CDF Silicon Cooling

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Intermediate Silicon Layer Cooling

Space Frame Cooling System
Beryllium Ledges
Carbon Fiber Ribbon

Alluminum Pipes outer diameter 4.5 mm

Maximum of 9 ladders in one cooling channel
ΔT(IN–OUT)~1°C

coolant flowing in aluminum tubes attached to beryllium ledges mounted on space frame

64 cm
Recent History

- SVX and Intermediate Silicon Layer have different cooling systems, but linked
- Conductivity of ISL coolant after 2006 shutdown 3 orders of magnitude too high
- Recent problems with valves in the ISL cooling at the detector
  - Suspect related to the high conductivity
- Measured pH of coolant pH=2
  - SVX coolant pH=4
  - Fresh mix of deionized water with 10% ethylene glycol pH=6
  - Now suspect warming up last shutdown caused formation of glycolic and formic acids from the glycol
- Concern about corrosion, especially of aluminum pipes on detector
Flush the entire system

• Flush the system and start over
• Go back to pure deionized water
  – Non-trivial change to interlocks to prevent freezing of cooling lines
• Air in the system during its commissioning was a significant problem
  – Big risk
Dilution

• Dilute the current coolant with a fresh solution
• pH is logarithmic
• Can only exchange relatively small quantities at a time (10-20%)
• Even getting to a pH of 3 or 4 takes ~2-5 volume exchanges
  – System volume is 1000L
• Any amount of glycol makes the fluid removed special waste
• 20 55-gallon drums
Chemical treatment

- Adding chemicals to bring up the pH
- Consulted first with FNAL chemist Anna Pla-Dalmau and then water system specialists GE Betz
- Recommend sodium hydroxide caustic to bring pH up to 7-8 and borate buffer (aluminum pipes)
  - Existing resin would clear up the conductivity from that point
  - Concern about precipitate: some cooling lines were blocked by epoxy and drilled through with a laser → 0.5-2.0mm orifice
- GE Betz will do chemical analysis of coolant samples (SVX as well as ISL) before and after proposed treatment
  - Measure size of particulates
- Will also test for bacteria
Plan

- Studying feasibility of pushing new coolant in while pumping out old
  - More like flushing than dilution but not with air
  - Less mixing $\rightarrow$ fewer volume exchanges
    - Likely still 5-10 drums of special waste
  - Will valve off detector loop to keep isolated
    - Avoid riskiest area for problems with air in the system
- Replace with deionized water with no glycol
  - Will still have $\sim$1% glycol due to portion in detector loop
  - Also ISL shares a spare chiller with SVX cooling (30% glycol)
- Monitor pH and follow up with chemical treatment if needed