pressure | Swagelok | PGU-50-PC160-C-4FSF | 1/4" female VCR | 30"vac-0-160 psig | center back mount | due 12/18 |
| PI | 511 | Pressure Indicator vacuum pumping line | Swagelok | PGU-50-PC30-C-4FSF | 1/4" female VCR | 30"vac-0-30 psig | center back mount | due 12/18 |
| PI | 512 | Pressure thermocouple gauge, vacuum line | Hastings | DV6R | | | | Yes |
| PI | 614 | Pressure gage for Stripping Gas In | Noshok | 25-400-60-O2 | 1/4" MNPT | 0-60 psig | dry, no liquid fill | Yes |
| PI | 742 | Pressure Indicator Gauge, water into Liqui-Cel | Noshok | 25-500-60-HALOCARB-O2 | 1/4" MNPT | 0-60 psig | halocarbon filled | Yes |
| PSV | 100 | Pressure safety relief valve, vessel # 1 | Circle Seal Controls | M5180T1-4M(L)-150 | 1/2" MNPT | 150 psig | ASME | Yes |
| PSV | 120 | Pressure safety relief valve, vessel # 1 | Circle Seal Controls | M5180T1-4M(L)-150 | 1/2" MNPT | 150 psig | ASME | Yes |
| PSV | 200 | Pressure safety relief valve, vessel # 2 | Circle Seal Controls | M5180T1-4M(L)-150 | 1/2" MNPT | 150 psig | ASME | Yes |
| PSV | 220 | Pressure safety relief valve, vessel # 2 | Circle Seal Controls | M5180T1-4M(L)-150 | 1/2" MNPT | 150 psig | ASME | Yes |
| PSV | 500 | Pressure safety relief valve, vacuum line | Circle Seal Controls | K520T1-2M-15 | 1/4" MNPT | 15 psig SP | 1.5 scfm air or 0.5 gpm | Yes |
| PSV | 705 | Millipore internal relief valve | Millipore | Milli-Q Element, ZMQS6VE01 | Internal | 11 psig | | Yes |
| PSV | 743 | Pressure safety relief valve, water to Liqui-Cel | Circle Seal Controls | K520T1-2M-100 | 1/4" MNPT | 100 psig SP | | |
| PU | 451 | High purity Recirculation Pump | KNF Neuberger, Inc. | UNF 100TTE 115v/60 Hz | 1/8" FNPT | 15 psig | 0.75 - 1.2 lpm water | Yes |
| PU | 704 | Millipore internal pump | Millipore | Milli-Q Element, ZMQS6VE01 | Internal | 34 psig | 0.9 - 1.3 lpm water | Yes |
| RE | 711 | Millipore resistivity sensor | Millipore | Milli-Q Element, ZMQS6VE01 | Internal | n/a | 2.4 - 18.2 Mohm/cm | Yes |
| TE | 710 | Millipore internal Water temperature | Millipore | Milli-Q Element, ZMQS6VE01 | Internal | n/a | 0 - 45 Celcius | Yes |
| TI | 1 | Chiller #1 fluid supply Temperature Indicator | PolyScience | 5360T11A110C | Internal | n/a | -10 C to 70 Celcius | |
| TI | 2 | Chiller #2 fluid supply Temperature Indicator | PolyScience | 5360T11A110C | Internal | n/a | -10 C to 70 Celcius | |
| TI | 101 | Temperature Indicator, Vessel # 1 jacket inlet | Omega | SA2C-RTD-3-100-B-80 | flat | 100 ohm Pt | -200 C to 850 Celcius | Yes |
| TI | 102 | Temperature Indicator, Vessel # 1 jacket outlet | Omega | SA2C-RTD-3-100-B-80 | flat | 100 ohm Pt | -200 C to 850 Celcius | Yes |
| TI | 201 | Temperature Indicator, Vessel # 2 jacket inlet | Omega | SA2C-RTD-3-100-B-80 | flat | 100 ohm Pt | -200 C to 850 Celcius | Yes |
| TI | 202 | Temperature Indicator, Vessel # 2 jacket outlet | Omega | SA2C-RTD-3-100-B-80 | flat | 100 ohm Pt | -200 C to 850 Celcius | Yes |
| UL | 706 | Dual wavelength UV Lamp module | Millipore | ZFA10UV01 Lamp, ZMQUVLP01 unit | | | | Yes |
| WT | 103 | Weight / Force | Industrial Comm. Scale | ICS 2424-500 | 24" x 24" platform | 1000 lbs | 0 - 450 kg, 0.1 kg res. | Yes |
| WT | 203 | Weight / Force | Industrial Comm. Scale | ICS 2424-500 | 24" x 24" platform | 1000 lbs | 0 - 450 kg, 0.1 kg res. | Yes |
| | | | | | | | | |
| | | Chiller # 1, Refrigerating and Heating recirculator | PolyScience | 5360T11A110C | 1/2" NPT | 45 psig | -10 C to 70 C, 3 - 3.5 gpm | Yes |
| | | Chiller # 2, Refrigerating and Heating recirculator | PolyScience | 5360T11A110C | 1/2" NPT | 45 psig | -10 C to 70 C, 3 - 3.5 gpm | Yes |

# DRAFT - TECHNICAL AND PERFORMANCE SPECIFICATION

WBS 1.2 HIGH PURITY FLUID HANDLING
WBS 1.2.1 Documentation
WBS 1.2.1.1 Specification

**Water quality:**
Alpha emitters at less than $10^{-16}$ g/g of Uranium to reduce alpha induced background rate in the experiment to ~ 1 event /year = $7x10^{-5}$ events/kg-day.
Decay rate less than 1 decay/Liter-day of Radon and less than 0.1 decays/Liter-day of Uranium, Polonium, Radium and Thorium combined.
Maximum foreign particulate size: 15 microns
Maximum mass of foreign particulates: ? Grams

**Water volume and flow rate:**
Water production rate: Produce a net of 45 liters of radio-pure water for transfer into the bubble chamber within one eight hour shift.
The system must be capable of holding 100 liters of radio-pure water that can be dispensed at a rate of 25 lpm for rinsing operations.
Distillation rate – Distill a quantity of 50 liters of water from one distillation vessel to the other over the course of two eight hour days or less.
Dispense by distillation at a 40 C, 45 liters of water from a distillation vessel into the COUPP bubble chamber over the course of two eight hour days or less.

# DRAFT - TECHNICAL AND PERFORMANCE SPECIFICATION

WBS 1.2 HIGH PURITY FLUID HANDLING
WBS 1.2.1 Documentation
WBS 1.2.1.1 Specification

**CF3I volume and flow rate:**

Distillation rate: Distill a quantity of 50 liters of CF3I from an external supply into a distillation vessel over the course of two eight hour days or less.

Distill a quantity of 50 liters of CF3I from one distillation vessel to the other over the course of two eight hour days or less.

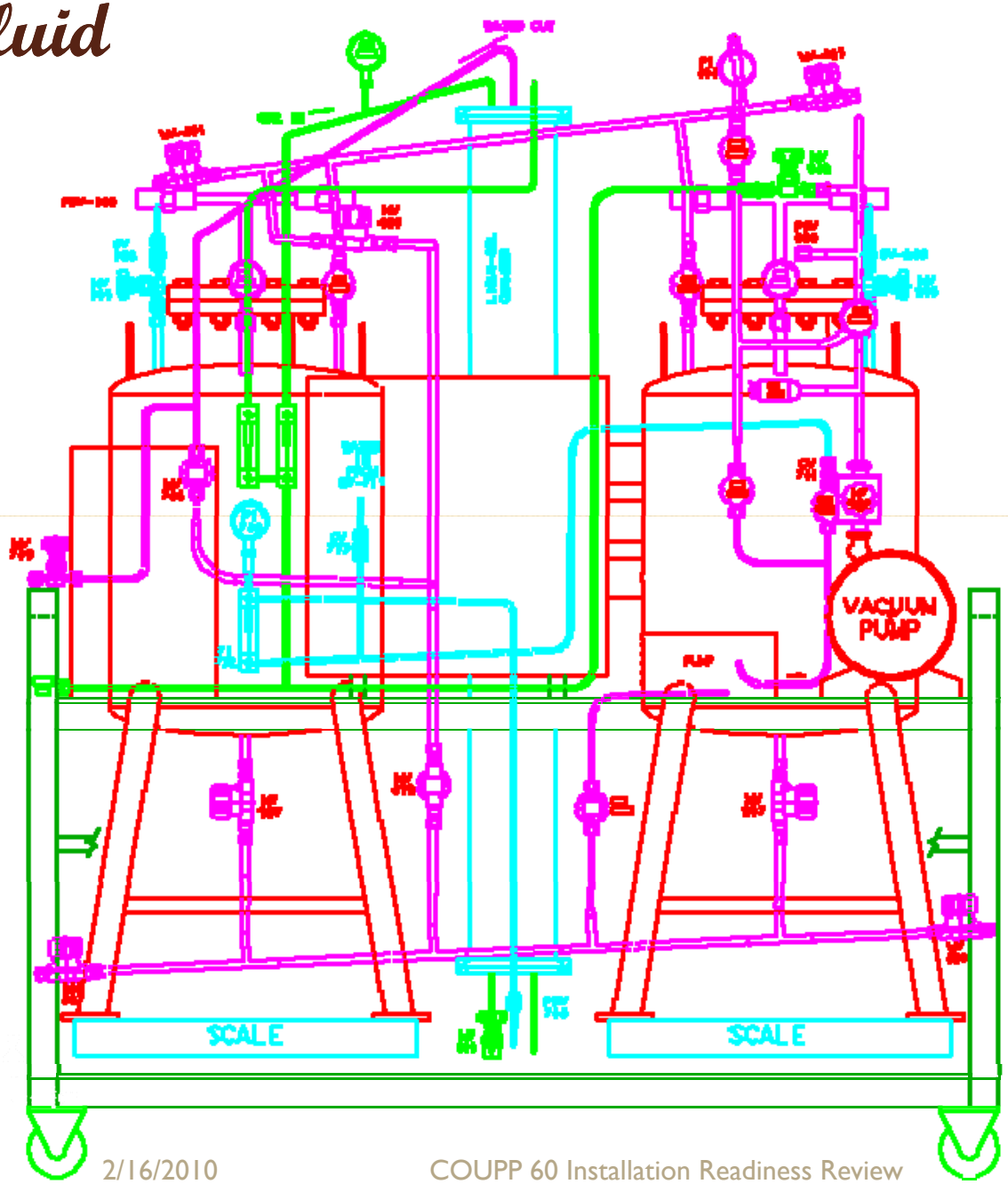
Dispense by distillation at a 40 C, 45 liters of CF3I from a distillation vessel into the COUPP bubble chamber over the course of two eight hour days or less.

**Reference Documentation**

•COUPP Water System description, Andrew Sonnenschein, Oct. 10, 2007
(Andrew, I didn't see this document in the docDB.)
•Projects Document 754-v1
Sandia Lab Ultra High Piping specification, Standard SEMI E49-1104 Semiconductor UHP piping guide, Swagelok UHP specification
•Projects Document 515-v1
Cleaning Specifications for COUPP Expansion Chamber and High Purity Tanks at Astropak
•Projects Document 516-v1
Cleaning and Clean Room Standards and Procedures

# High Purity Fluid Handling cart

**Tubing Layout completed.**



# R. Rucinski's current work list for COUPP 60

| COUPP WORK LIST: | |
|---|---|
| **Low rad Water system** | |
| | Order DI water conductivity meter for checking rinsing tube outflow |
| | Motivate technician progress on HP tubing work |
| | Order filters, sight glass, MV-502 KF25 vacuum valve, KF25 x 0.5 od tube |
| | Contact APC, why isn't jacket rated for full vacuum? |
| | Order heat tape for distillation tubing line |
| | Non permeable Seal solution for top flange, energized spring in teflon? |
| | Plan side panels/keep it clean order slot covers |
| | Finish design document with technical specification |
| | Organize a peer review |
| | |
| **DZero Integration run** | |
| | Confined space entry Davit system solution for NUMI |
| | Order scale for crane |
| | Get control system laudry list of items fixed |
| | Order a replacement hydraulic pump |
| | Call 312-226-1506, Charlie Voss x3110 or Dennis Comia x3116 when PSV's are ready |
| | for re-building with stainless steel wire and body plug. Allied Valve |
| | Test the water weekly and add chemicals as needed (delegated to PGS) |
| | Make sketches for techs of optical calibration |
| | |
| **High Purity chamber** | |
| | Test assembly HP expansion chamber to jar after astro-pak cleaning? |
| | PT-83 replacement for underwater, attachment detail |
| | Sketch up tight elbows & tubing to mount PT-83 & MV-80, MV-81 |
| | Check flatness of synthetic quartz jar flange prior to bolt up |
| | Eliminate spring to eliminate motion during recompression |
| | |
| **Documentation** | |
| | Finish Design Engineering note, into DocDB |
| | |
| **Coordination** | |
| | Water conditioning, get Pushka to get a solution |
| | DAQ system required for integration run - Get filled w/CF3I to force issue |
| | |
| **Underground siting** | |
| | SNOLAB, follow up on Water tank and Crane procurement |
| | Trip to SNOLAB in January? |
| | Design feet/frame to raise vessel up in water tank |
| | |
| **Other** | |
| | Assay method for radiopurity, testing of Fluid handling performance |
| | Larger volume bubble chamber, the next phase of COUPP |