

# Neutrino Beamline Absorber Hall RAW Exchange System Preliminary Design Review

## Technical Design Aspects

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# Absorber Hall RAW Exchange System

## Outline

- Purpose and Options
- Design Requirements
- Design Standards and Codes
- Design Layout and Details
  - System Operational Parameters
  - Approximate Room Layout
  - Flow Model and P&ID
- Summary
  - Pending Items
  - Questions

# Absorber Hall RAW Exchange System

## Purpose and Options – Option 1

- There will be two options presented; the first is Drain and Fill/Make-up of the radioactive cooling water (RAW) and Intermediate Water (INTW) systems. This option includes two independent functional sections:
  - Draining the Absorber RAW system into radiation safe drums located outside of Absorber Hall for radioactive waste safe disposal and hauling offsite, and Fill/Make-up supply of low conductivity water (LCW) to the Absorber RAW system, located in the LBNF Absorber Hall RAW room.
  - Draining the Intermediate Water system into drums located outside of Absorber Hall for safe disposal, and Fill/Make-up supply of low conductivity water (LCW) to the Intermediate Water system, located in the LBNF Absorber Hall RAW room.

# Absorber Hall RAW Exchange System

## Purpose and Options – Option 2

- The second option allows for Drain and Fill/Make-up of the radioactive cooling water (RAW) and Intermediate Water (INTW) systems, or Bleed and Feed (Burping) of just the radioactive cooling water (RAW) system. This option includes five independent functional sections:
  - Fill/Make-up supply of low conductivity water (LCW) to the Expansion/Storage Tank.
  - Fill/Make-up supply of low conductivity water (LCW) to the Absorber RAW or Intermediate Water (INTW) systems located in the same LBNF Absorber Hall RAW room.
  - Bleed and Feed (Burping) or periodically removing predetermined quantity of RAW from the Absorber RAW system during operation to reduce the contamination concentration of the RAW and thus maintain required cooling water quality.

# Absorber Hall RAW Exchange System

## Purpose and Options – Option 2 (cont.)

- The second option continued:
  - Draining the Absorber RAW cooling system and Intermediate Water (INTW) system completely during repair and maintenance modes, with Absorber RAW drainage initially pumped to a Polyethylene Storage Tank, and Intermediate Water (INTW) drainage into drums located outside of Absorber Hall for safe disposal.
  - Transferring all the drained Absorber RAW into radiation safe drums located outside of Absorber Hall for radioactive waste safe disposal – hauling offsite.

# Absorber Hall RAW Exchange System

## Design Requirements

- The Absorber Hall RAW Exchange System shall:
  - Require minimal unscheduled interventions for maintenance.
  - The system shall meet established lab standards for safety, flow, capacity, and pressure.
  - The Intermediate Water System (INTW) shall be considered non-radioactive with a maximum radioactivity of 1900 pCi/ml.
  - Be supplied with Make-up water filtered to remove all particles larger than 5 microns.
  - Pumps will be constructed of PVDF plastic with Magnetic Drives to eliminate shaft seal leakage.

# Absorber Hall RAW Exchange System

## Design Standards and Codes

- In addition to complying with the following industrial and Fermilab standards and codes, the system design, particularly the system's operation modes, capacity, and valve regulating & controls, is mainly based on Numi/Nova systems' operational experience, lessons learned, and the latest feedback in operational input and upgrades.
  - ASME B31.3 Code for Normal Fluid Service.
  - ASME BPVC Section IX for Welding Process Specifications (WPS's) and welders & pipefitters' Personal Weld Qualifications.
  - Both piping and vessels will adhere to FESHM Chapters 5031, 5031.1, 5031.3, 5034 as well as the Fermilab Engineering Manual.
  - ASTM-D-1998-15, Standard Specification for Polyethylene Upright Storage Tanks.
  - Piping and Tubing will be 304L or 316L ASTM A312 Stainless Steel

# Absorber Hall RAW Exchange System

## System Operational Parameters

- Option 1, Drain and Fill/Make-up only:

Option 1, Drain and Fill/Make-up only - Table-1 - Design Values						
#	Functional Section	System Name	Fluid	Flow Rate (GPM)	Pressure (Psig)	
					Source	Destination
1	Drain RAW to radiation safe drums	Absorber RAW System	RAW	15	0	0
	Fill/Make-up	Absorber RAW System	DI or LCW	10	10 Drum Or LCW	0
2	Drain INTW to drums	Absorber INTW System	INTW	15	0	0
	Fill/Make-up	Absorber INTW System	DI or LCW	10	10 Drum Or LCW	0



# Absorber Hall RAW Exchange System

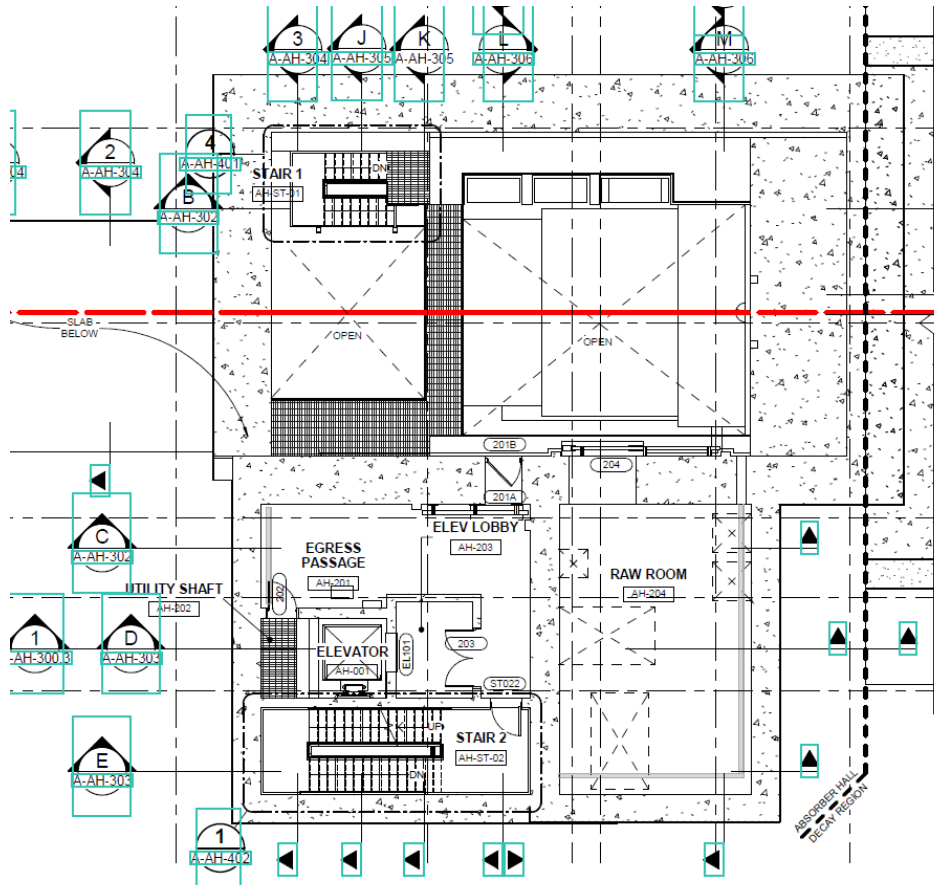
## System Operational Parameters

- Option 2, Fill/Make-up, Bleed and Feed (Burping), Drain, and Transfer:

#	Option 2, Fill/Make-up, Bleed and Feed, Drain, and Transfer - Table-2 - Design Values					
	Functional Section	System Name	Fluid	Flow Rate (GPM)	Pressure (Psig)	
					Source	Destination
1	Fill/Make-up to LCW Expansion/Storage tank	LCW Expansion/Storage Tank	LCW	15	150	5
2	Fill/Make-up to one skid each time from LCW Expansion/Storage Tank	Absorber RAW System	LCW	3 or 10	20 (pumped)	0
		INTW System		10		
3	Bleed and Feed (Burp)	Absorber RAW	RAW	3	25	0
4	Drain to RAW holding tank	Absorber RAW	RAW	30	0	0
	Drain LCW to waste capture drum(s)	Intermediate LCW system	LCW	10	0	0
5	Drain RAW transfer to disposal	From RAW holding tank	RAW	30	0 RAW holding tank	0 RAW waste capture drum

# Absorber Hall RAW Exchange System

## Approximate Layout – General Rooms Arrangement



**MIDDLE LEVEL PLAN @ EL. 693.33'**

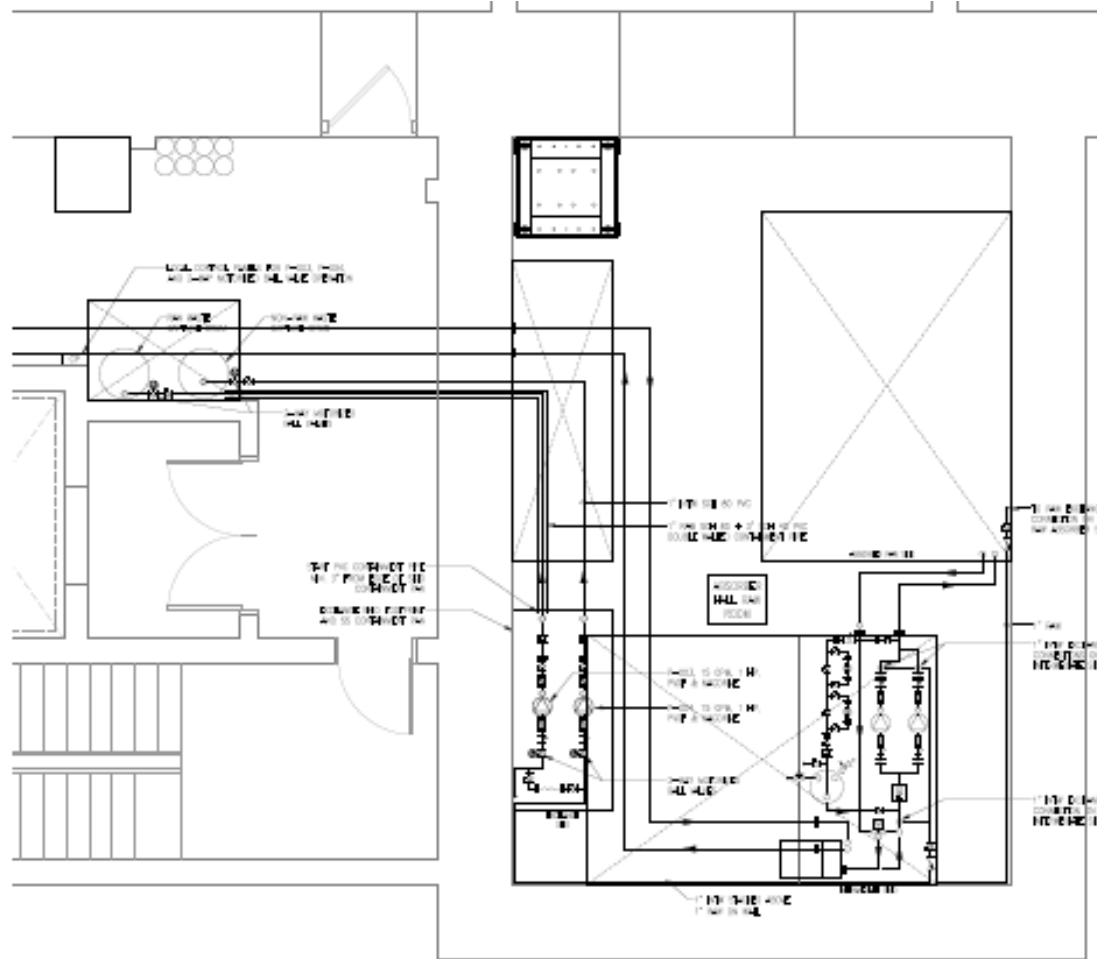
SCALE: 1/8" = 1'-0"

**1**  
A-AH-102

Rad Waste Fill Area has not been shown (Noted in 50% NSCF Design Review)

# Absorber Hall RAW Exchange System

## Approximate General Layout – Option 1 Only

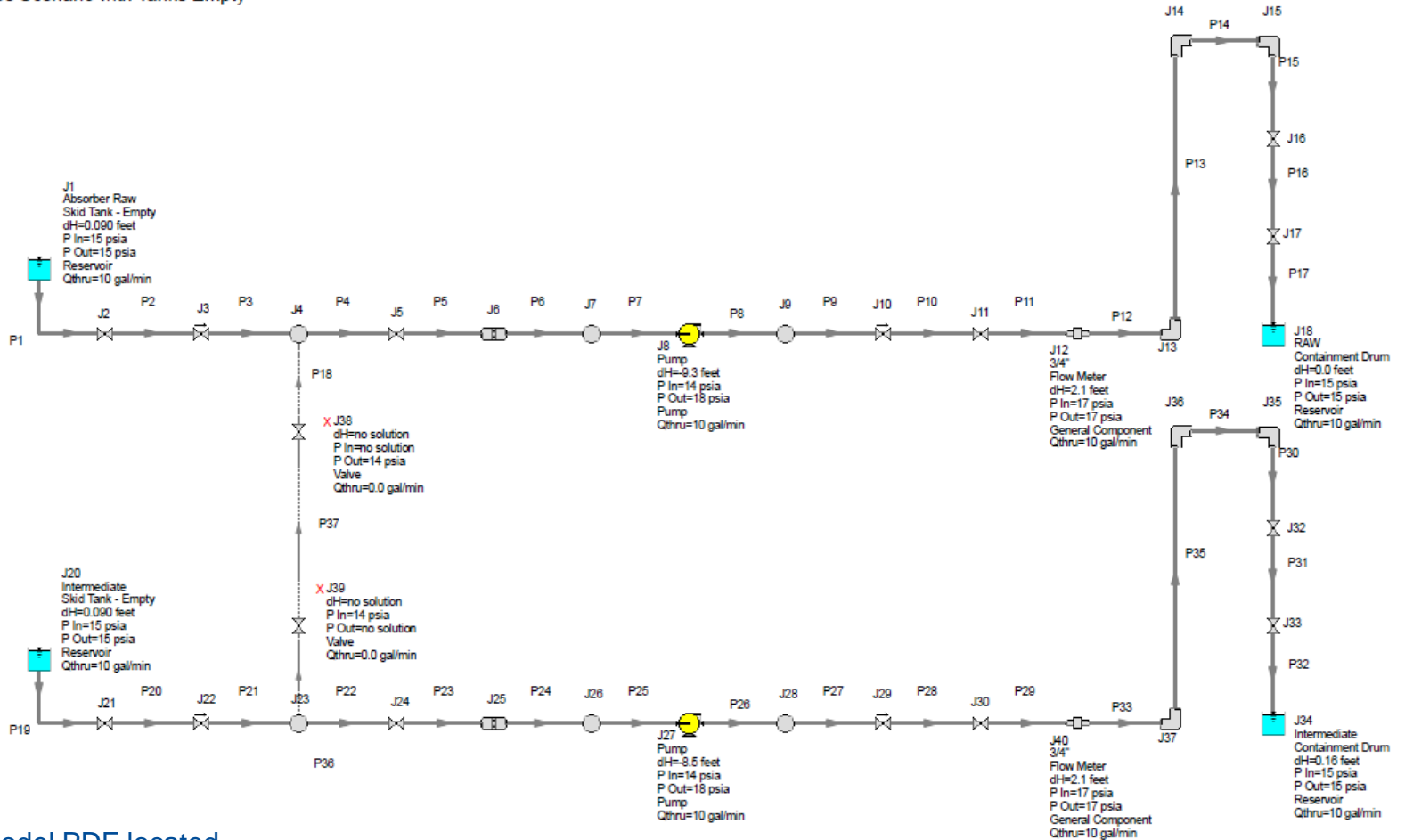


Rad Waste Fill Area has not been shown (Noted in 50% NSCF Design Review)

# Absorber Hall RAW Exchange System

## Flow Models – Option 1 Only – Worst Case for RAW Pump

Base Scenario/Base Scenario with Tanks Empty

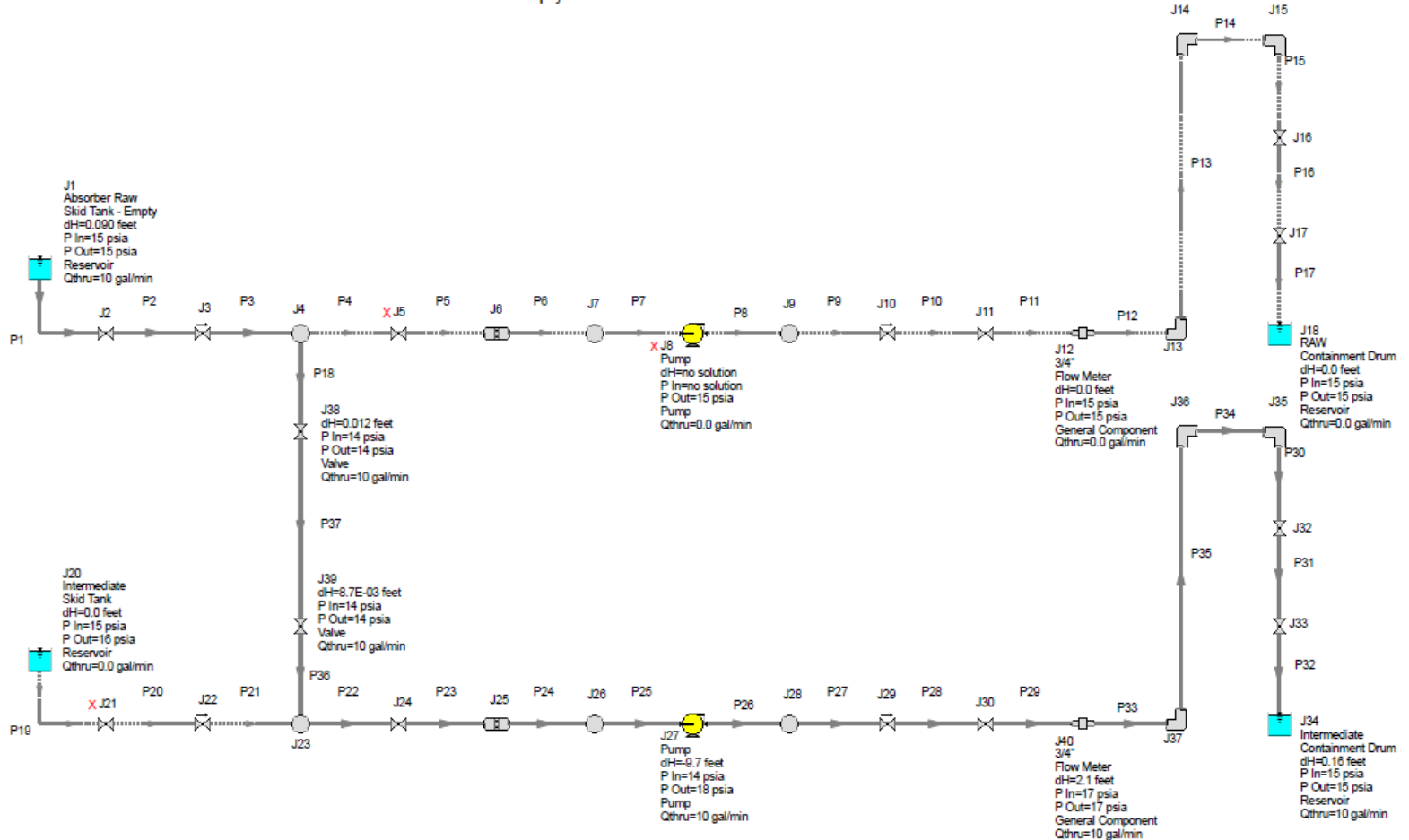


Flow Model PDF located  
in LBNF DocDB

# Absorber Hall RAW Exchange System

## Flow Models – Option 1 Only – Worst Case for INTW Pump

Base Scenario/Absorber RAW thru IRAW/Absorber RAW thru IRAW with Tanks Empty



Flow Model PDF located  
in LBNF DocDB

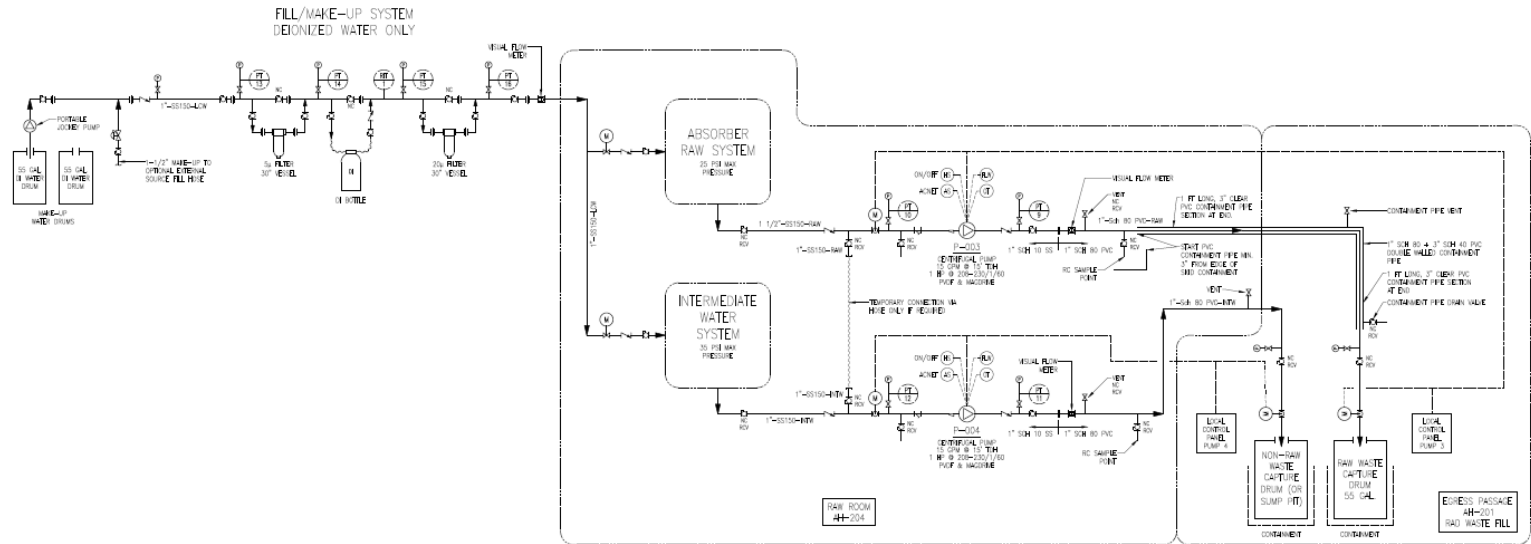
# Absorber Hall RAW Exchange System

## P&ID Drawing – Option 1

PIPING SYMBOL LIST			
DN	IS	FL	FLW SWICH
DN	IS	FL	PRESSURE GAUGE/INDICATOR
DN	IS	FL	TEMPERATURE/TEMP. INDICATOR
DN	IS	FL	OPEN FLOW
DN	IS	FL	ADMET. HANDED
DN	IS	FL	ADMET. AS REQUIRED
DN	IS	FL	ADMET. AUTO. SERVICED
DN	IS	FL	ADMET. HANDED
DN	IS	FL	ADMET. INTERMEDIATE WATER
DN	IS	FL	ADMET. NORMALLY CLOSED
DN	IS	FL	ADMET. NORMALLY OPEN
DN	IS	FL	ADMET. ONE TOUCH/OPEN
DN	IS	FL	ADMET. INHIBITABLE
DN	IS	FL	ADMET. INHIBITABLE SAFETY
DN	IS	FL	ADMET. CONTROL VALVE
DN	IS	FL	ADMET. PUMP

INSTRUMENTATION – RAW EXCHANGE SYSTEM			
INSTRUMENT	INSTRUMENT ID	NOMINAL RANGE	ACTUATOR
PUMP 004 BEARING PRESSURE	PI70	21.5 PSIG	TO
PUMP 005 BEARING PRESSURE	PI71	21.5 PSIG	TO
PUMP 006 BEARING PRESSURE	PI72	21.5 PSIG	TO
PUMP 007 BEARING PRESSURE	PI73	21.5 PSIG	TO
PUMP 008 BEARING PRESSURE	PI74	21.5 PSIG	TO
PUMP 009 BEARING PRESSURE	PI75	21.5 PSIG	TO
PUMP 010 BEARING PRESSURE	PI76	21.5 PSIG	TO

REV	DESCRIPTION	DATE	BY	CHKD
1	ISSUED FOR CONTROL DOCUMENT			
2	REVISED			

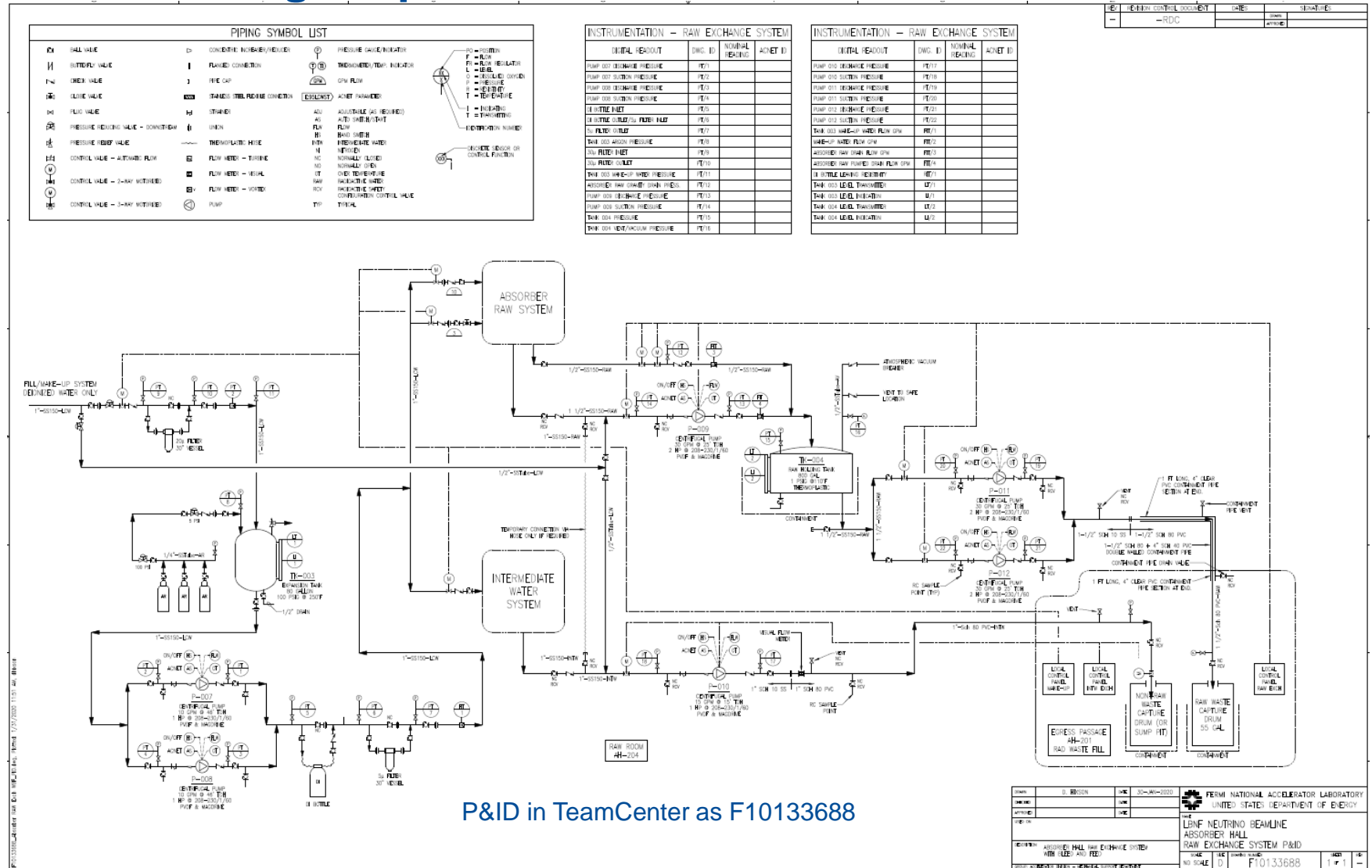


P&ID in TeamCenter as F10133687

DATE	01/03/2020	REV	01	DATE	01/03/2020
DESIGNER	D. HIXSON	CHECKED	D. HIXSON	DATE	01/03/2020
APPROVED	D. HIXSON	DATE	01/03/2020	 FERMIONATIONAL ACCELERATOR LABORATORY UNITED STATES DEPARTMENT OF ENERGY	
LBNF NEUTRINO BEAMLIN ABSORBER HALL RAW EXCHANGE SYSTEM P&ID					
SCALE	NO SCALE	REV	01	DATE	01/03/2020
PROJECT NO.	F10133687	REV	1	DATE	01/03/2020

# Absorber Hall RAW Exchange System

## P&ID Drawing – Option 2



# Absorber Hall RAW Exchange System

## P&ID - Major Equipment, Piping, Fittings, Estimate – Option 1

- Major Equipment has been sized and selected
  - Pumps and Heat Exchangers
- Piping has been sized
  - Final Pipe Routing may vary based upon the final RAW Room layout and
- Major Valves and Fittings have been sized and selected
  - Flanges, Large Valves, Strainers, etc.
- Item costs selected above show good equivalence to the estimate
  - Per LBNF DocDB 9504 - BOE form for 131.01.03.03.03.06.03



# Absorber Hall RAW Exchange System

## Summary

- There are two options, the first is Drain and Fill/Make-up of the radioactive cooling water (RAW) and Intermediate Water (INTW) systems.
- The second option allows for Drain and Fill/Make-up of the radioactive cooling water (RAW) and Intermediate Water (INTW) systems, or Bleed and Feed (Burping) of just the radioactive cooling water (RAW) system.

# Absorber Hall RAW Exchange System

## Pending Items for Final Design

- Rad Waste Fill Area has not been shown
  - Noted in 50% NSCF Design Review
- Finalize RAW Exchange Skid Footprint based on finalized RAW room layout and the other RAW skid footprints
  - Need a determination of which RAW Exchange Option to pursue:
    - Drain and Fill/Make-up of the radioactive cooling water (RAW) and Intermediate Water (INTW) systems – Option 1
    - - or -
    - Drain and Fill/Make-up of the radioactive cooling water (RAW) and Intermediate Water (INTW) systems, or Bleed and Feed (Burping) – Option 2
- Coordinate and route piping to the RAW and INTW skids.
- Finalize water exchange control parameters

# Absorber Hall RAW Exchange System

## Questions?