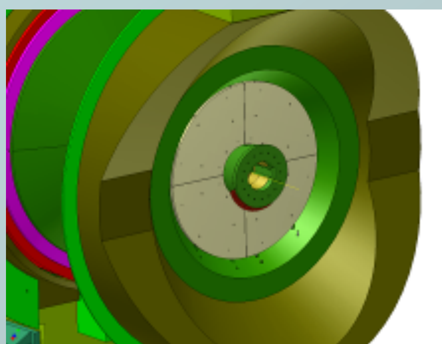
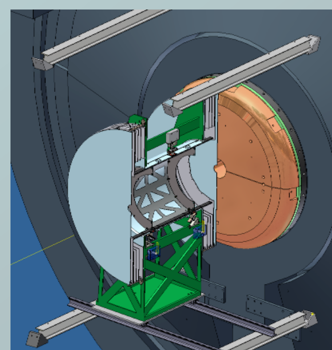
PHENIX
Technical Support '10

PHENIX
Shutdown 2010





April 7,2010

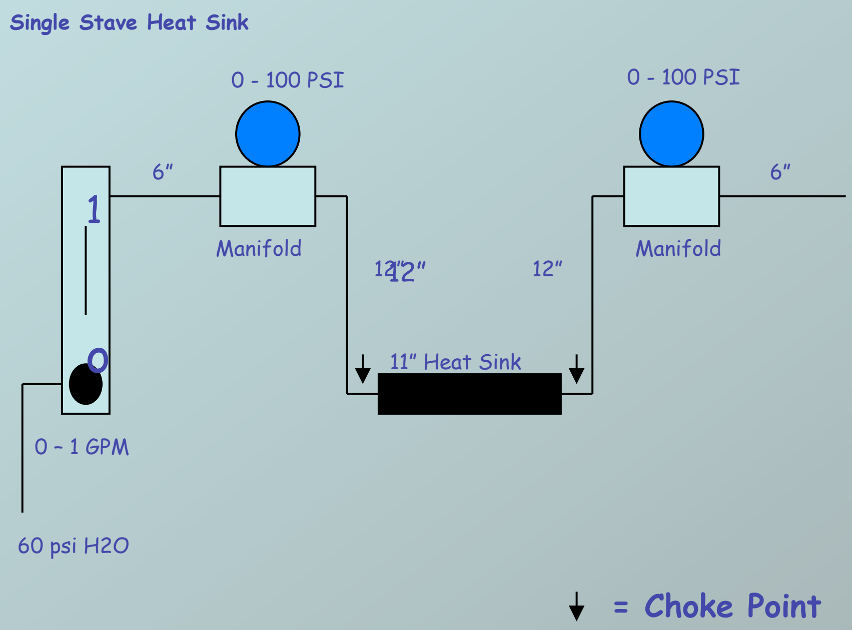
Don Lynch

New Argon Dewar and Empty Gas Bottle Storage Area

(skip 24 slides)

VTX Cooling System Redesign

BNL Test Set-up

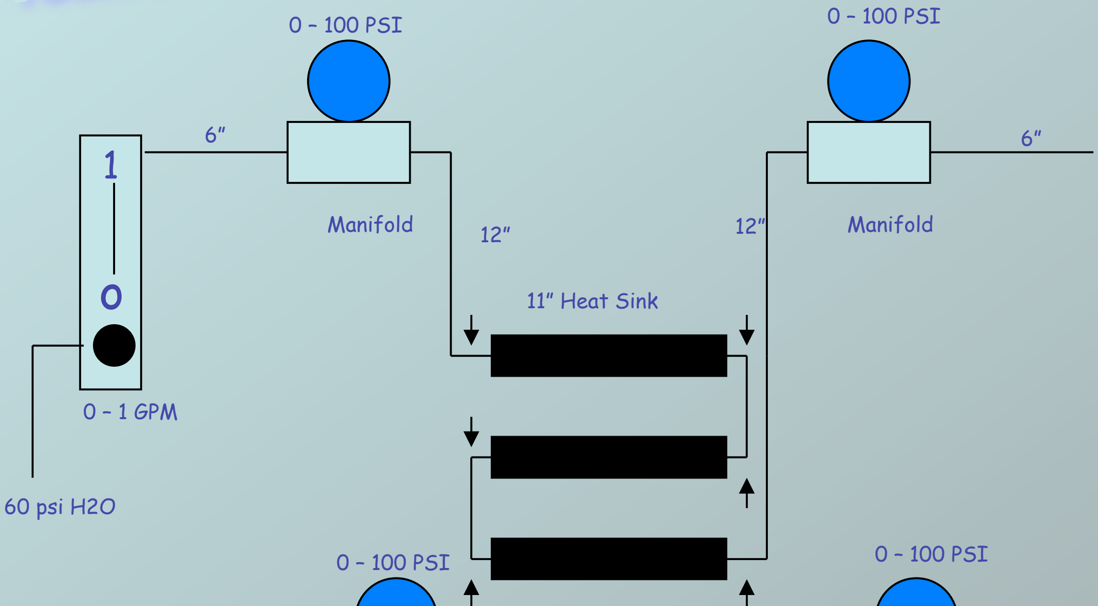


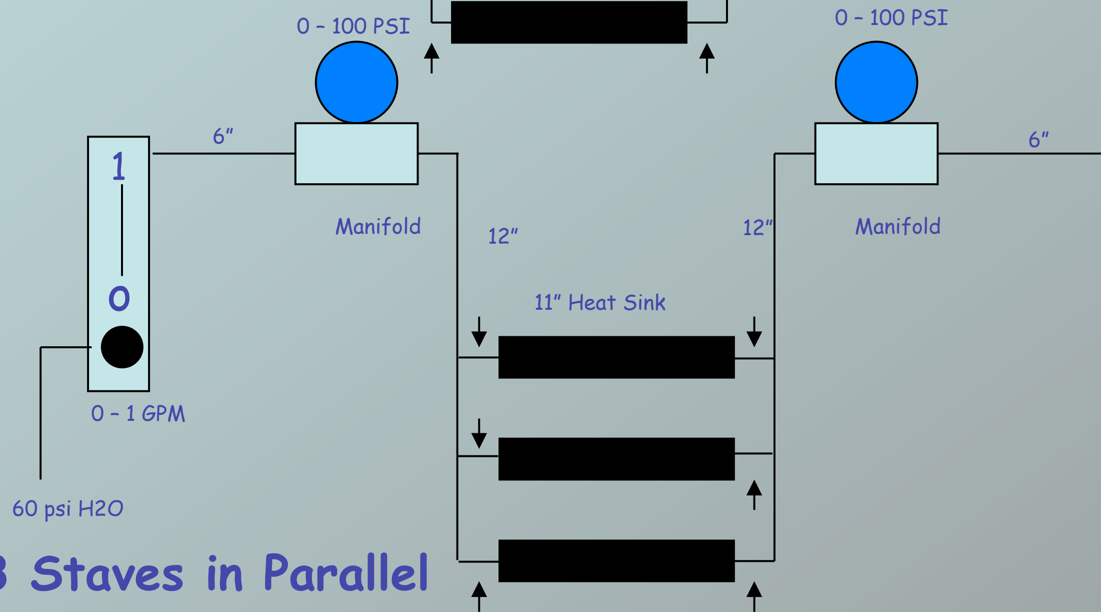
All connections were made with 1/4" polyflow fittings with a minimal ID of .125" except of the stave heat sinks themselves (45 deg barbed with <u>max</u> ID of .080")

Tubing = Tygon 1/4" OD, 1/8" ID   Formula 2001 (max pressure 30 psi) or SE-200 (max pressure 85 psi) clamped to the polyflow inner tube with a plastic 'herbie' clamp.

Flowmeter 0 -1 GPM (H_2O), Gages 0 -100 psi, Manifolds 1" x 1" x 2" Alum with 1/2" ID.

BNL Tests: 3 Staves in Series





3 Staves in Parallel

↓ = Choke Point

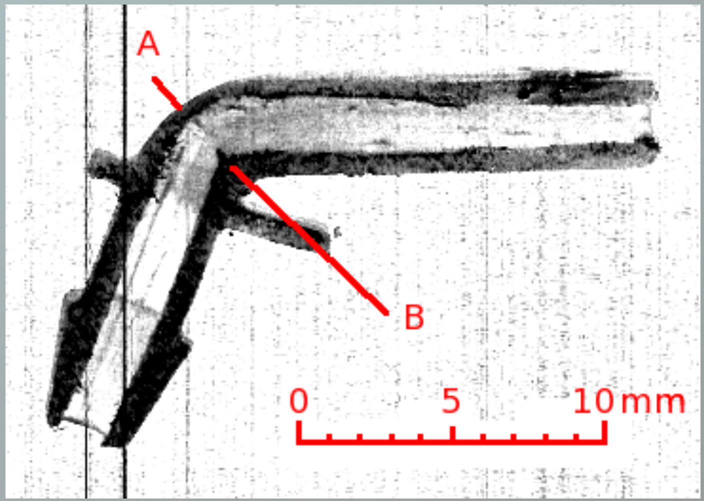
Tests indicate that the choke points in the sysem are the 45 deg bends in the plastic barbed fittings on the stave heat sinks (see below)

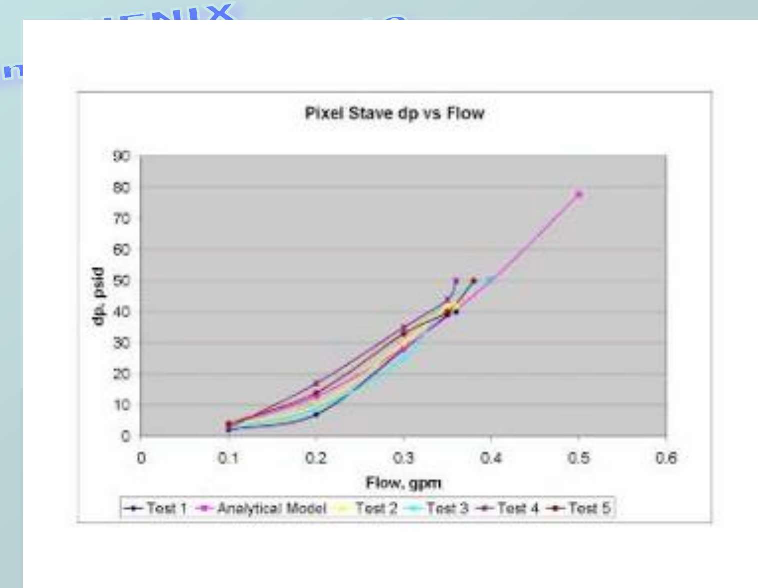
Obstruction (cross-section A – B) can't be filed or cut out very easily without doing damage to the fitting.

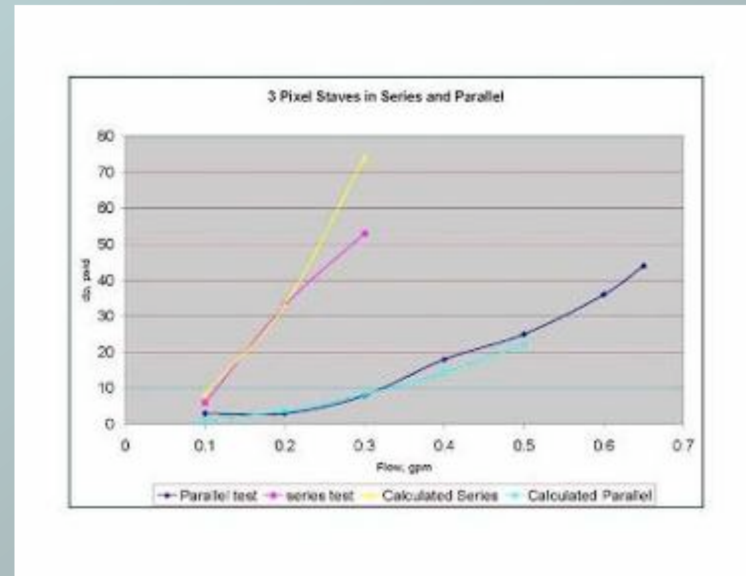
Barbed fitting glued to ends of carbon fiber heat sink

Cut away view of fitting showing choke point

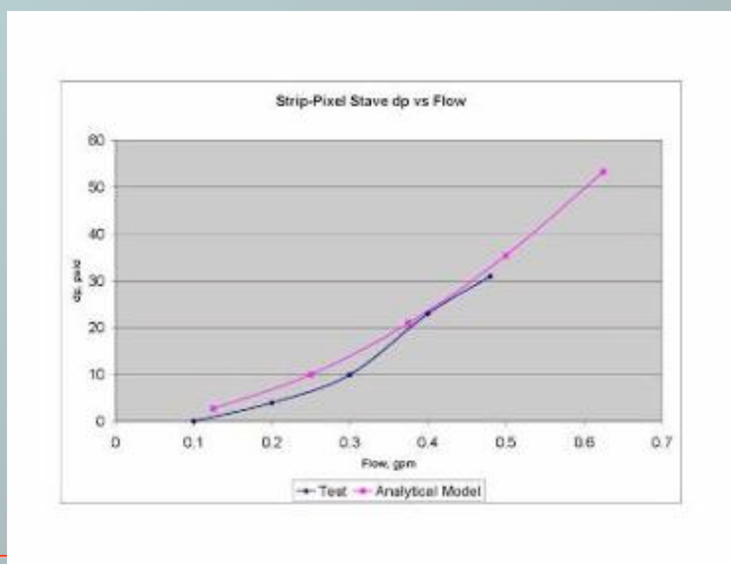
(Image courtesy of Hubert)

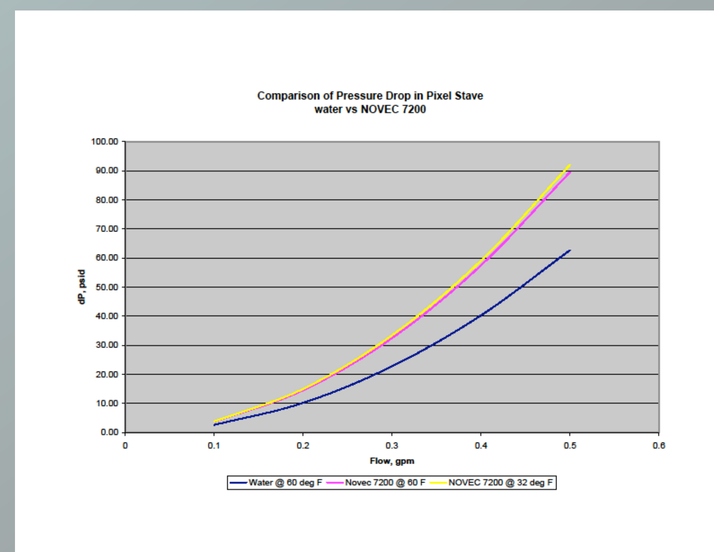






Test Results used to adjust pixel analytical flow model for choke point only. Strip pixel model required no adjustment.





In order to find an acceptable configuration and set of flow parameters a completely new set of flow and thermal calculations for the pixel staves, strip-pixel staves and FVTX disks 1-4 was set up.

The specifications fixed for the analyses were as follows:

Maximum inlet pressure: 20 psig
Maximum pixel sensor temperature: 20°C
Maximum strip-pixel sensor temperature: 0°C
Maximum FVTX disk sensor temperature: 20°C
Maximum pressure drop between external inlet manifold and external outlet manifold: 10 psid
Electronics heatloads

Additional input for the calculations: estimate ambient heat gain for detector is distributed among all cooling loops as a ~ 35% increase in sensor heat load. (Based on conservative ambient heat gain analysis.)

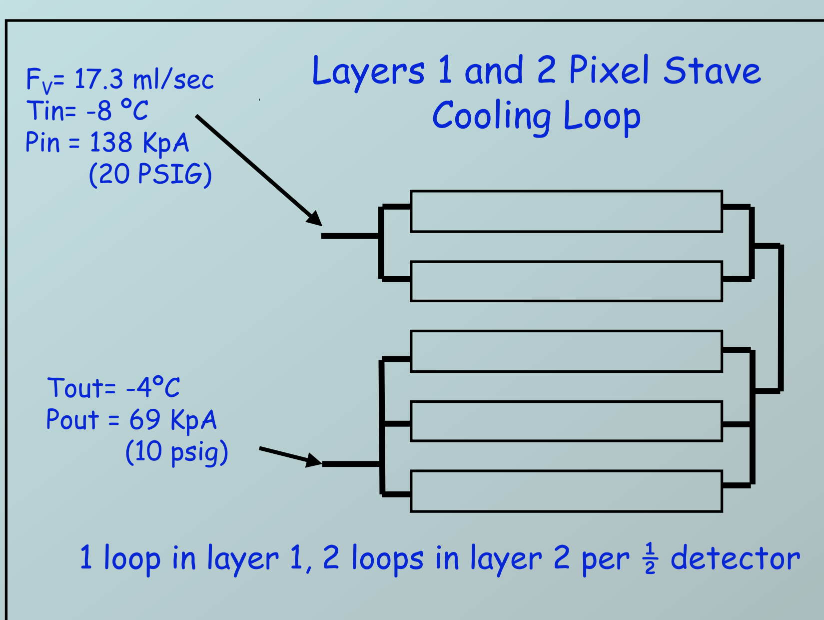
Temperature rise from cooling circuit wall temperature to sensor is derived from HYTEC thermal analyses: scaled from FEA calculation specified heat loads to tabulated (spreadsheet heatloads) and scaled again for 35% ambient load allowance described above. It is assumed that the FEA analyses

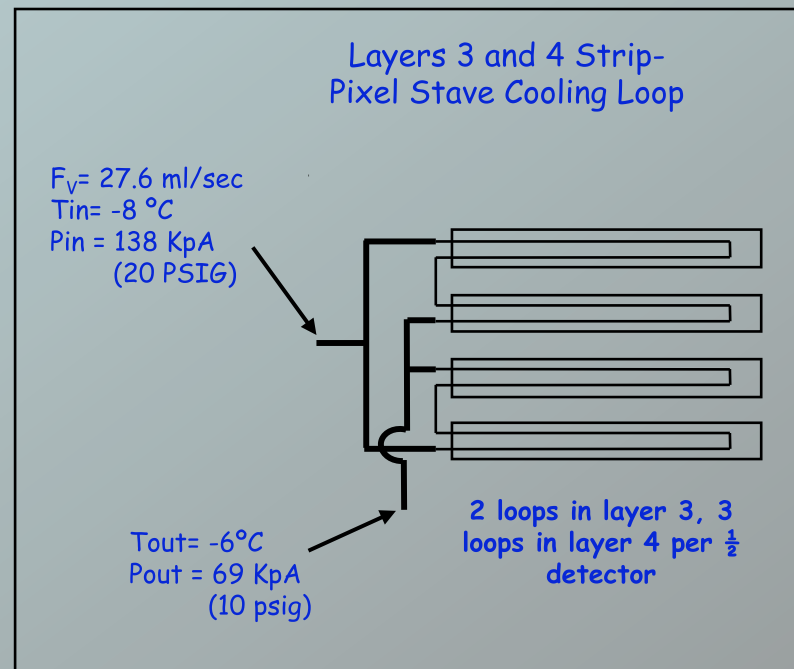
Flow calculations for FVTX based on available information in FEA, tabulating spreadsheet and flow diagrams provided by HYTEC. Calculations should be considered as design requirements for future FVTX design work to assure appropriate flow balancing.

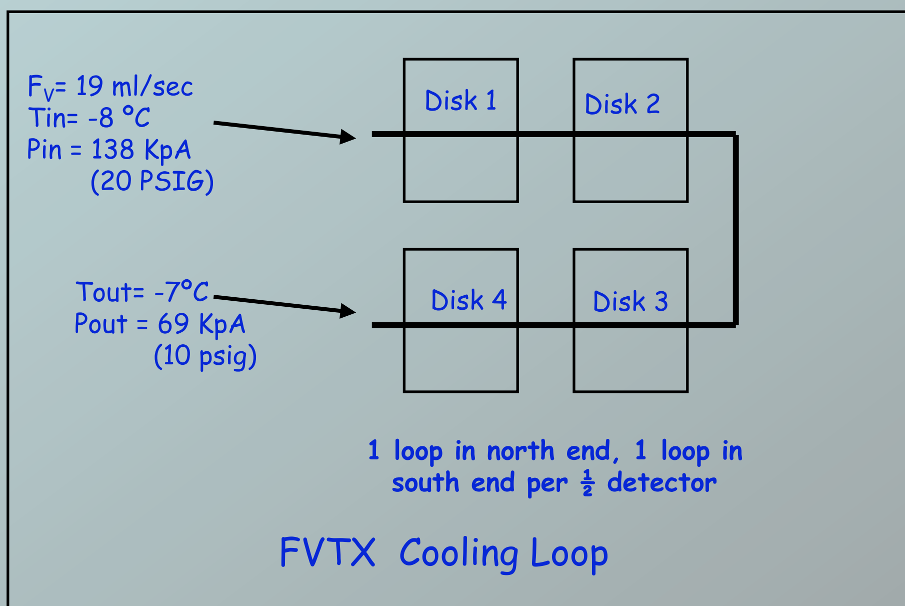
Flow calculations were iterated until flows were balanced by pressure drop among all parallel loops and maximum exit temperatures for all loops met above requirements

The FVTX exit flow will be channeled through an external heat exchanger to precool N2 flow to the detector gas enclosures. This will be established empirically during VTX installation and the results provided to FVTX for final thermal/flow design refinements after VTX installation this summer.

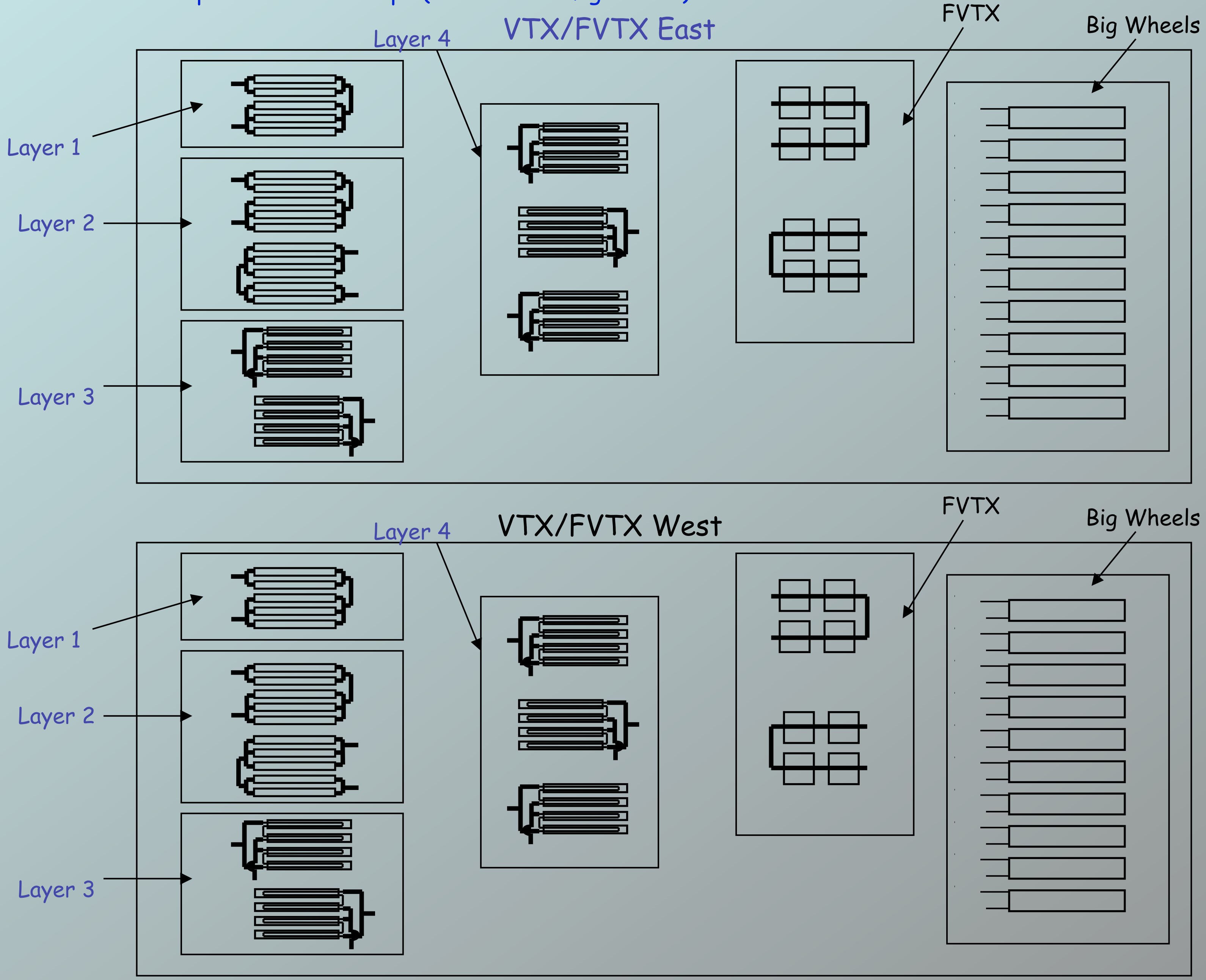
New internal loop designs which meet design requirements



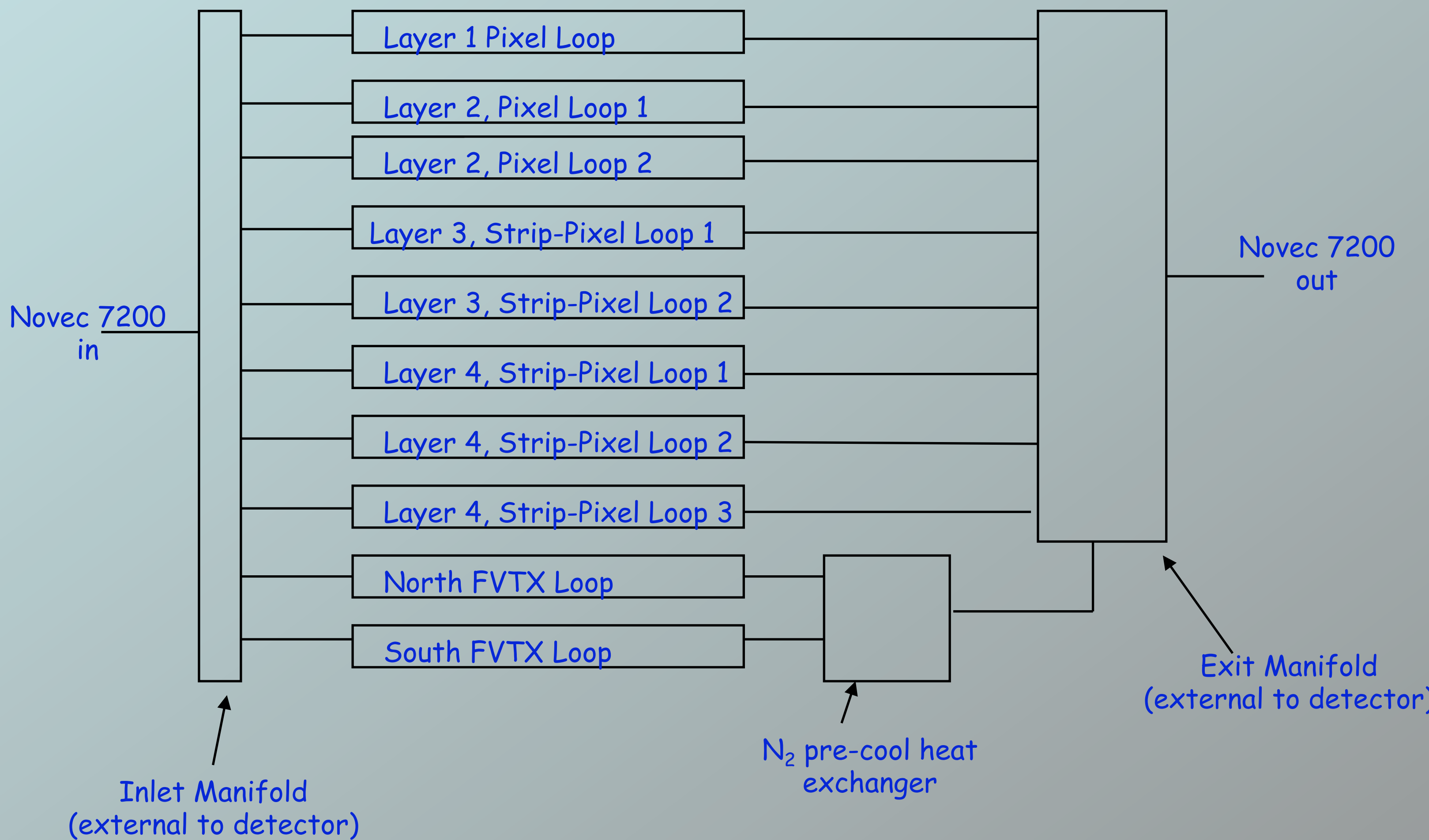




Current Proposed Flow Concept (Internal Configuration)



VTX/FVTX Flow Schematic, ½ detector



VTX/FVTX Thermal Calculation Summary

Layer	Coolant	Number of loops/layer	# Circuits in parallel per loop	# of passes in series per loop	Fluid Inlet Temperature		Inlet Pressure		Flow rate in circuit		Total flow rate in loop	
					°F	°C	psi g	kPa	gpm	ml/sec	gpm	ml/sec
1	Novec 7200	1	3*	2	17.5	-8.056	20	137.895	0.137	8.64	0.274	17.29
2	Novec 7200	2	3*	2	17.5	-8.056	20	137.895	0.137	8.64	0.274	17.29
3	Novec 7200	2	2	2	17.5	-8.056	20	137.895	0.219	13.82	0.438	27.63
4	Novec 7200	3	2	2	17.5	-8.056	20	137.895	0.212	13.38	0.424	26.75
FVTX	Novec 7200	2	1	4	17.5	-8.056	20	137.895	0.3	18.93	0.3	18.93

Layer	Total Loop Heat Load		Fluid Outlet Temperature		Loop Pressure drop		Maximum Sensor Temperature		Notes
	BTU/hr	Watts	°F	°C	psid	kPa	°F	°C	
1	450	132	25.1	-3.9	10.0	68.9	67.1	19.5	2 circuits in 1st pass, 3 circuits in 2nd pass
2	450	132	25.1	-3.9	10.0	68.9	66.7	19.3	
3	340	100	21.1	-6.1	10.0	68.9	31.5	-0.3	
4	392	115	21.8	-5.7	10.0	68.9	32.2	0.1	
FVTX	500	146	25.2	-3.8	10*	68.9	65.8	18.8	* includesDisk 1 through 4 in series and N2 pre-cool heat exchenger

Inlet and Return Piping
Calculations & Requirements

After determining internal flow requirements, the inlet and exit piping requirements were analyzed with the following results:

Flow: ~7.5 gpm
Piping length: 100 feet each, inlet and outlet
Inlet and outlet ambient heat gain: 1.4 kW (total for inlet and outlet assumes moderately insulated piping)
Pipe size: 1 inch ID
Piping pressure drop: 8.45 psid inlet and same for outlet (maximum allowed 10 psid both sides)

VTX/FVTX Chiller Requirements (not including "Big Wheels")

Coolant: Novec 7200

Flow rate: 7.5 gpm

Coolant Supply Temp.: -9°C

Coolant Supply Pressure: 30 psig

Capacity: ~4 kW

VTX/FVTX Chiller Requirments ("Big Wheels")

Coolant: Ethylene Glycol/Water 60/40

Flow rate: TBD gpm

Coolant Supply Temp.: TBD °C

Coolant Supply Pressure: TBD psig

Capacity: ~2.5 kW

Where To Find PHENIX Engineering Info

The shutdown starts in just over 2 months. Keep track of our progress on the PHENIX Engineering Web site at the link below.

Links for the weekly planning meeting slides, archives of past meeting slides,long term planning, pictures, videos and other technical info can be found on the PHENIX Engineering web site:

http://www.phenix.bnl.gov/WWW/INTEGRATION/ME&Integration/DRL_SSint-page.htm