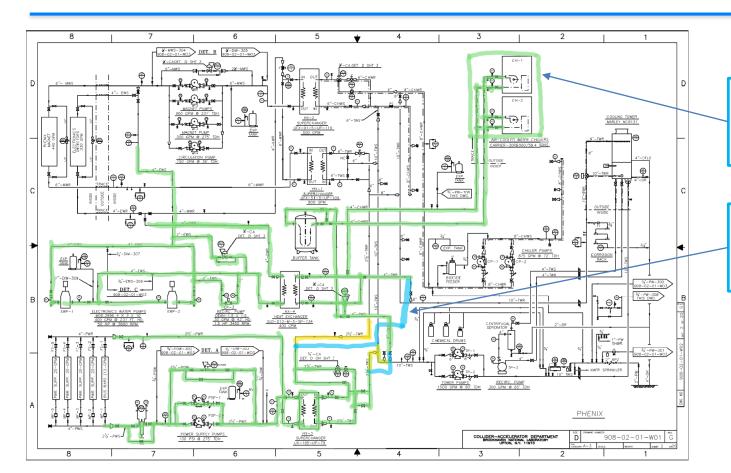


ECW Distribution System for sPHENIX

Brookhaven National Laboratory
Peter Hamblen
August 23rd, 2022

1008C Water P&ID for PHENIX from C-AD



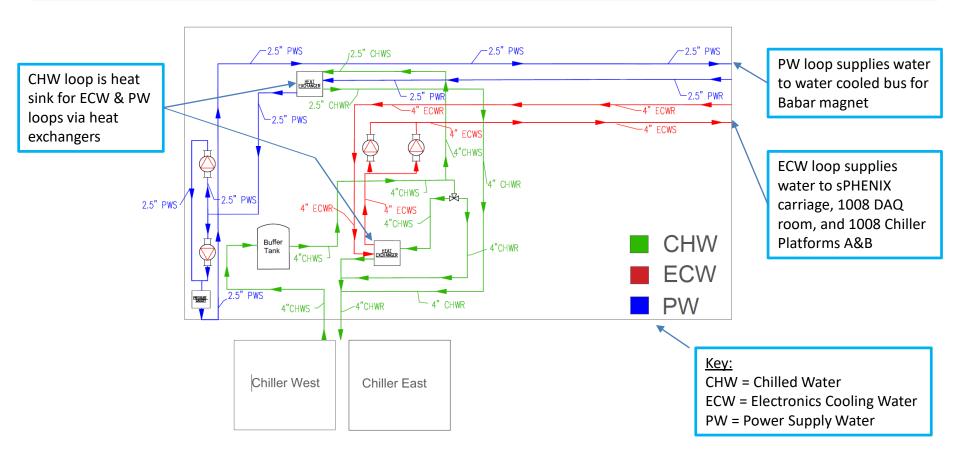


Green highlights are portion of existing 1008C system to be used for sPHENIX

Blue/yellow highlights are modifications that have been made to existing 1008C system for sPHENIX

1008C Pump Room Diagram for sPHENIX from C-AD





ECW Distribution Design for sPHENIX Carriage

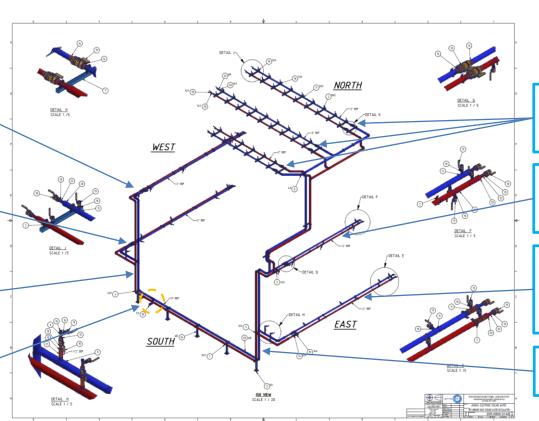


Ø2"CU 2nd level west distribution branch for electronics racks

Ø2"CU 1st level west distribution branch for electronics racks and detector components

Ø3"SS west carriage supply & return riser

Ø3"SS ECW supply & return connection points for carriage



Ø2"CU 3rd level distribution branches for electronics racks

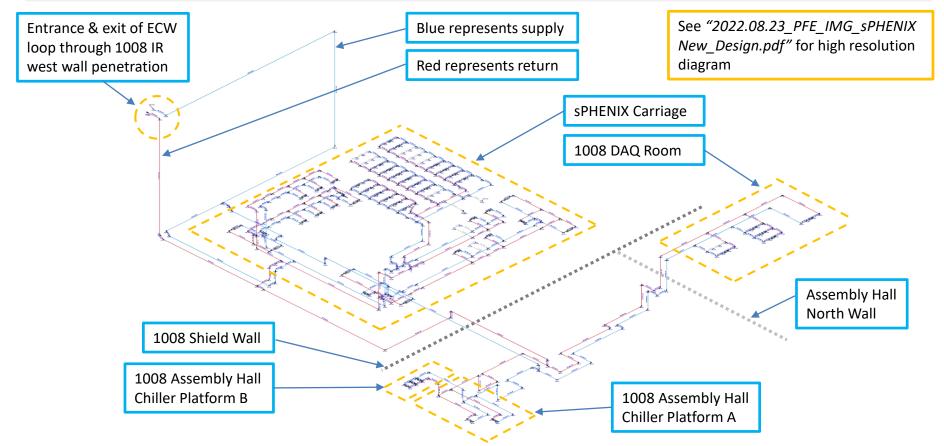
Ø2"CU 2nd level west distribution branch for electronics racks

Ø2"CU 1st level east distribution branch for electronics racks and detector components

Ø3"SS east carriage supply & return riser

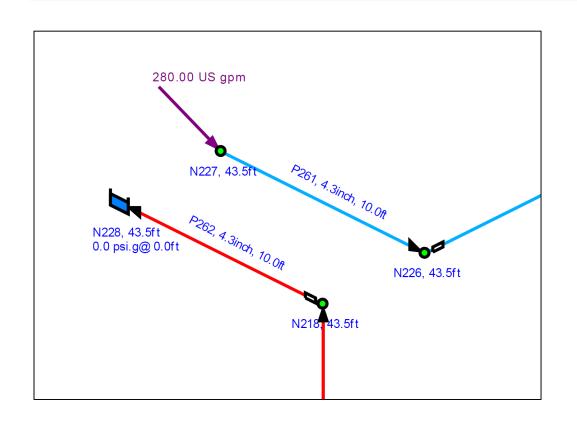
ECW Distribution Design for sPHENIX





Analysis Boundary Conditions





Fluid:

Water (H₂O), 68 F

Boundary Conditions:

Entrance point

Node: N227

Type: Join point

Elevation: 43.5 ft

Demands in: 280 US gpm

Exit point

Node: N228

Type: Tank

Fluid elevation: 0 ft

Surface pressure: 0 ft

• Elevation: 43.5 ft

<u>Solver:</u>

Non-Compressible Flow with Darcy-Weisbach Equation (Colebrook-White Friction Factors)

Analysis Constraints



Constraints

- Carriage Racks
 - Flow rate demand set at each according to number of HX's in each rack
 - Pressure loss across each rack assumed to be <u>6.4 psi</u> (based on single HX test set-up)
- Carriage Detector Panels
 - Flow rate demand set at each according to "Day 1" subsystem requirements
 - Pressure loss across each panel assumed to be <u>10 psi</u> (cons.)

DAQ Room Equipment

- Flow rate demand set at each according to number of HX's in each rack
- Pressure loss across each rack assumed to be <u>10 psi</u> (cons.)

Chiller Platforms A & B Equipment

- Flow rate demand set at each according to subsystem requirements
- Pressure loss across each unit assumed to be <u>10 psi</u> (cons.)

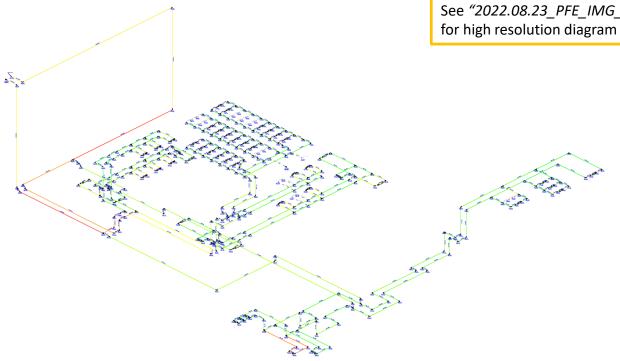
Analysis Results



Pipe Flow Software - ECW Distribution System for sPHENIX - PF Expert Solution

23 August, 2022

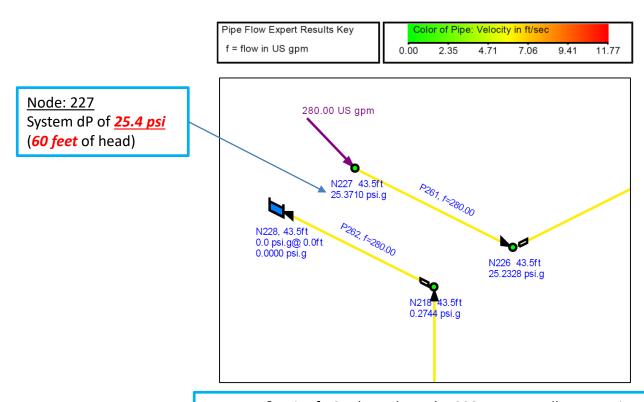




See "2022.08.23_PFE_IMG_sPHENIX New_Analysis.pdf" for high resolution diagram

Flow Analysis Results (1 of x)

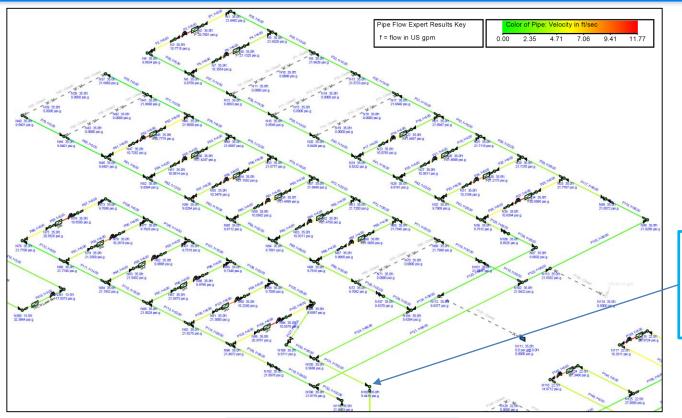




Entrance & exit of ECW loop through 1008 IR west wall penetration

Flow Analysis Results (2 of x)





Node: N109 dP of ~12 psi across <u>3rd level</u> distribution system

3rd level ECW distribution system

Summary/Conclusions:



- 1. The analysis indicates that the <u>pressure drop</u> or <u>pump head</u> across the 1008 ECW distribution system, according to the BC's and assumptions, will be at least <u>26 psi</u> (60 feet of head)
- 2. With a flow rate "in" of **280 US gpm**, everything will get the flow we want it to get on **"Day 1"**
- 3. The ECW loop is a closed loop system. Flow restriction is needed at each piece of equipment to balance the system as a whole. The sPHENIX carriage racks and panels have or will have flow restriction by design. The equipment on Chiller Platforms A & B have flow restriction built in. The Trigger rack will have flow restriction built in by design, but the other equipment in the DAQ room need to have flow restriction installed. The list includes:
 - 1. PRR3.1
 - 2. PRR3.2
 - 3. PRR4.1
 - 4. PRR4.2
 - 5. Portable A/C Unit

Supporting Documents List



- 1. 2022.08.23 PFE Report.pdf
- 2. 2022.08.23_PFE_Results.xlxs
- 3. 2022.08.23_IMG_sPHENIX New_Design.pdf
- 4. 2022.08.23_IMG_sPHENIX New_Analysis.pdf
- 5. 2022.08.23_IMG_sPHENIX New_Analysis Re Study.pdf
- 6. 2022.08.23_IMG_sPHENIX New_Analysis Total dP.pdf
- 7. 2022.08.23_IMG_sPHENIX New_Analysis Internal Pipe Diameter.pdf
- 8. sPHENIX ECW Loads_2022.08.23.xlsx
- 9. sPHENIX Water and Gas Systems ICD_WORKING COPY.pptx
- 10. sP.SE-ICD-042_WORKING COPY.xlsx
- 11. 908-02-01-W02.pdf
- 12. 1008C Pump Room rev1.pdf



Backup Slides

Friction Factor Setup – Typical Carriage Rack



