

Primary Beamline Low Conductivity Water (LCW) Preliminary Design Review

Print Package Review & Major Electrical Requirements

131.01.03.03.02.04.02 Primary Water LCW System

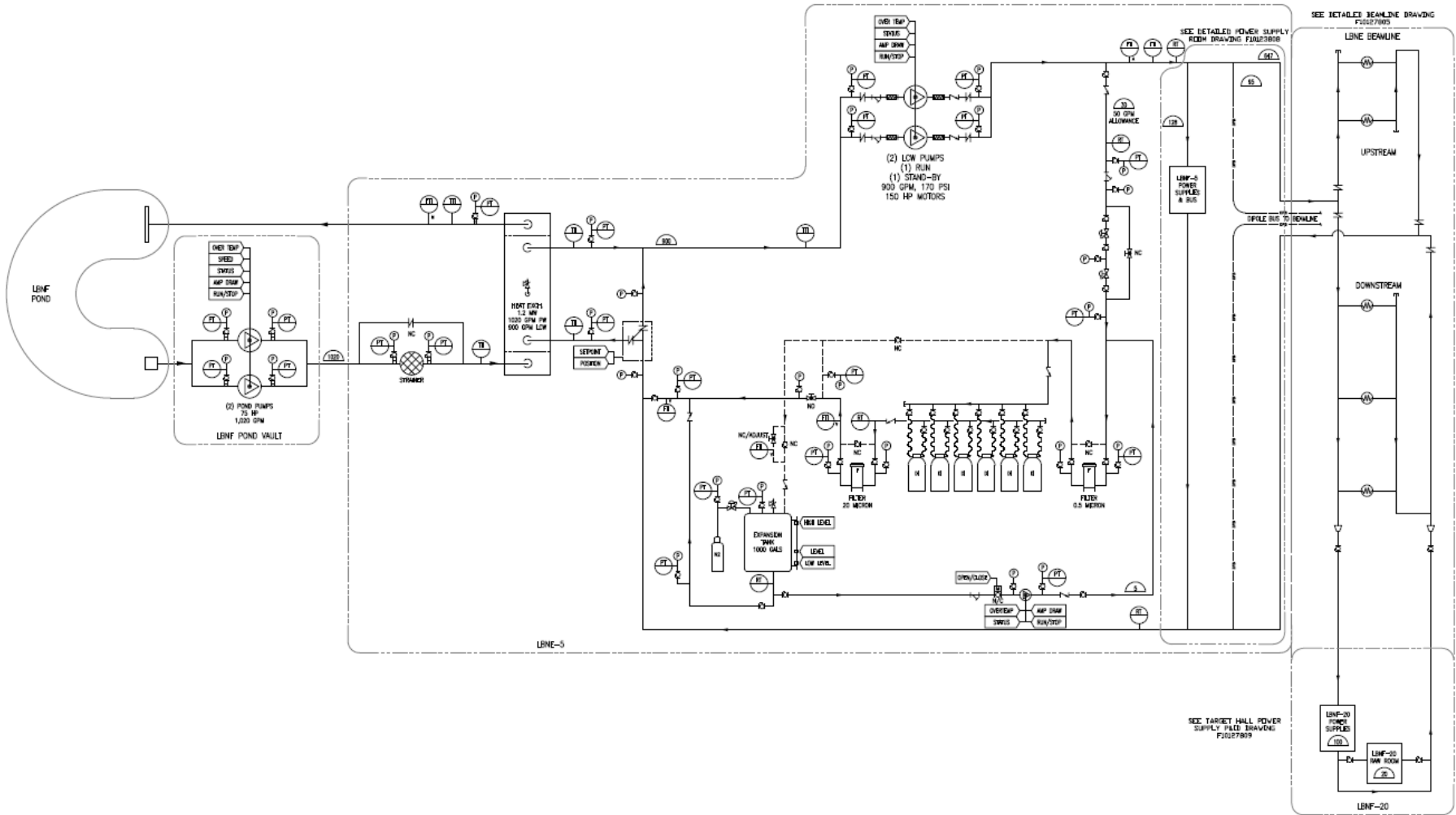
131.01.03.03.02.04.03 Electrical Bus

Noah Curfman

October 31, 2019

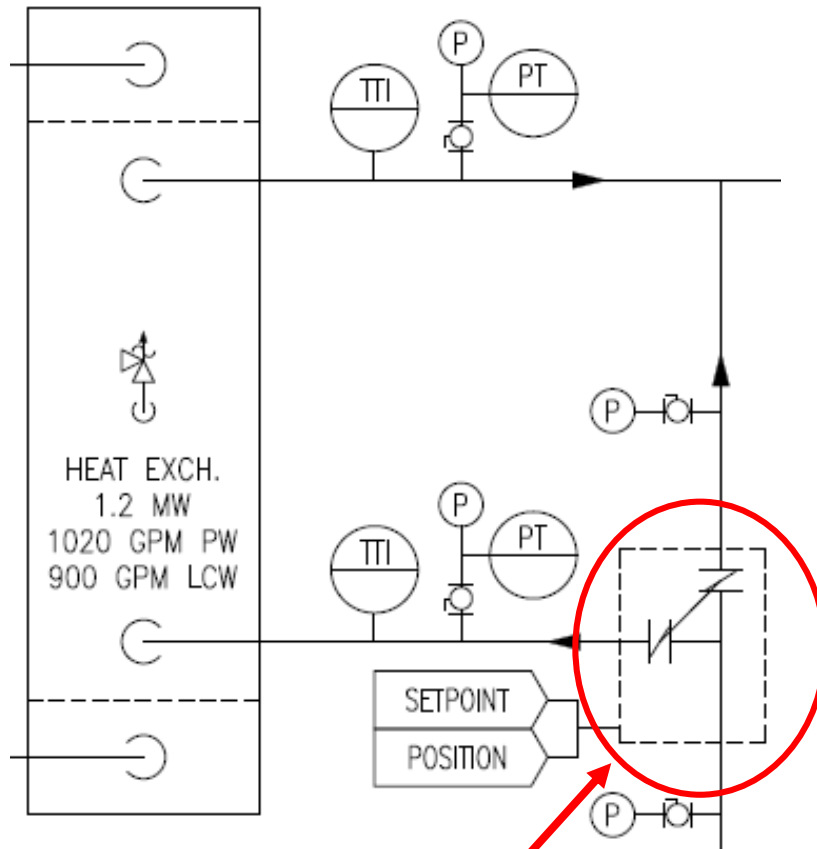


LBNF-05 Magnet LCW Overall Flow Schematic



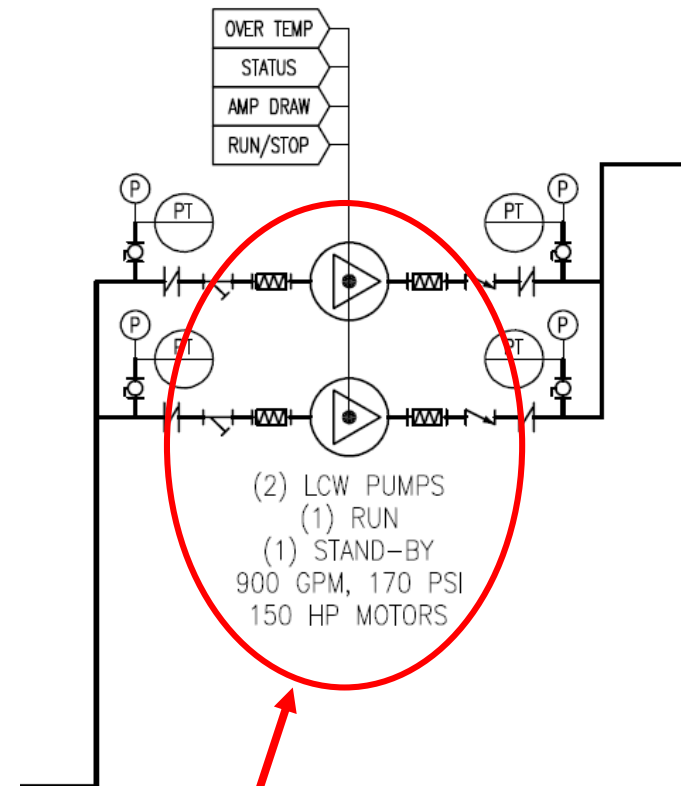
LBNF-05 Magnet LCW Overall Flow Schematic

Heat Exchanger Bypass



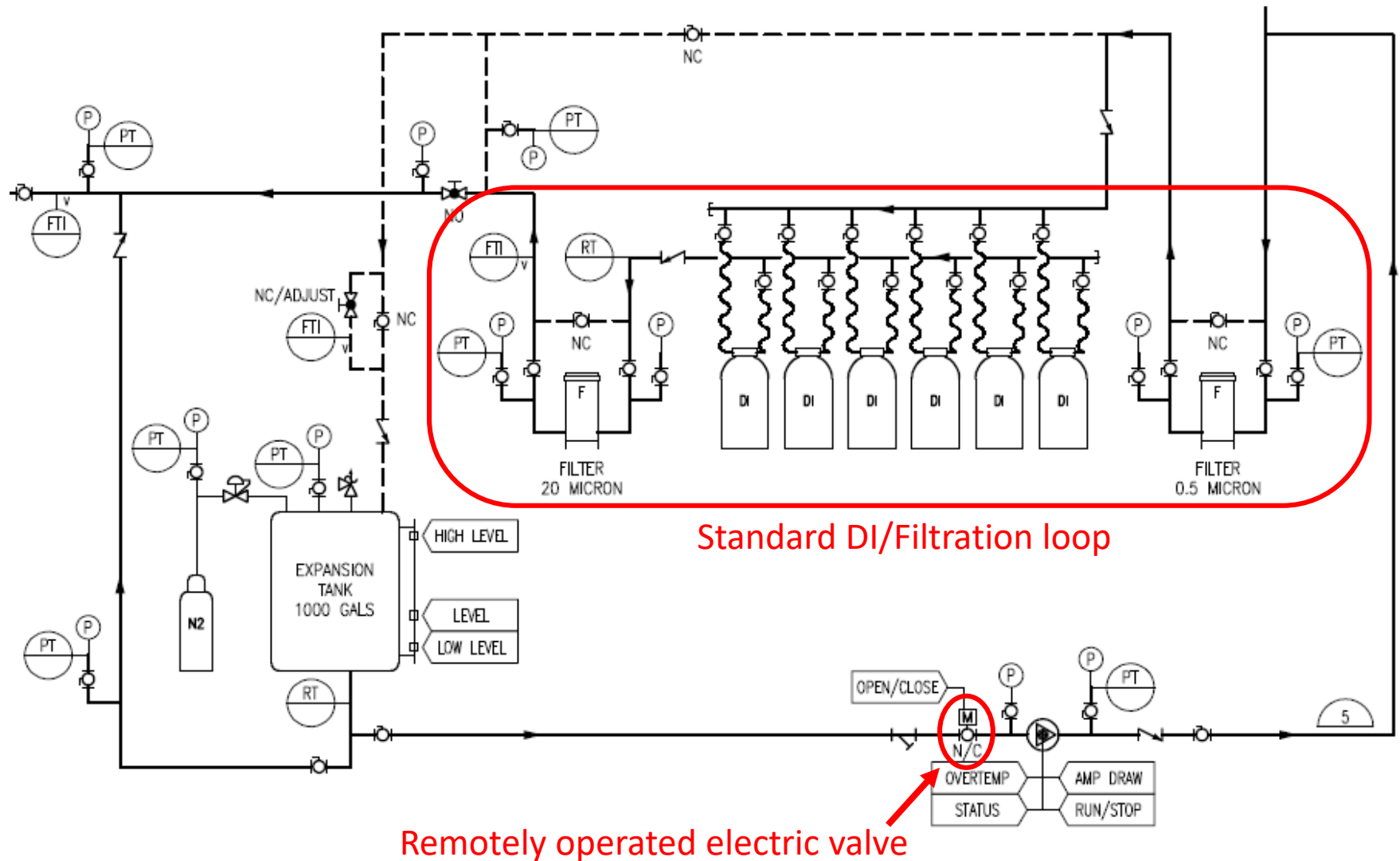
Remotely operated 3-way valve

Pump Diagram

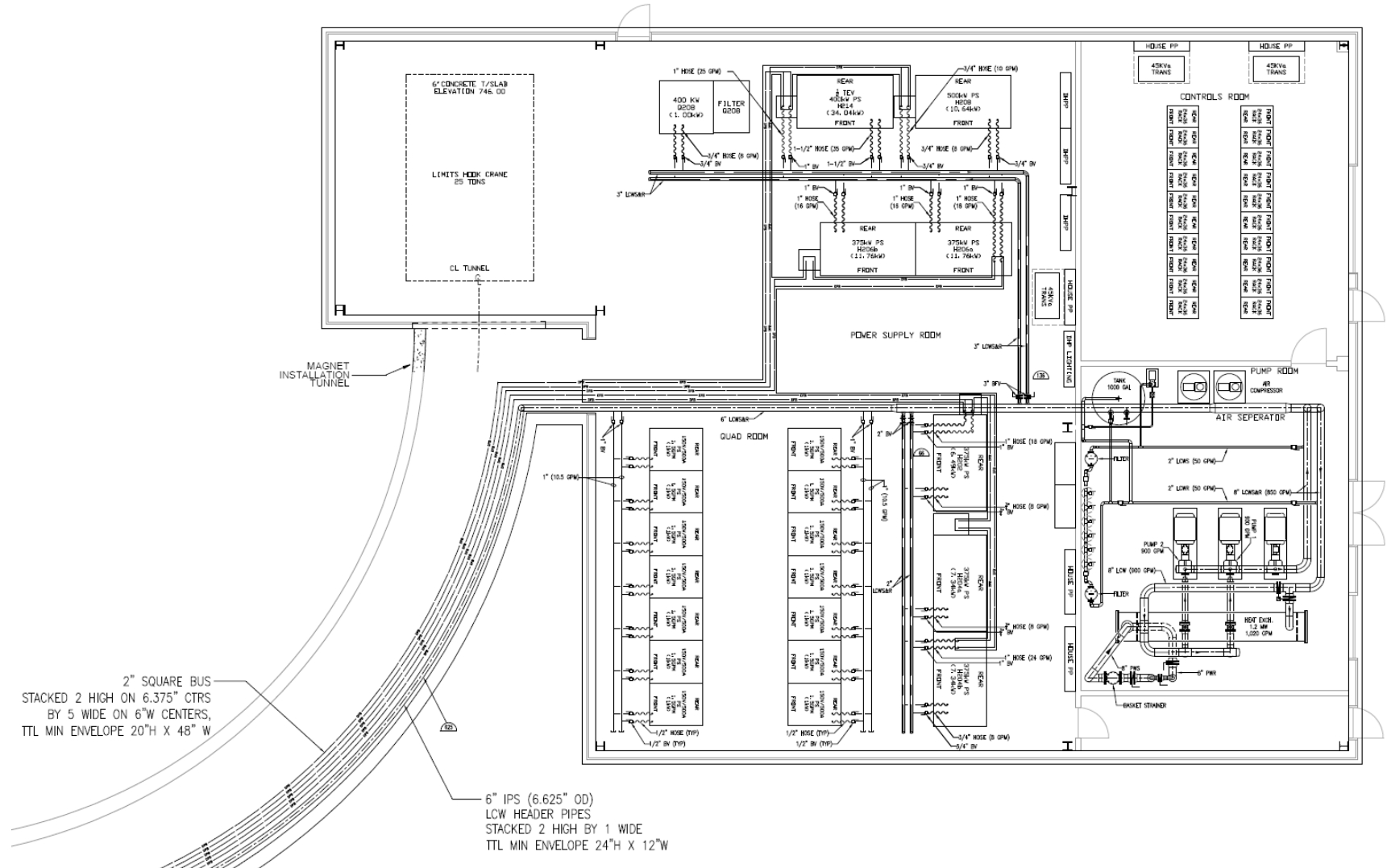


Primary LCW pumps

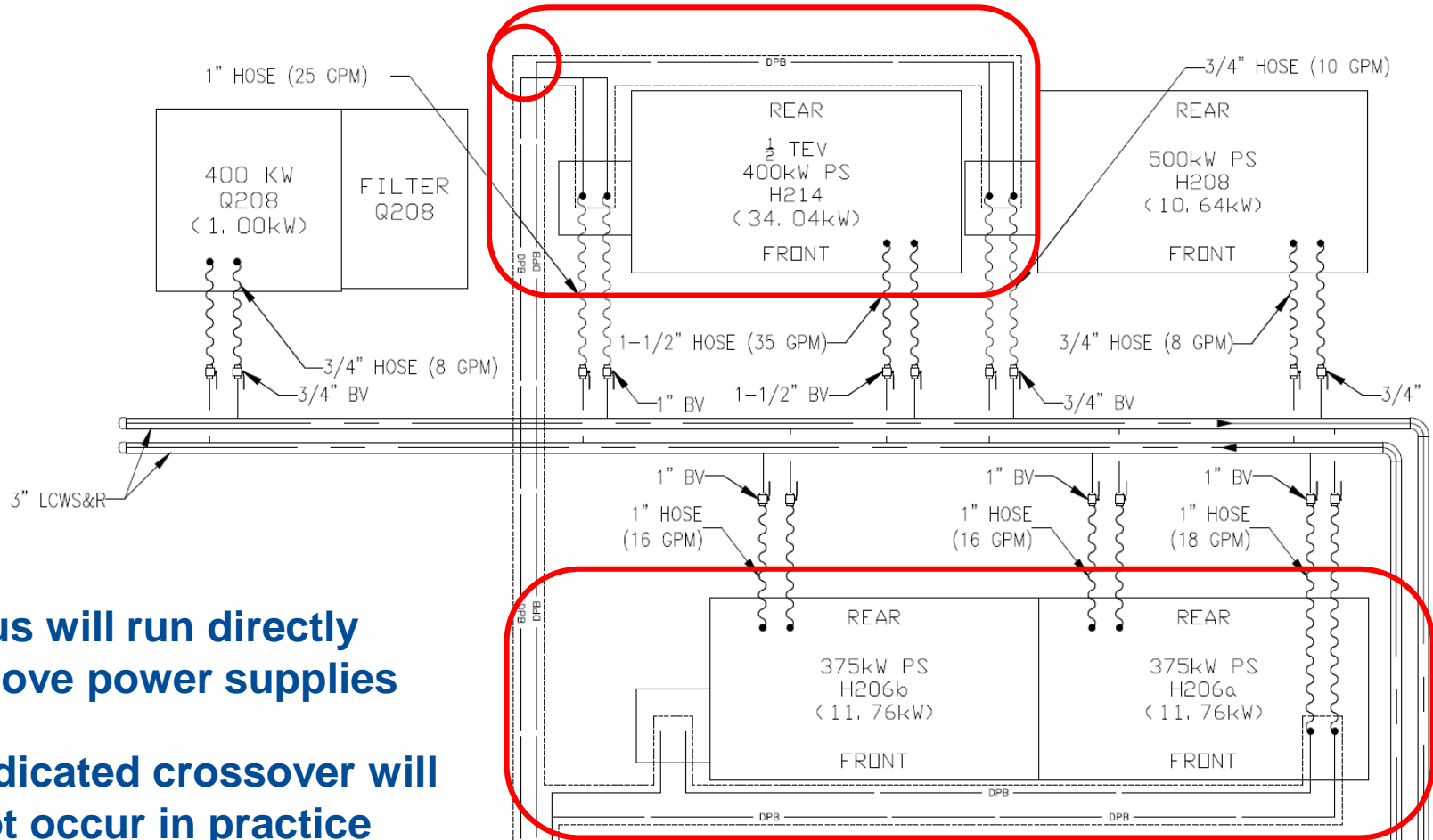
LBNF-05 Magnet LCW Overall Flow Schematic



LBNF – 5 Service Building LCW Piping Arrangement



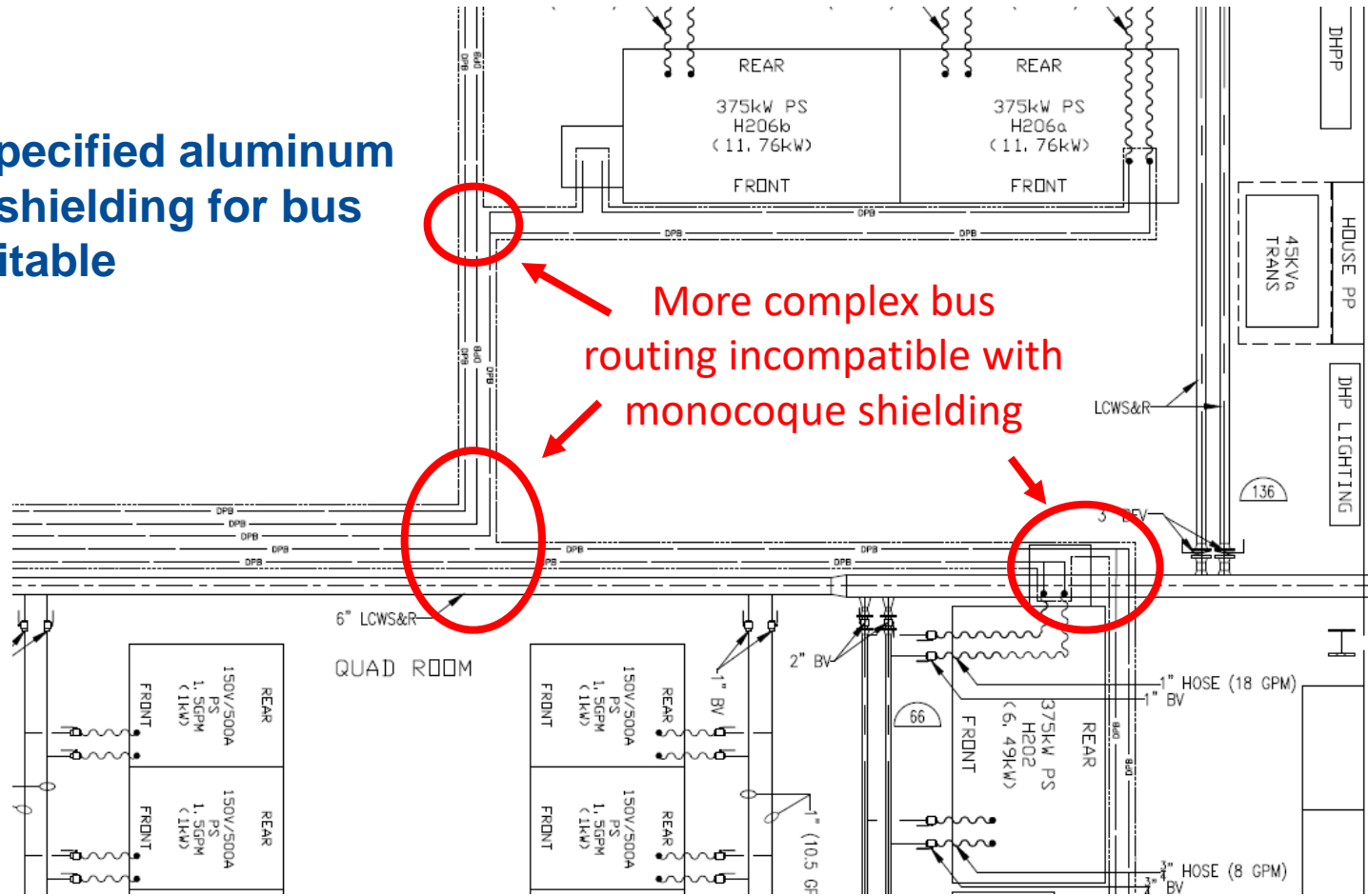
LBNF – 5 Service Building LCW Piping Arrangement



- **Bus will run directly above power supplies**
- **Indicated crossover will not occur in practice**

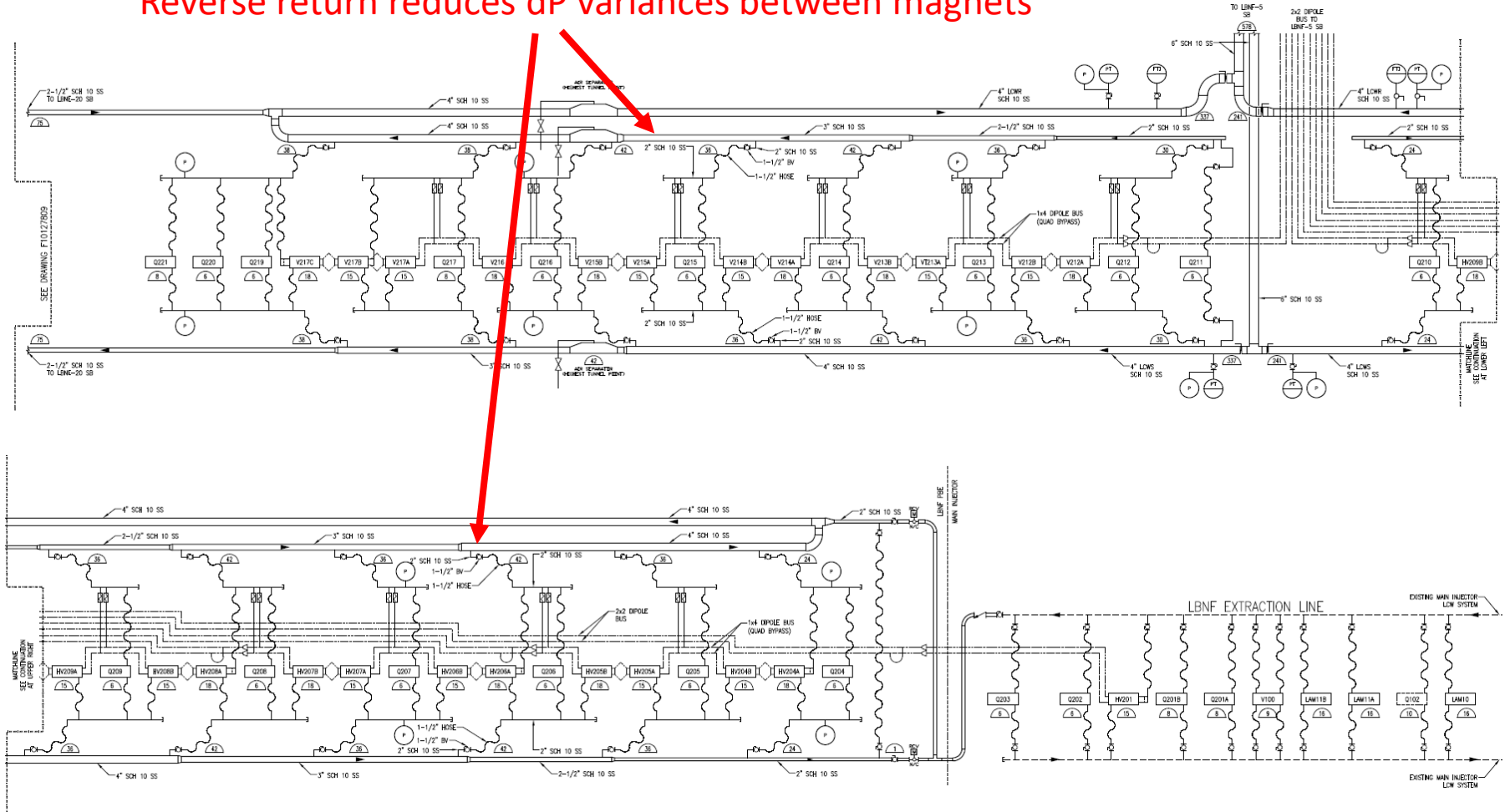
LBNF – 5 Service Building LCW Piping Arrangement

- Previously specified aluminum monocoque shielding for bus no longer suitable



LBNF Primary Beamline LCW & Bus Flow Schematic

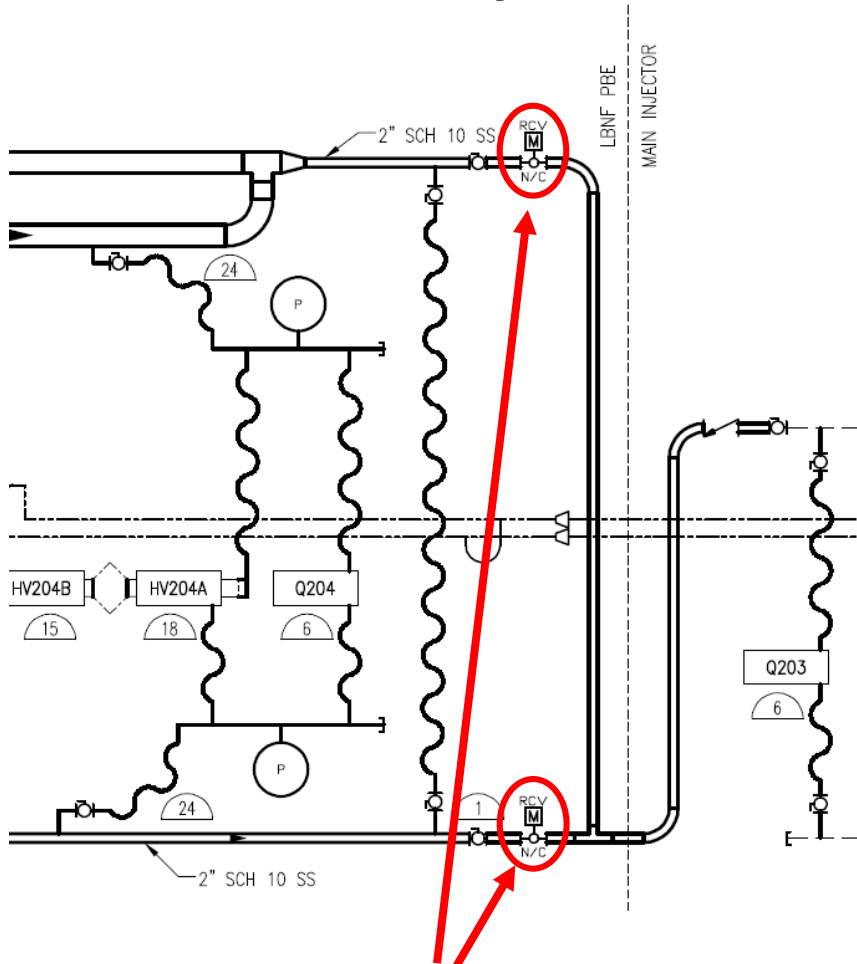
Reverse return reduces dP variances between magnets





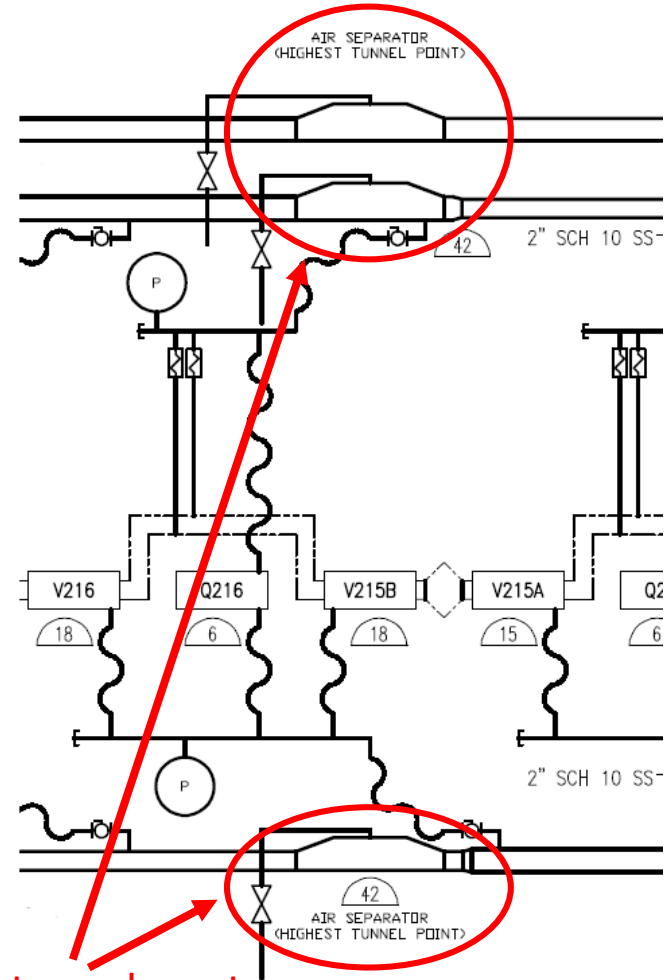
LBNF Primary Beamline LCW & Bus Flow Schematic

LBNF LCW Fill System



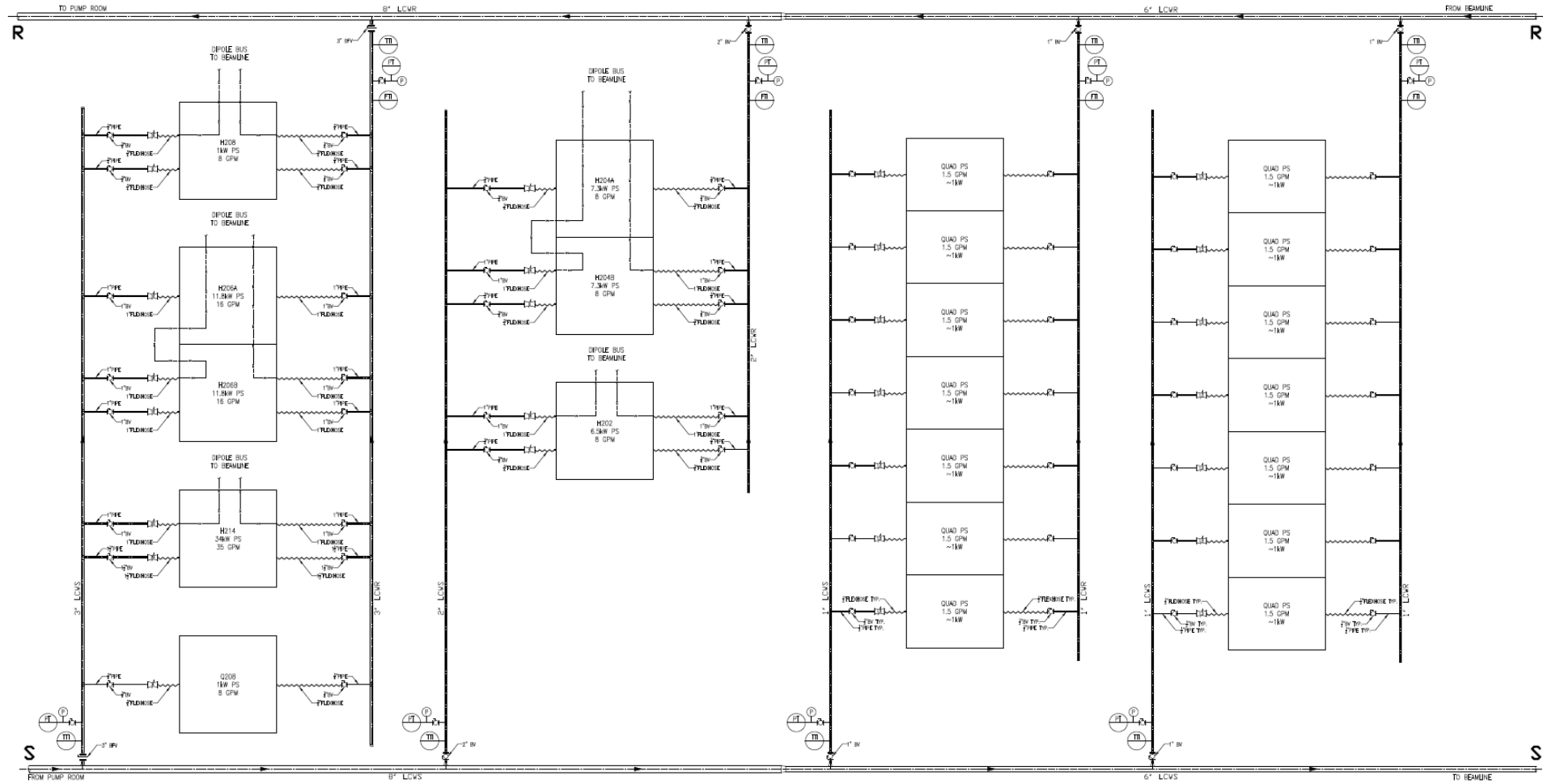
Remotely operated electric valves

Beamline Tunnel Crest



Air separators at tunnel crest

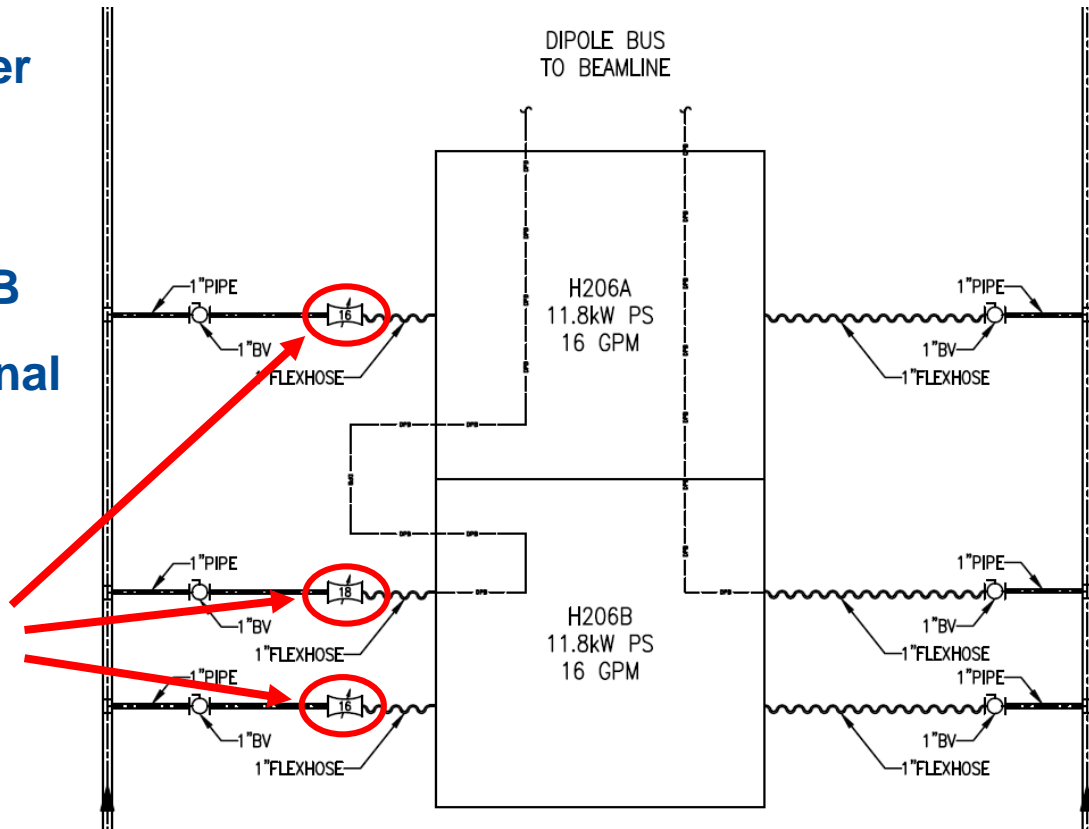
LBNF – 5 Service Building Power Supply P&ID



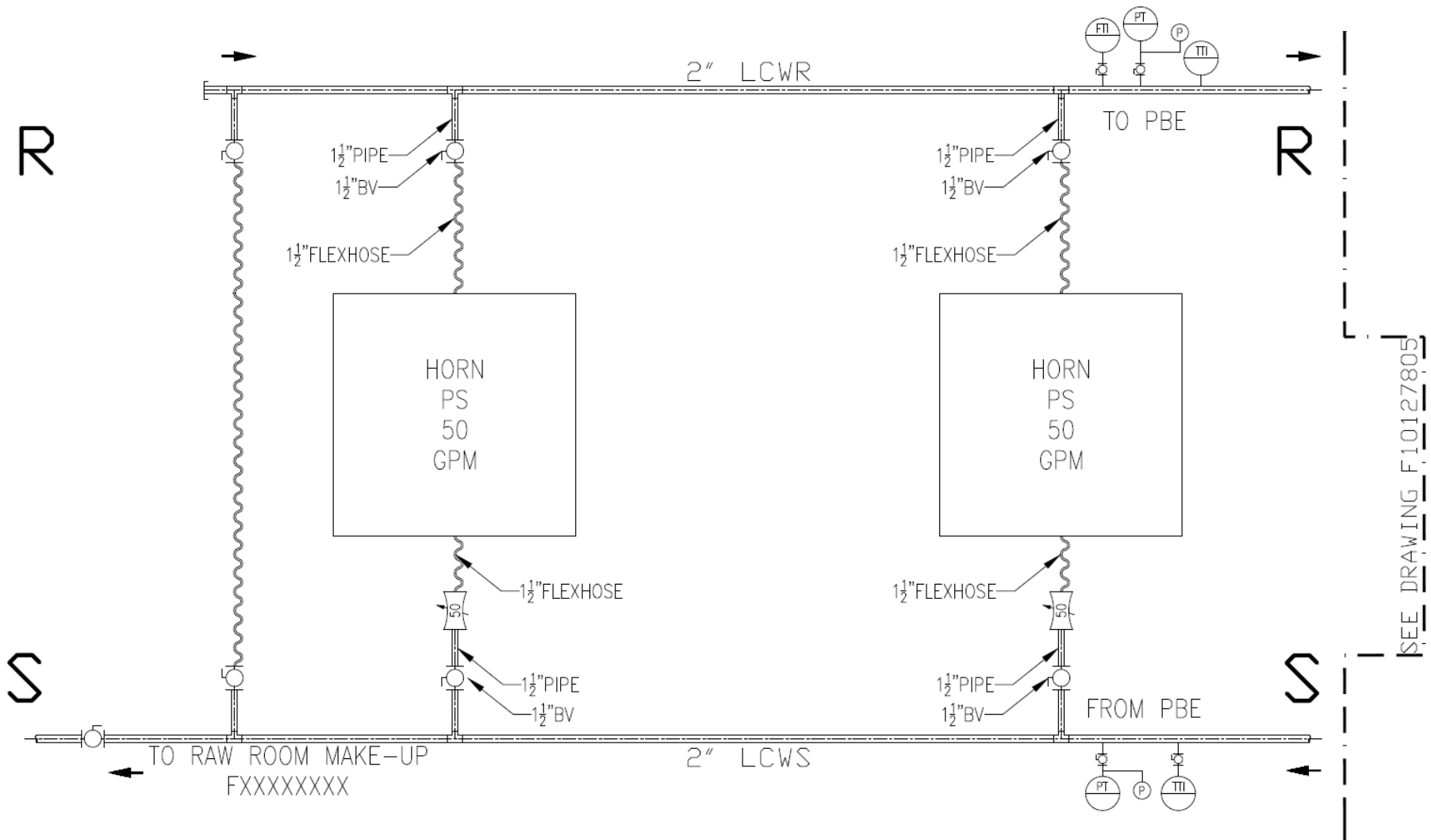
LBNF – 5 Service Building Power Supply P&ID

- One flow control valve per power supply
- Bus jumpers between A/B power supplies are external

Griswold Flow Control Valves



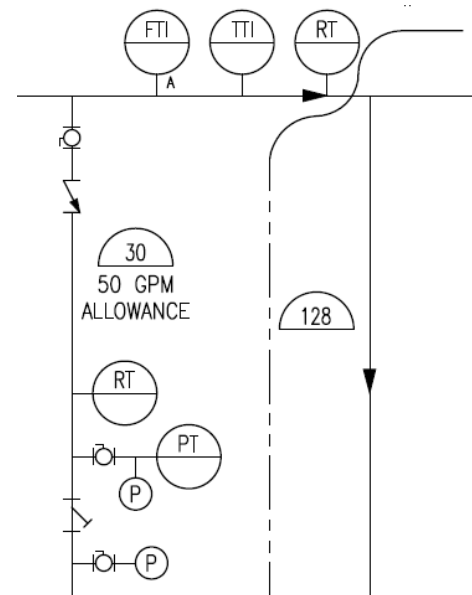
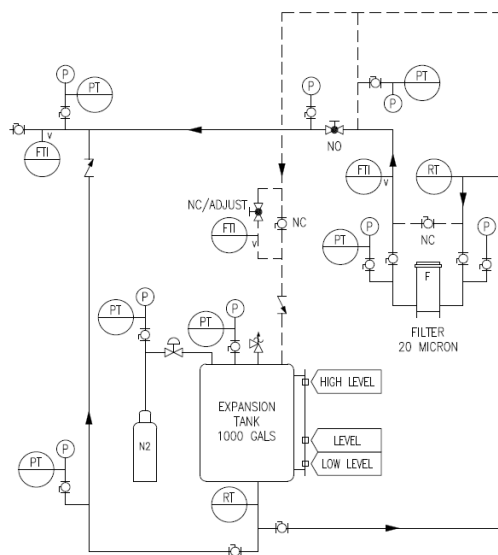
LBNF – 20 Target Hall Power Supply P&ID



SEE DRAWING F10127805

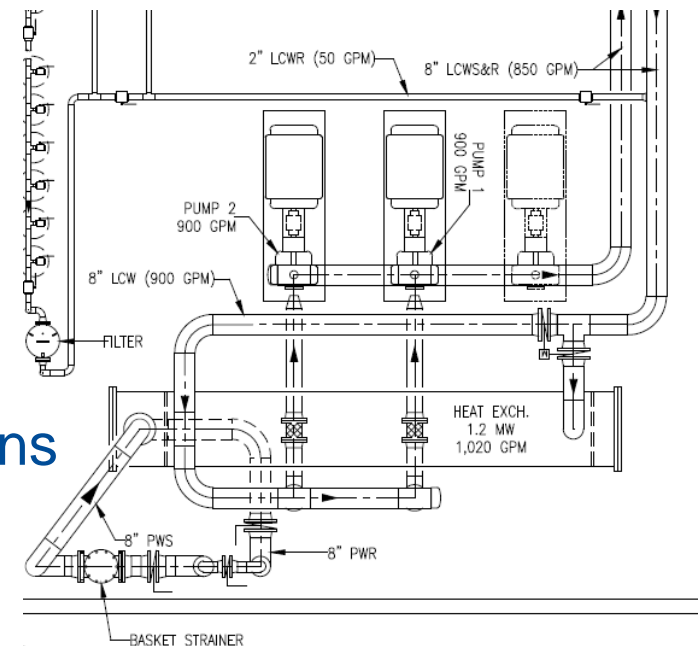
Instrumentation

- Designed based on MI and similar LCW Systems
- Detailed estimates and info found in DUNE DocDB Doc #9955
- Specific component selection delayed to take advantage of emerging technologies



System Redundancy

- Two 150HP Pumps, one running, one hot spare
 - Both pumps VFD controlled
- All major components may be valved out for replacement
 - Filters
 - DI bottles
 - Power supplies
 - Instrumentation
 - Magnet cells
- Recirculation jumpers on all supply/returns



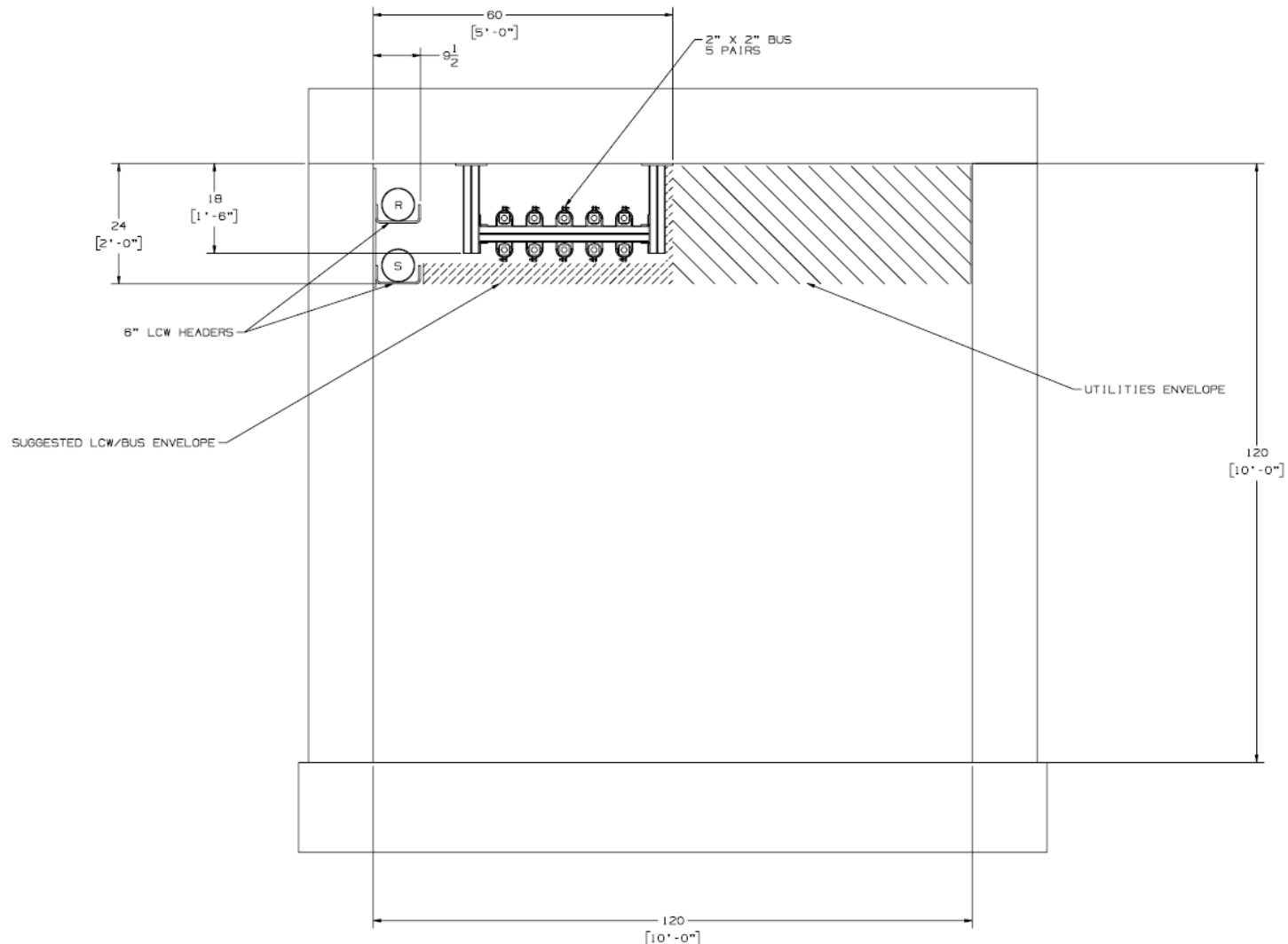
Electrical Requirements

- 2 primary circulation pumps with VFDs
- 3 electrically actuated valves
 - 1 valve in pump room
 - 2 valves in beam enclosure
- 1 three-way valve to control HX flow

Power Requirements

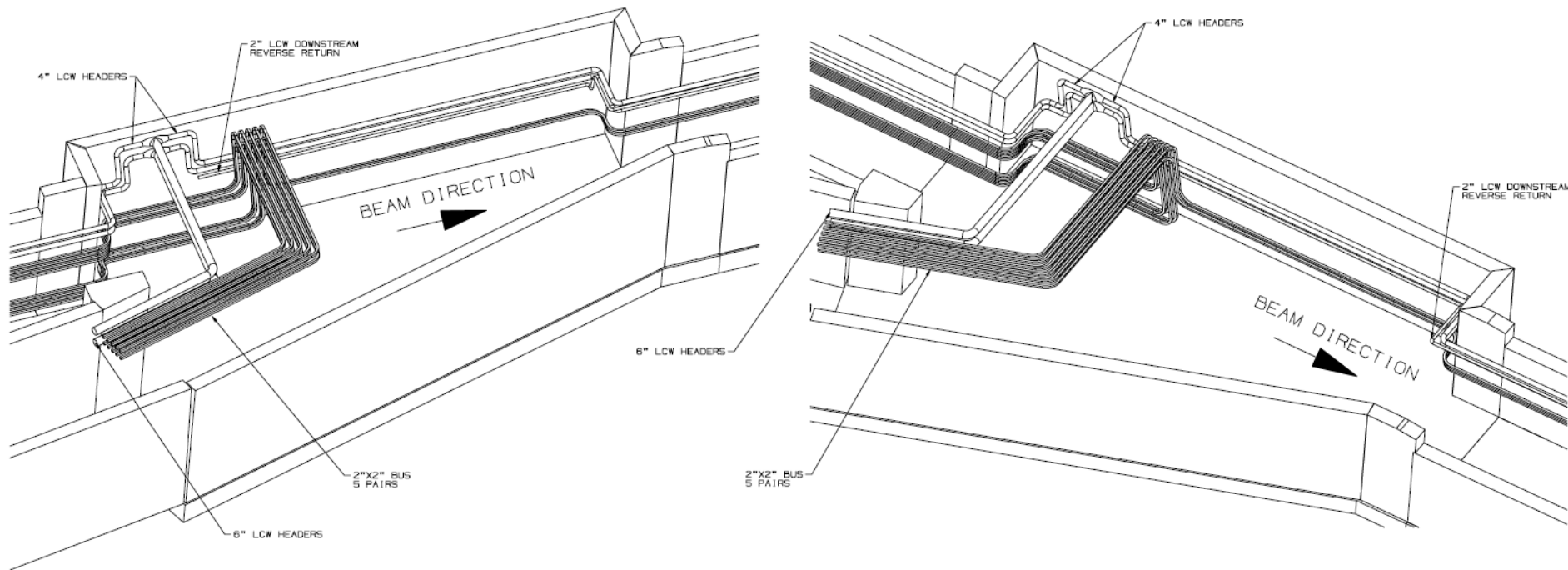
	Quantity	Rated Power	Voltage	Input Phase	I @ Full Load	I @ Stall
Primary Pumps	2	150 HP	480 V	Three	177 A	969.4 A
Recirculation Pump	1	1/2 HP	480 V	Three	2.2 A	Not Listed
Primary Pump VFDs	2	150 HP	480 V	Three	180A	N/A
3 Way Valve Actuator	1	1/12 HP	480 V	Three	0.32 A	1.16 A
Electrically Operated Valves	3	0.5 HP	120 V	Single	Not Listed	3A (est.)
Control Panel	1	N/A	110V	Single	15A	N/A

LBNF Vehicle Access Tunnel LCW Piping & Bus Layout



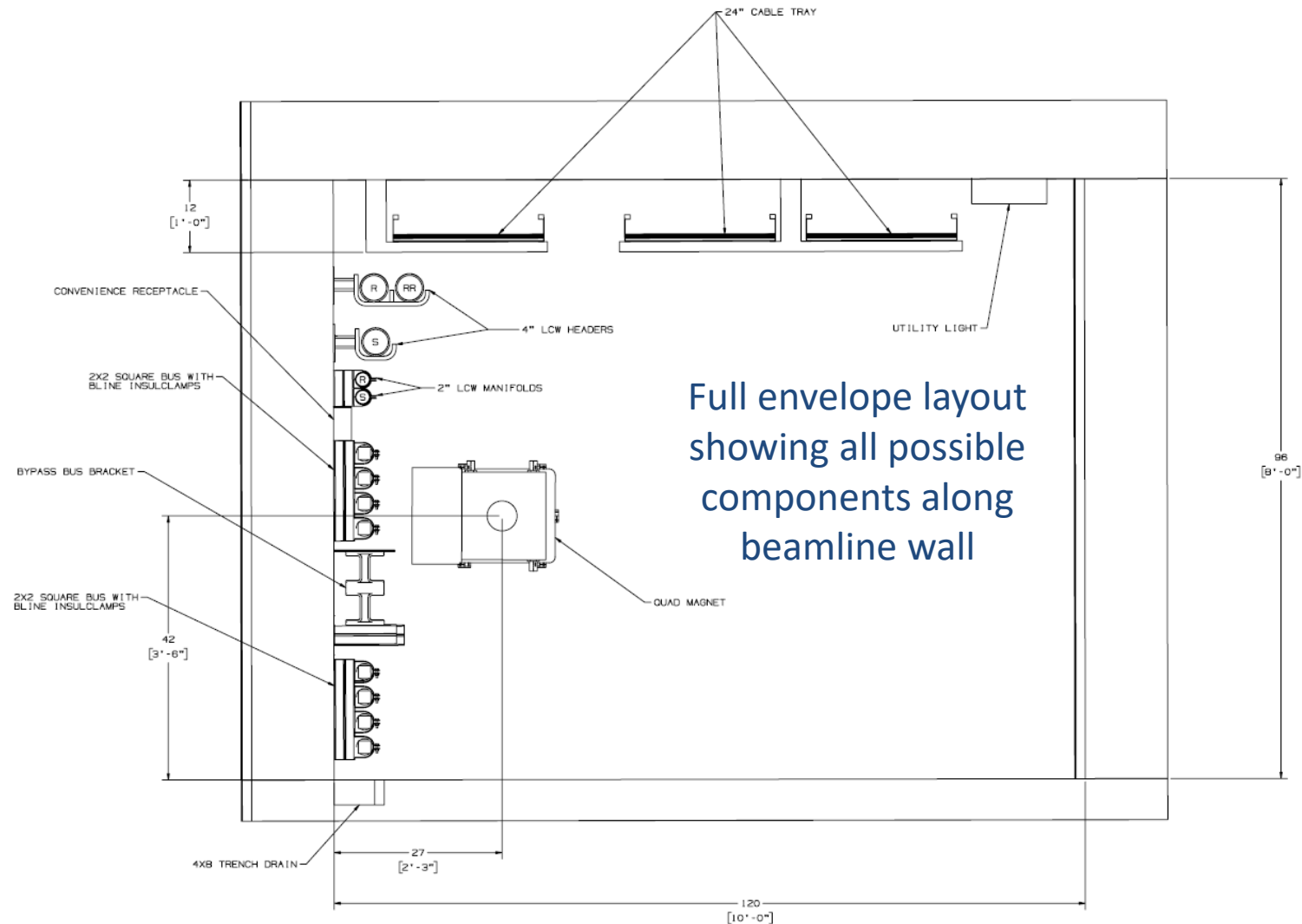
LBNF Beamline LCW Pipe & Bus Routing

- Provides maximum room for cable trays in alcove
- 2" LCW Downstream return continues into alcove for Q211

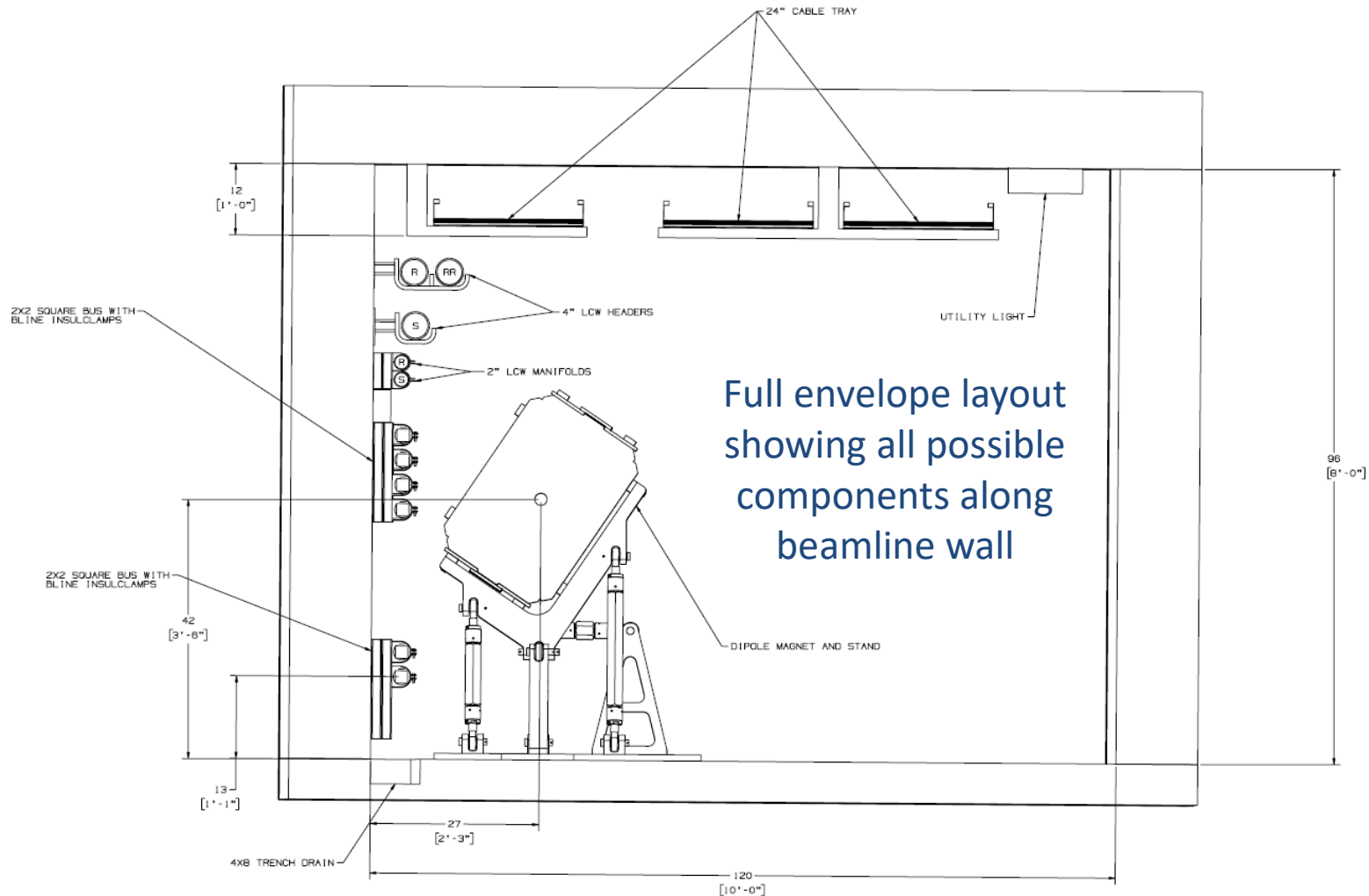


VIEW FROM ABOVE WITH CEILING REMOVED

Full Layout Envelope Showing Bus LCW Cable Trays and Headers



Full Layout Envelope Showing Bus LCW Cable Trays and Headers



System Design Requirements

- Meet previously described operational goals
- Require minimal unscheduled interventions
- Meet established lab standards for flow and capacity
- Operate over a range of elevations determined by CF
- Use pond water for cooling and MI LCW for fill
- Conform to ASME B31.3 and FESHM 5031.1

Fluid	Low Conductivity Water
Resistivity	9MΩ·cm or better
Nominal Temperature	95°F
Radioactivity	< 1900 pCi/ml
MAWP	200 psig