

Neutrino Beamline Target Hall Intermediate Water (INTW) Preliminary Design Review

Technical Design Aspects

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Target Hall Intermediate Water (INTW)

Outline

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

Target Hall Intermediate Water (INTW)

Purpose

- The Target Hall Intermediate Water (INTW) System provides:
 - A means of heat transfer between conventional facilities cooling equipment and Radioactive Water (RAW) using Fermilab equipment .
 - A means of isolating that conventional facilities cooling equipment from any Fermilab equipment that may become radioactive.
 - A medium to cool the Helium Compressors located in the Compressor Room.

Target Hall Intermediate Water (INTW)

Design Requirements

- The Target Hall Intermediate Water (INTW) System shall:
 - Require minimal unscheduled interventions for maintenance.
 - Have flows and capacities based on the connected loads obtained from the various RAW systems engineers and the helium compressor cooling requirements.
 - Have a nominal design temperature of 65°F.
 - Be considered non-radioactive with a maximum radioactivity of 1900 pCi/ml.
 - Be filtered to remove all particles larger than 5 microns.
 - Reject heat to a water chiller furnished and installed under the Conventional Facilities portion of the LBNF Project.

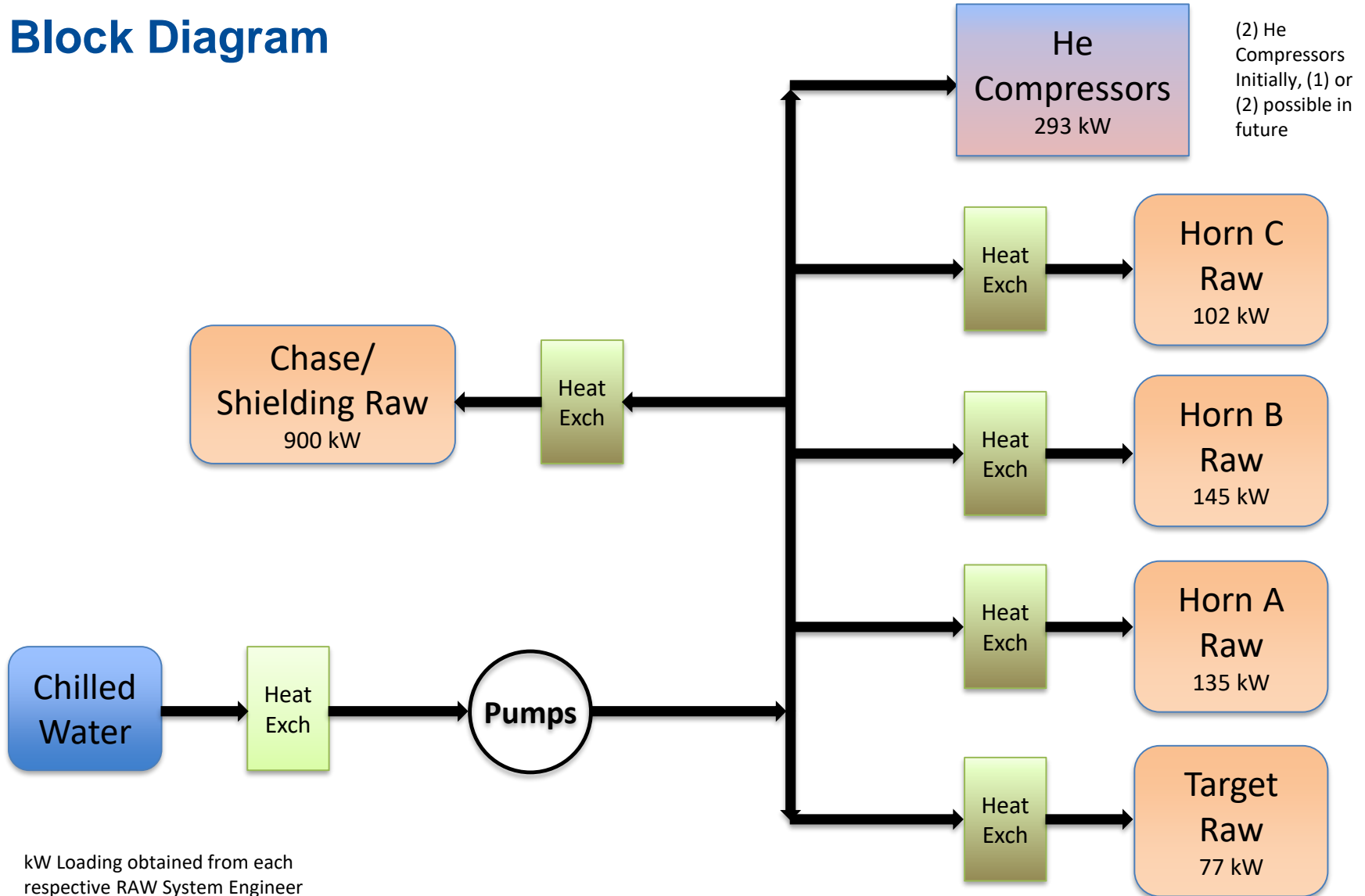
Target Hall Intermediate Water (INTW)

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 Category D 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.
 - Piping and Tubing will be 304L or 316L ASTM A312 Stainless Steel

Target Hall Intermediate Water (INTW)

Block Diagram



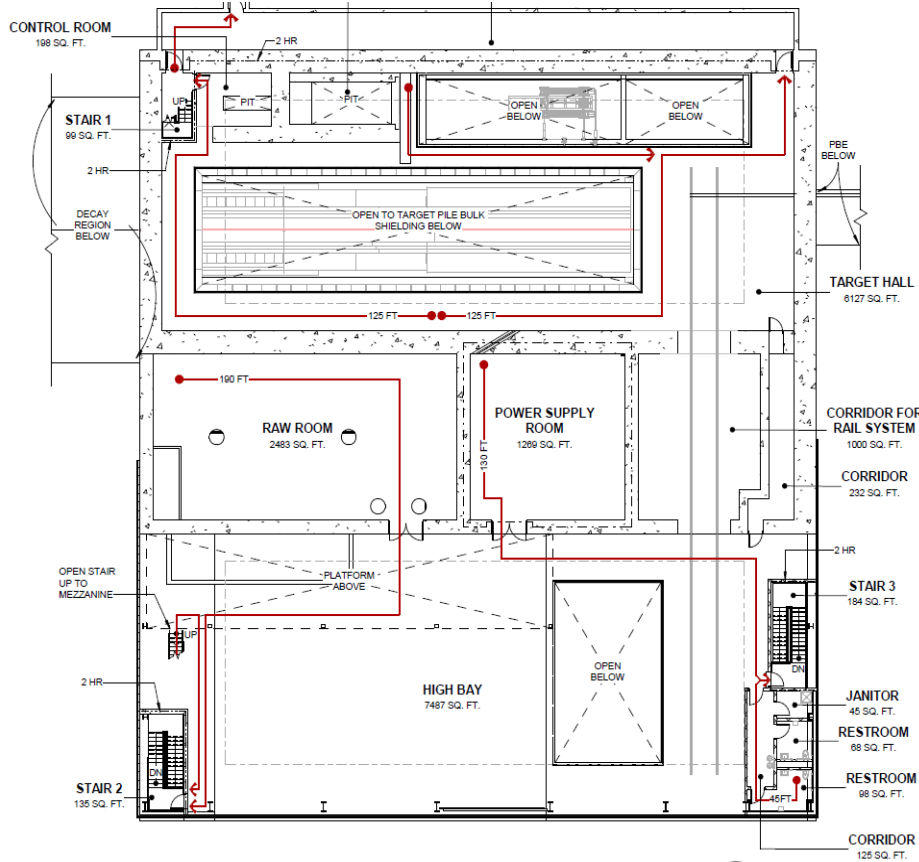
Target Hall Intermediate Water (INTW)

System Operational Parameters

Target Hall INTW Skid @ 2.4 MW	RAW System			INTW System					
Target Hall Skids @ 2.4 MW Item	Design kW	Design GPM	Design TD °F	Design kW	Design GPM	Design TD °F	Design EWT °F	Design LWT °F	Notes
Target and Baffle (Chase) RAW	77	50	10.5	77	45	12	65	77	RAW kW includes SF (RAW values per RW 2020-01-30)
Horn A RAW	135	193	4.8	134	75	12	65	77	(per KW 2019-10-01 email)
Horn B RAW	145	430	2.3	145	85	12	65	77	INTW kW includes 10% SF (per KW 2019-10-01 email)
Horn C RAW	102	287	2.4	102	60	12	65	77	(per KW 2019-10-01 email)
Chase / Shielding / Window RAW	900	435	15	900	490	13	65	78	RAW kW includes SF (RAW values per RW 2020-01-30)
RAW Subtotal:	1,359	1,395		1,359	755				(INTW EWT uncertain)
Helium Comp INTW	438	na	na	438	120	25	65	90	He Comp HP, INTW Flow, 1 GPM/5 HP @ 25°F ΔT
Totals:	1,797			1,808	875				
10% Safety Factor:	136			136	na				INTW kW 10% SF includes pumps, , excludes HE Comps.
Target Hall Totals:	1,933			1,933	875	15			INTW Values for 2.4 MW
Filtration Loop:					15				Approx: 50 mins to filter 500 gallon system volume
Pump Size:					890	GPM			
HE Compressors									
"The system is relatively un-designed. RAL will be doing the final design"									
@ 1.2 MW, (2) compressors will run. @ 2.4 MW, (3) compressors might run with an unlikely 4th as backup									
INTW will route 2-1/2" pipes to HE Compressors. This will work for 80 and 120 GPM									
Horns, Target and Baffle (Chase), and Chase/Shielding/Window (RW) – 2.4 MW Design Basis									
The INTW system must provide stable flow to the (5) RAW Heat Exchangers.									
Since the 1.2 MW Beamline case loading is approximately 60% of the 2.4 MW Beamline case loading, the INTW system designed for a 1.2 MW load would provide a very modest cost savings. The rework cost incurred to upgrade the INTW system for the 2.4 MW loading would exceed the 1.2 MW load savings.									
The 2.4 MW Beamline Case will be used as the design basis for the INTW system.									

Target Hall Intermediate Water (INTW)

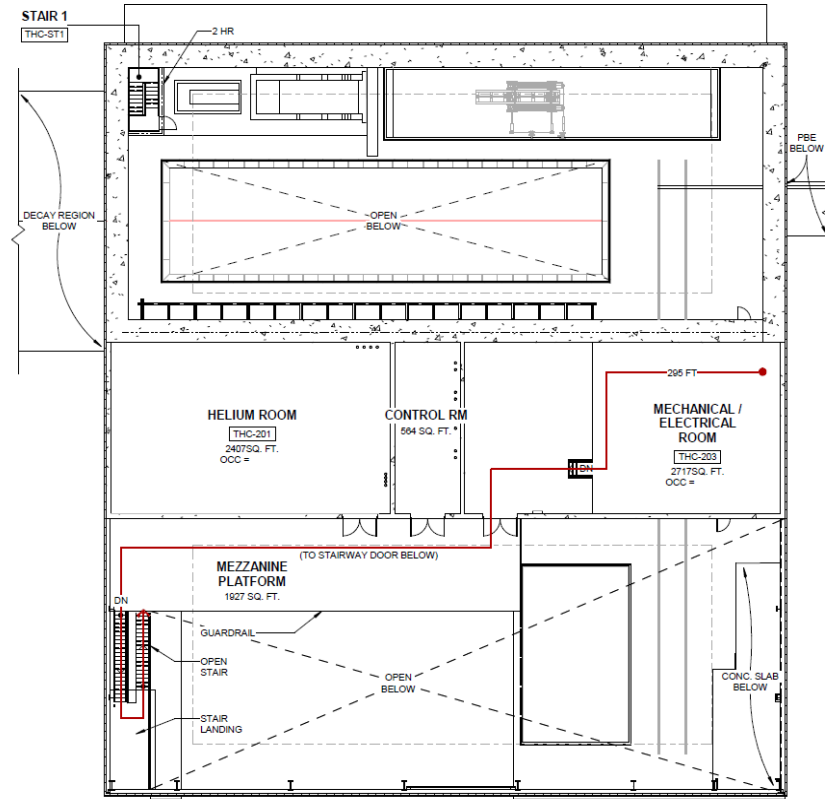
Approximate Layout – General Rooms Arrangement



LIFE SAFETY PLAN - MAIN LEVEL @ EL. 765.00'

1
GLS-104

SCALE: 1/16" = 1'-0"



LIFE SAFETY PLAN - UPPER LEVEL @ EL. 784.00'

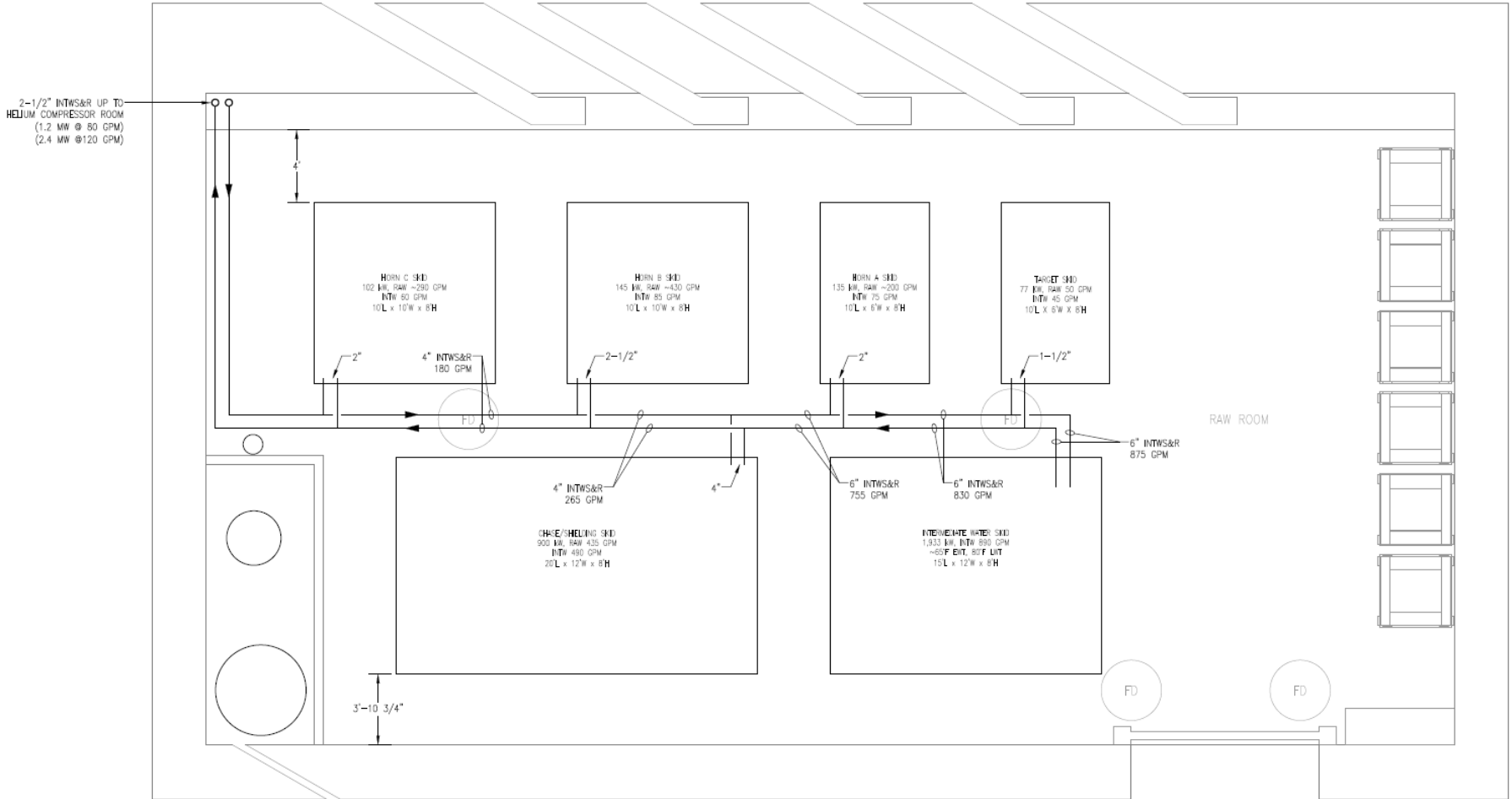
2
GLS-104

SCALE: 1/16" = 1'-0"

He Compressor Room directly above RAW Room
 Routing for Chilled Water from CF Chiller still undetermined (Noted in 50% NSCF Design Review)

Target Hall Intermediate Water (INTW)

Approximate General Layout



Piping up to He Compressor Room

Routing for Chilled Water from CF Chiller to INTW Skid still undetermined (Noted in 50% NSCF Design Review)

Target Hall Intermediate Water (INTW)

P&ID - Major Equipment, Piping, Fittings, Estimate

- The Target Hall Intermediate Water (INTW) system has been designed for the 2.4 MW Beam. (see page 7)
- 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
- 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 9501 - BOE form for 131.01.03.03.03.06.02

Target Hall Intermediate Water (INTW)

Summary

- A means of heat transfer between conventional facilities cooling equipment and Radioactive Water (RAW) using Fermilab equipment .
- A means of isolating that conventional facilities cooling equipment from any Fermilab equipment that may become radioactive.
- A medium to cool the Helium Compressors located in the Compressor Room.
- Have flows and capacities based on the connected loads obtained from the various RAW systems engineers and the helium compressor cooling requirements.
- Be considered non-radioactive with a maximum radioactivity of 1900 pCi/ml.
- Be filtered to remove all particles larger than 5 microns.
- Mainly based on Numi/Nova systems' operational experience Design Layout and Details, applicable ASME Codes, FESHM, and the Fermi Engineering Manual.
- Piping and Tubing will be 304L or 316L ASTM A312 Stainless Steel

Target Hall Intermediate Water (INTW)

Pending Items for Final Design

- CF Chilled Water piping routing to the TH INTW Skid
 - Noted in 50% NSCF Design Review
- Finalize INTW Skid Footprint based on finalized RAW room layout and the other RAW skid footprints
- Determine arrangement of equipment, piping, fittings, etc. on the final INTW Skid footprint
- Coordinate and route INTW piping to each of the other RAW skids
- Finalize water temperature control parameters

Target Hall Intermediate Water (INTW)

Questions?