HYPER-NUCLEAR DESIGN STATUS

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HYPER-NUCLEAR

- **Charge 1A)** Status of the equipment required for this set experiments towards operation? What is the completion/commissioning schedule and tasks?
- **Charge 1B)** Status of the beam line and scattering chamber
- **Charge 1D)** Status of the HKS, HES, PCS, ENGE and the effect of the magnetic fields on the beam line. The status of the needed power supplies.
- **Charge 1E)** The integrated system, including the support structures for the magnets, as expected to be used during the experiment.
- **Charge 1F)** The Low Conductivity Water (LCW) requirements for the experimental equipment.
- **Charge 1G)** Final configuration of the Hall space.

HYPER-NUCLEAR

- **Drawing List**
  - Drawing Numbers for Experiment Assemblies
- **Nansemond Pre Cast Concrete – Concrete Rad Shielding**
  - P.O. 25-D1718-0 - Deliverables late Sept-Oct 2026
- **Power Supply Unit Procurements**
  - PR 451970 HKS Supplies
  - PR 452018 Enge Supplies
- **Experiment Design in Hall C**
  - Beam line layout
  - Common Vacuum
  - PCS Experiment Stand
  - PCS Transportation Stand
  - HKS, HES, Enge Stand
  - Cable and Hose Routing
  - Additional RAD Shielding
  - Radiation Analysis
- **LCW**
  - Pressure System Number PS-HALLC-26-001
  - Establish preliminary Bill of Materials
- **Schedules / Manpower Estimates**

HYPER NUCLEAR – DRAWING LIST

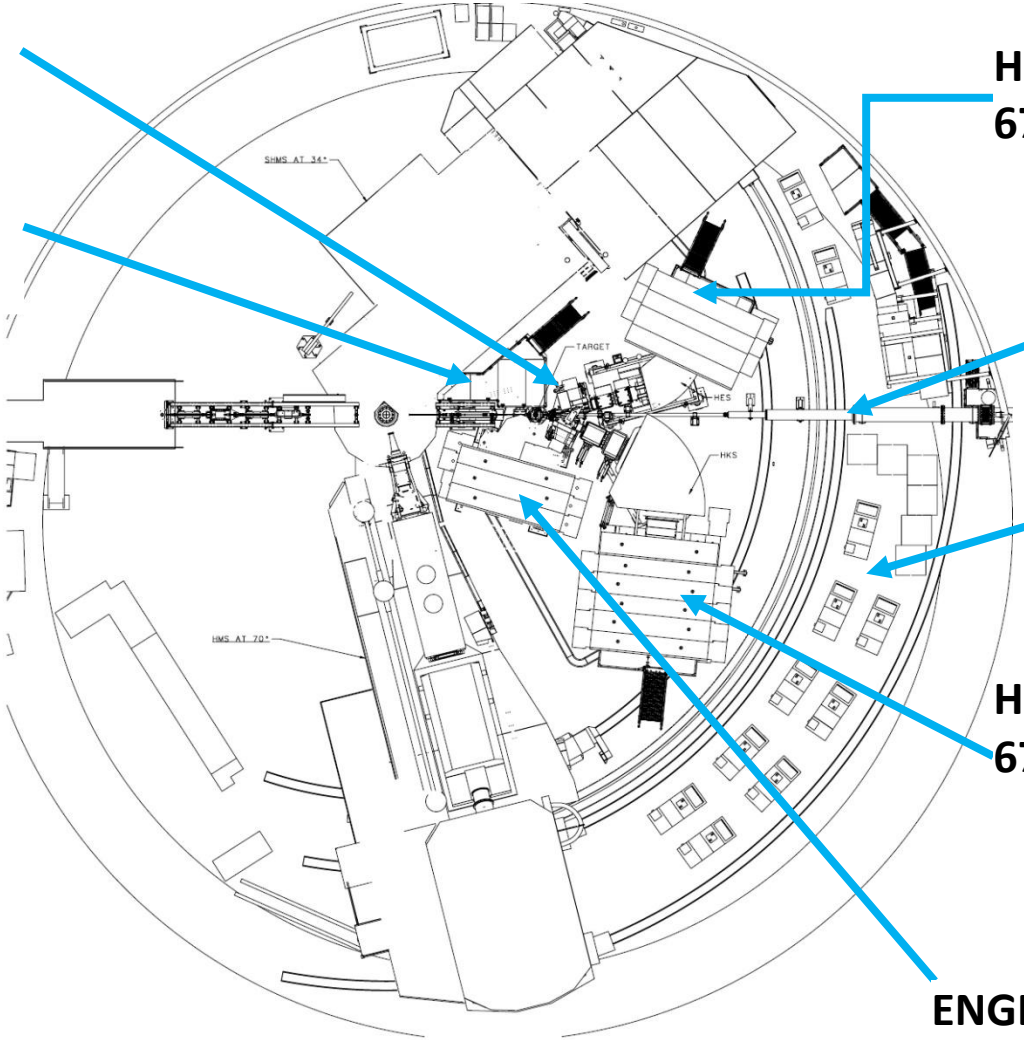
Charge 1F

PCS MAGNETS INSTALL
67510-00002

BEAM LINE/TARGET PLATFORM
67510-00130

LCW INSTALLATION
67510-00005

CABLE TRAY
67510-00037



HES SPECTROMETER
67510-00010

BEAM LINE INSTALL
67510-00200

POWER SUPPLIES

HKS SPECTROMETER
67510-00011

ENGE SPECTROMETER
67510-00012

HYPER-NUCLEAR PURCHASE REQUESTS/ORDERS

- ***Nansemond Pre Cast Concrete*** – Concrete Rad Shielding
  - P.O. 25-D1718-0 - Deliverables late Sept-Oct 2026
  - Long Term Storage of Concrete Rad Shielding
    - Discussion/Agreement with Property Management
    - TENTATIVE PLANS ARE FOR SHIELD BLOCKS TO BE STORED INSIDE GATE ALONG CEBAF BLVD ROAD BEHIND HALL C.

HYPER-NUCLEAR PURCHASE REQUESTS/ORDERS

CHARGE 1D

- Power Supply Unit Procurements
  - PR 451970 HKS Supplies (Qty 3)
    - SENT OUT FOR RFQ EXPECTED BACK EARLY JUNE 2026
  - PR 452018 Enge Supplies (Qty 1)
    - Waiting for Budget office approvals.

HYPER-NUCLEAR PURCHASE REQUESTS/ORDERS

ITEM	DESIGN STATUS	PURCHASE STATUS	DRAWING COMPLETION STATUS	PRODUCT NEED DATE
HES DETECTOR STAND	DRAWING NEEDED	**PR NOT YET SUBMITTED**	11/15/2026	Jan-28
ENGE MAGNET FEET	COMPLETE	PR SUBMITTED	COMPLETE	Sep-27
HES/HKS MAGNET FEET	COMPLETE	PR SUBMITTED	COMPLETE	Apr-28
SIEVE SLIT ASSY	COMPLETE	**PR NOT YET SUBMITTED**	6/15/2026	Nov-27
TUNGSTEN	COMPLETE	PR SUBMITTED	COMPLETE	Mar-27
POWER SUPPLIES CABLES	DRAWING NEEDED	**PR NOT YET SUBMITTED**	FEB. 21, 2027	Jan-28
NMR COILS	COMPLETE	**PR NOT YET SUBMITTED**	N/A	2028
PCS STAND	DRAWING NEEDED	**PR NOT YET SUBMITTED**	8/15/2026	2027

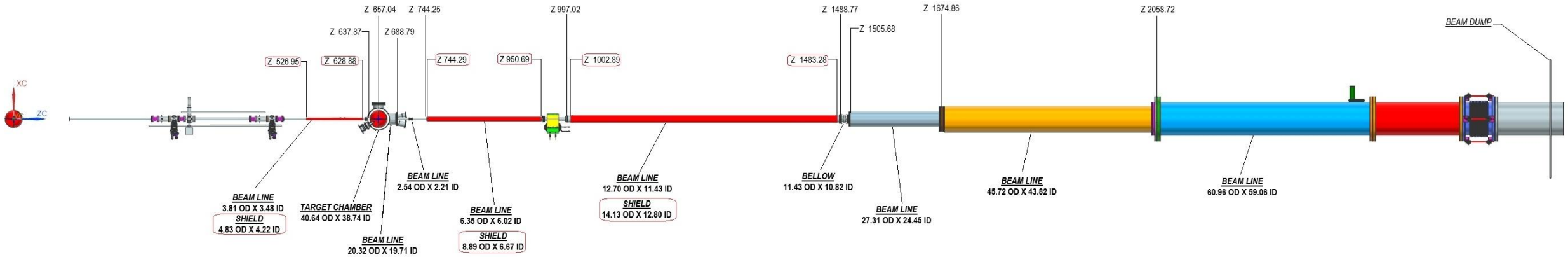
HYPER-NUCLEAR PURCHASE REQUESTS/ORDERS

- Current Purchase Requisitions
  - ENGE MAGNET FEET--PR 447231-Waiting for Budget office approval.
  - HKS/HES MAGNET FEET--PR 451681- Waiting for Budge office approval.
  - SIV SLIT TUNGSTEN- PR 451270 -Waiting for Budget office approval.
- Future Procurements (Estimates)

	Date Needed
HES DETECTOR STAND ~$40k	Jan 2028
ENGE Media Blast ~ $10k	Jan 2027
LCW Configuration Equipment ~ $130k	Aug 2027
SIV SLIT ASSEMBLIES ~ $40k	Sept 2027
PSU WIRING ~ $50K ($1500/100LF)	Aug 2027
VACUUM EQUIPMENT ~$50K	Jan 2027
PCS STAND-----~$60K	Jun 2027

HYPER-NUCLEAR BEAMLINE

CHARGE 1B

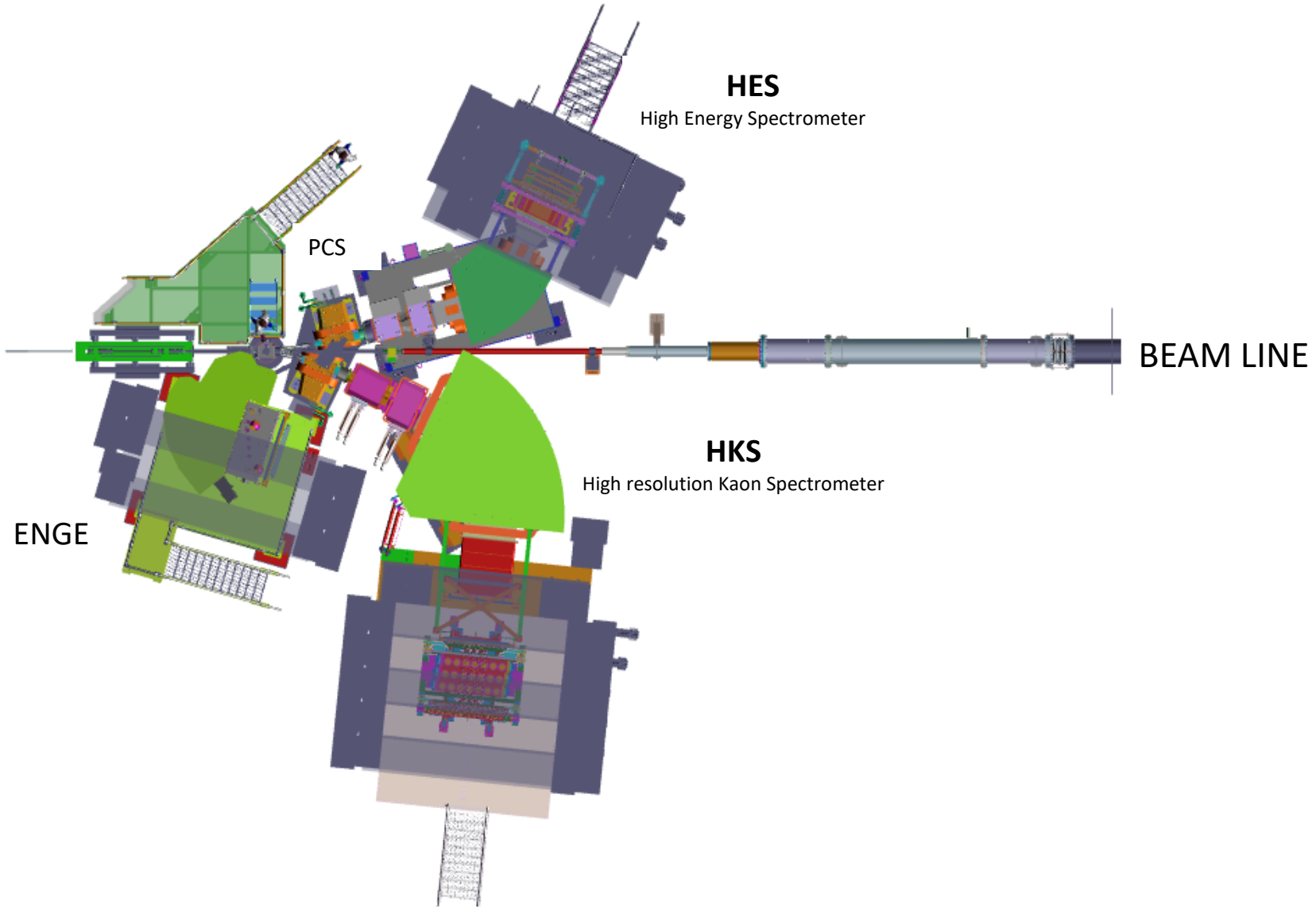


HYPER NUCLEAR BEAM LINE SIZE INFORMATION

04/14/2026

Dimensions in Centimeters(cm)

HYPER NUCLEAR – LAYOUT(TOP VIEW)



HYPER NUCLEAR – COMMON VACUUM

ION PUMP WILL BE INSTALLED ON UPSTREAM GIRDER

Gamma Vacuum: TiTan Ion Pumps,
PN# 25S-DIX-2V-SC-N-N
RFQ : $3k EACH

Pos	Product number Description	Qty	List Price	Discount (%)	Unit Price	Total
100	**25SDX2VSCNN** **25S TiTan Ion Pump** 25S TiTan Ion Pump with: Element Style: TiTan DIX, XHV/SEM Port Options: Vertical, 2.75 CFR HV Feedthrough: SAFECONN Heater Voltage: No Heaters TSP/NEG: None Edwards Part Number: 25SDX2VSCNN Country of origin: US Typical Lead-time: 7-8 Weeks Current availability: Out of Stock	1	3,544.00	-15.00	3,012.40	3,012.40
					Net Price	3,012.40
					Grand Total	3,012.40

IN HOUSE AVAILABLE
ROUGHING PUMPS AND TURBOS ON EACH INDIVIDUAL MAGNET DETECTOR.

VENDOR:

PFEIFFER VACUUM+FAB SOLUTIONS

Leybold

EDWARDS

HYPER NUCLEAR – PCS

CHARGE 1E

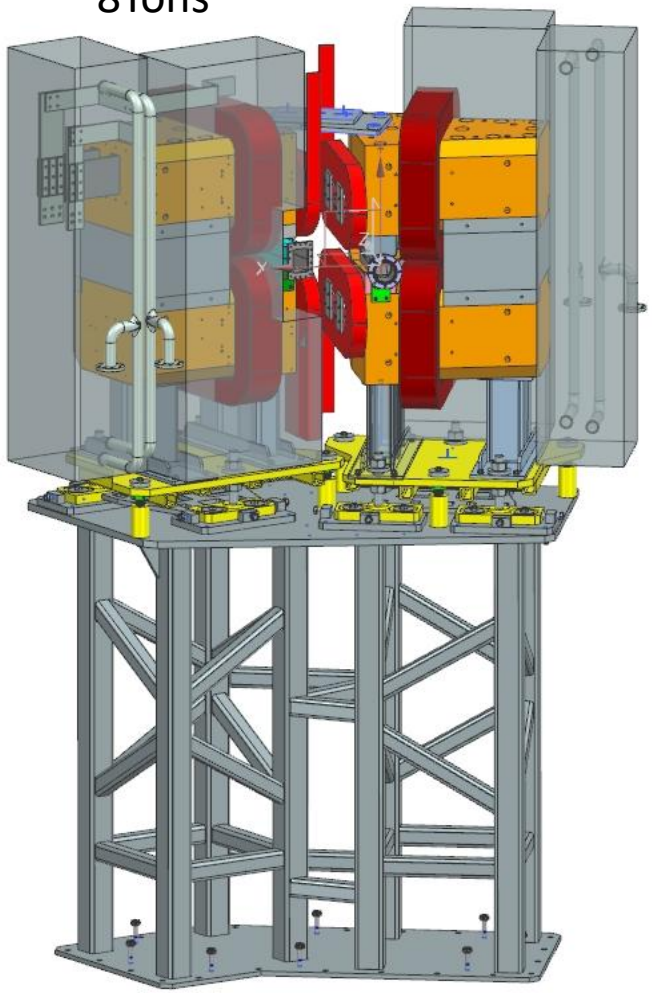
FACING TARGET

8Tons

8Tons

PCS-SM2

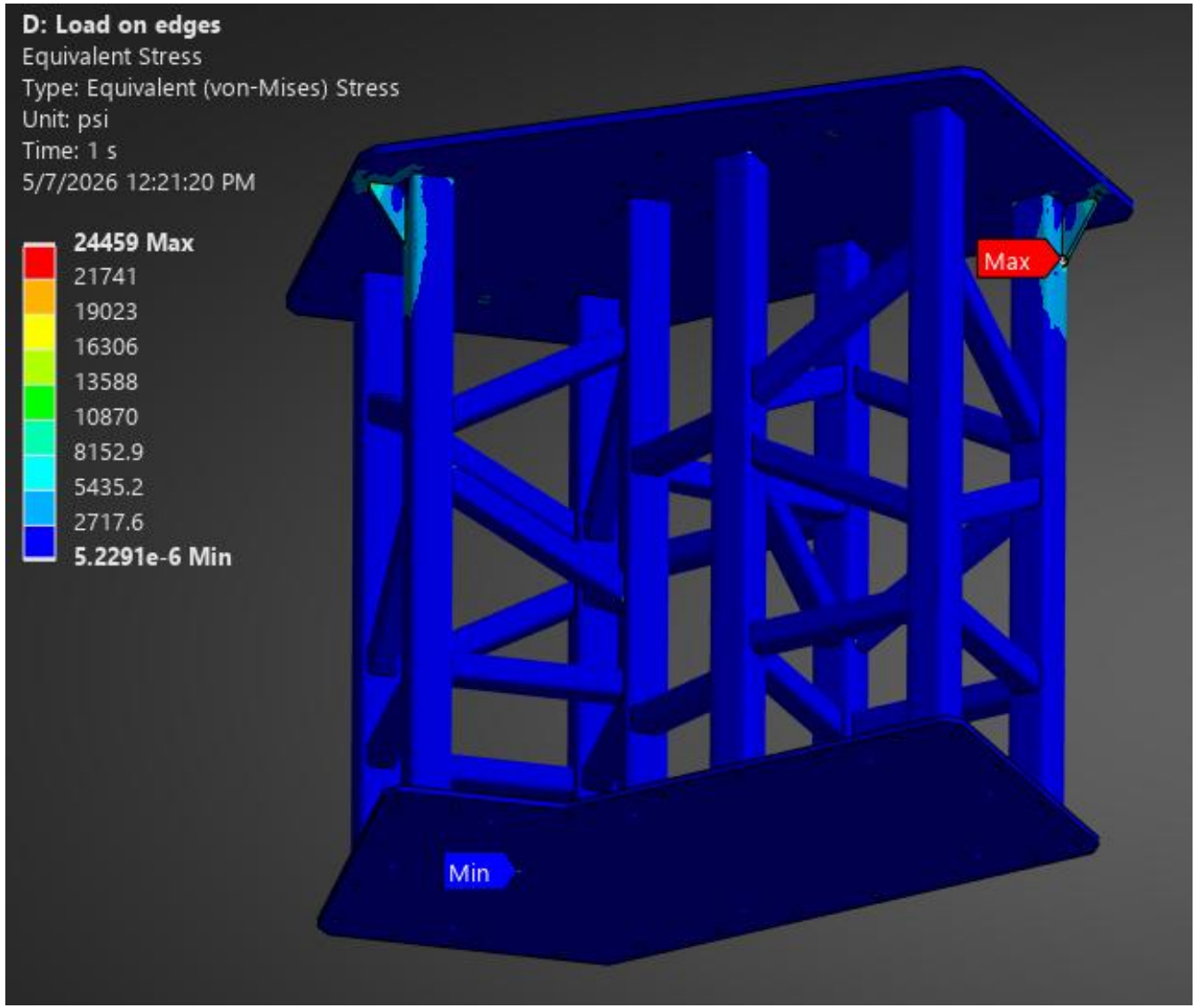
PCS-SM1



ADJUSTMENT ASSEMBLIES

PCS STAND
A36 Plate and A500 Box beam Weldment Construction.

HYPER NUCLEAR – PCS Von Mises Stress



Static Load Analysis

AMERICAN INSTITUTE OF STEEL CONSTRUCTION:
Steel Construction Manual
AISC 2005
Chap C: Stability Analysis and Design.

Factor of Safety : 1.67
Allowable Safety Design (ASD)

Peak Stress is an artifact of Stress Concentration
Majority of stress in FEA meets or exceeds factor of Safety needed for construction approval.

HYPER NUCLEAR – PCS TRANSPORTATION STAND

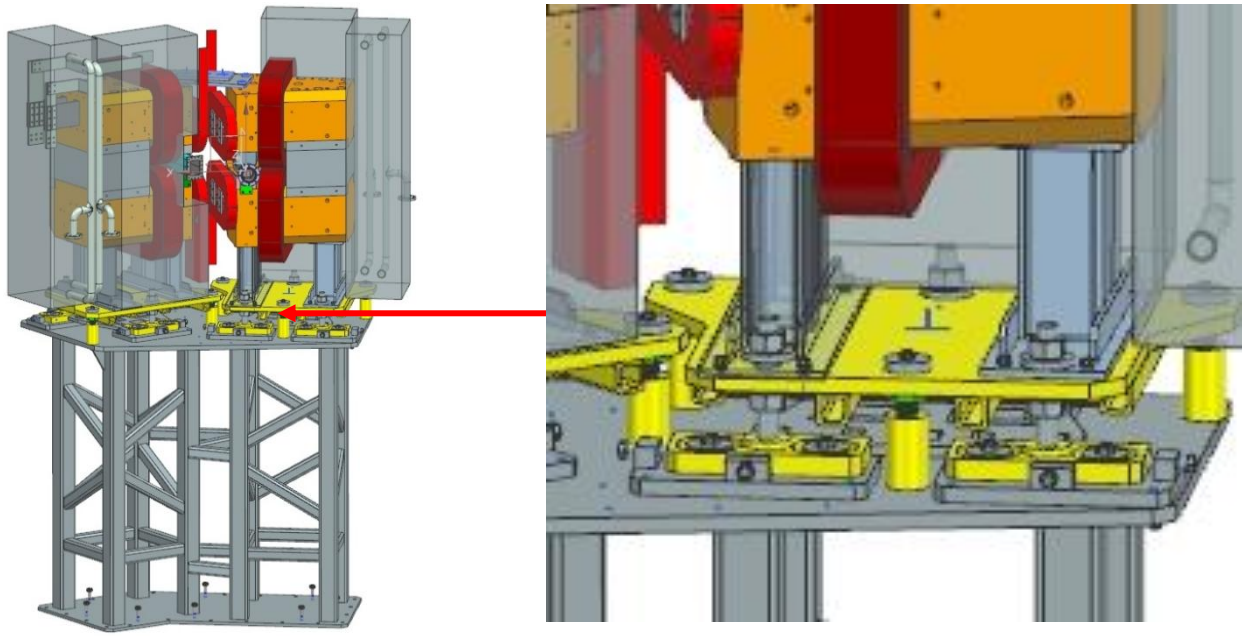
- Preliminary Design

A36 1” THK Steel Plate

A500 12” x 6” Rectangular beam .50” wall thickness

- Transportation stand will also be used to drill

2.25” diameter holes in the legs of each PCS magnet(qty 4)



HYPER NUCLEAR – HES/HKS/ENG DETECTOR STAND

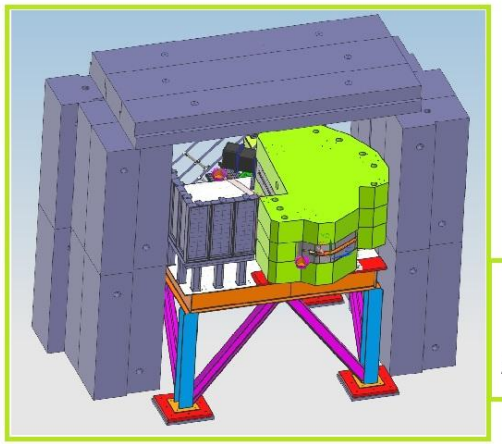
ENGE PLATFORM (pictured in Longterm storage)

Media blast and Paint

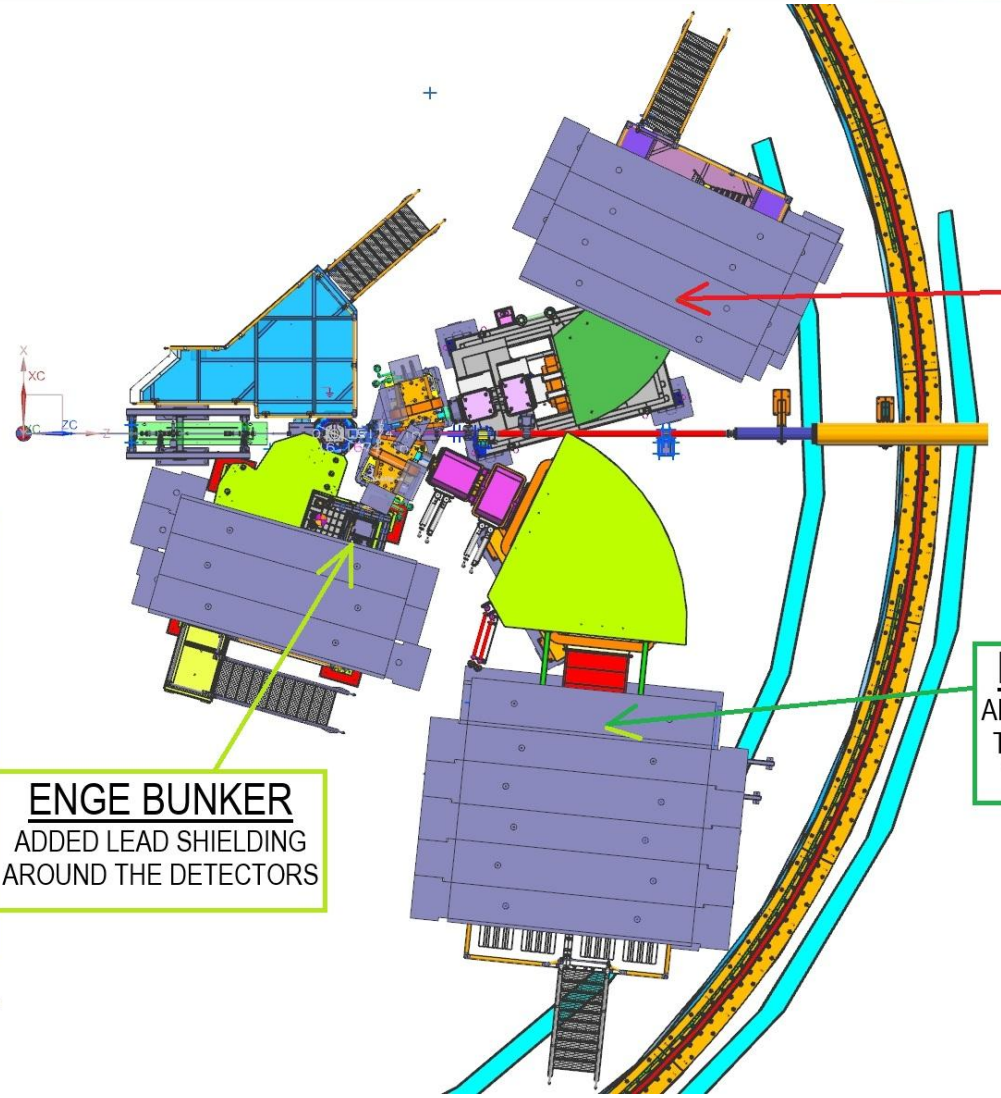
HES PLATFORM is in Preliminary Design Stage

HKS PLATFORM is located inside Hall C

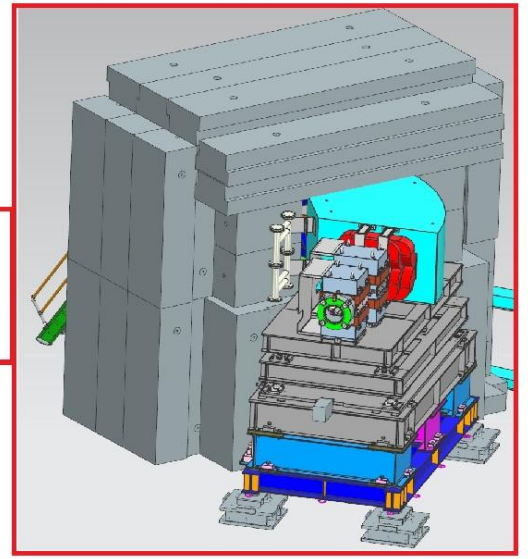
HYPER NUCLEAR – ADDITIONAL RAD SHIELDING



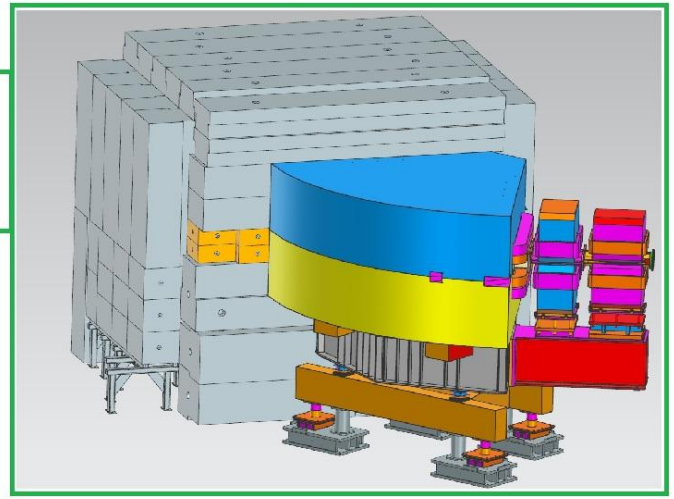
ENGE BUNKER
ADDED LEAD SHIELDING AROUND THE DETECTORS



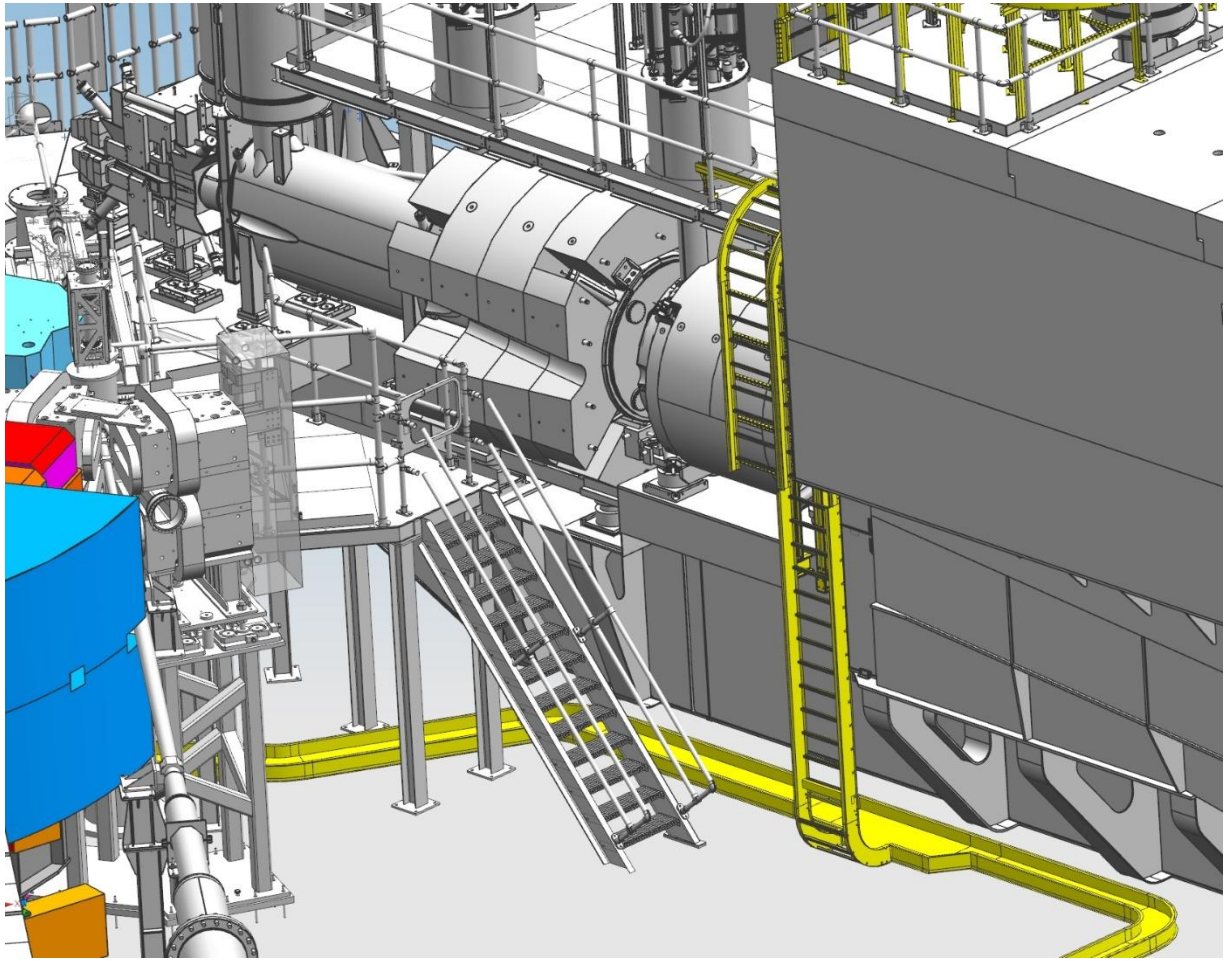
HES BUNKER
ADDED SHIELDING ON TOP AND TUCKED IN THE SIDE BLOCKS

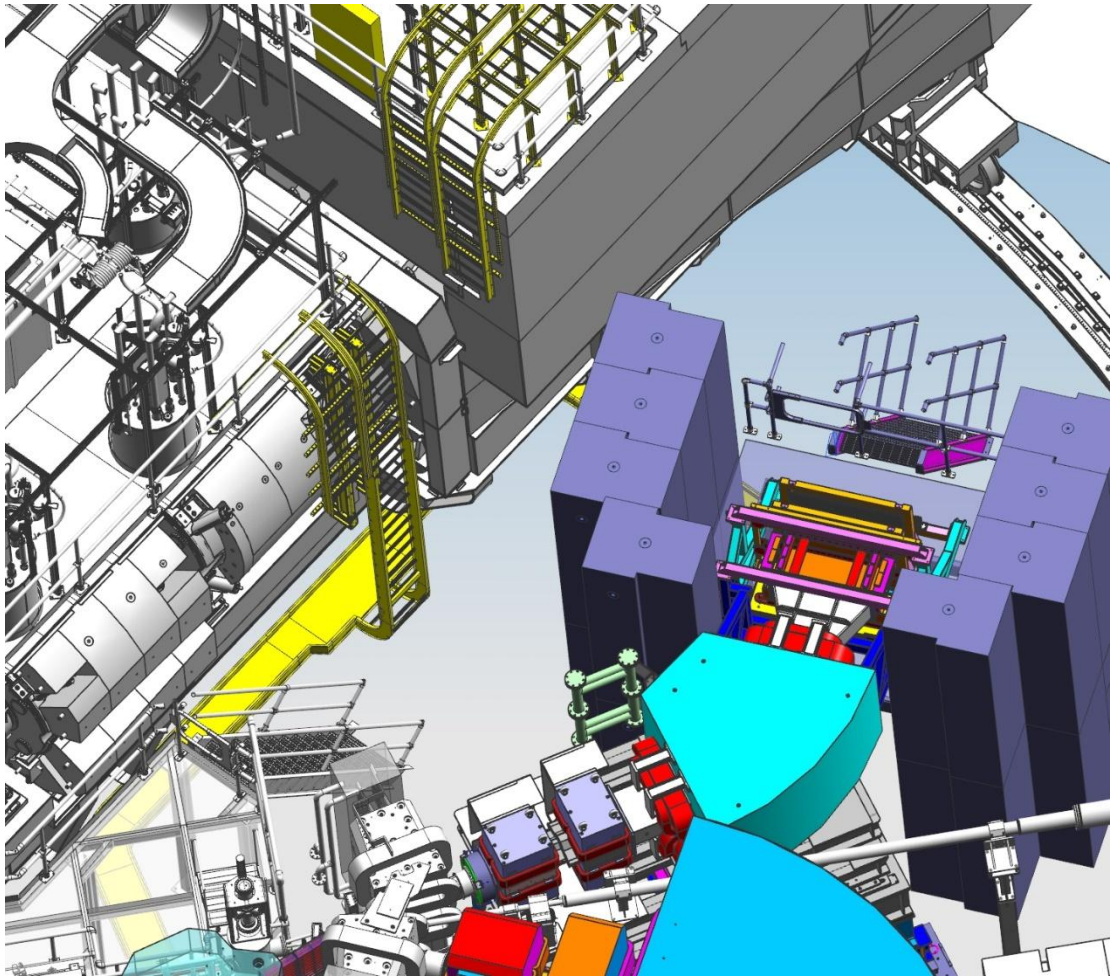


HKS BUNKER
ADDED SHIELDING ON TOP AND TUCKED IN THE SIDE BLOCKS



HYPER NUCLEAR – DATA CABLE ROUTING

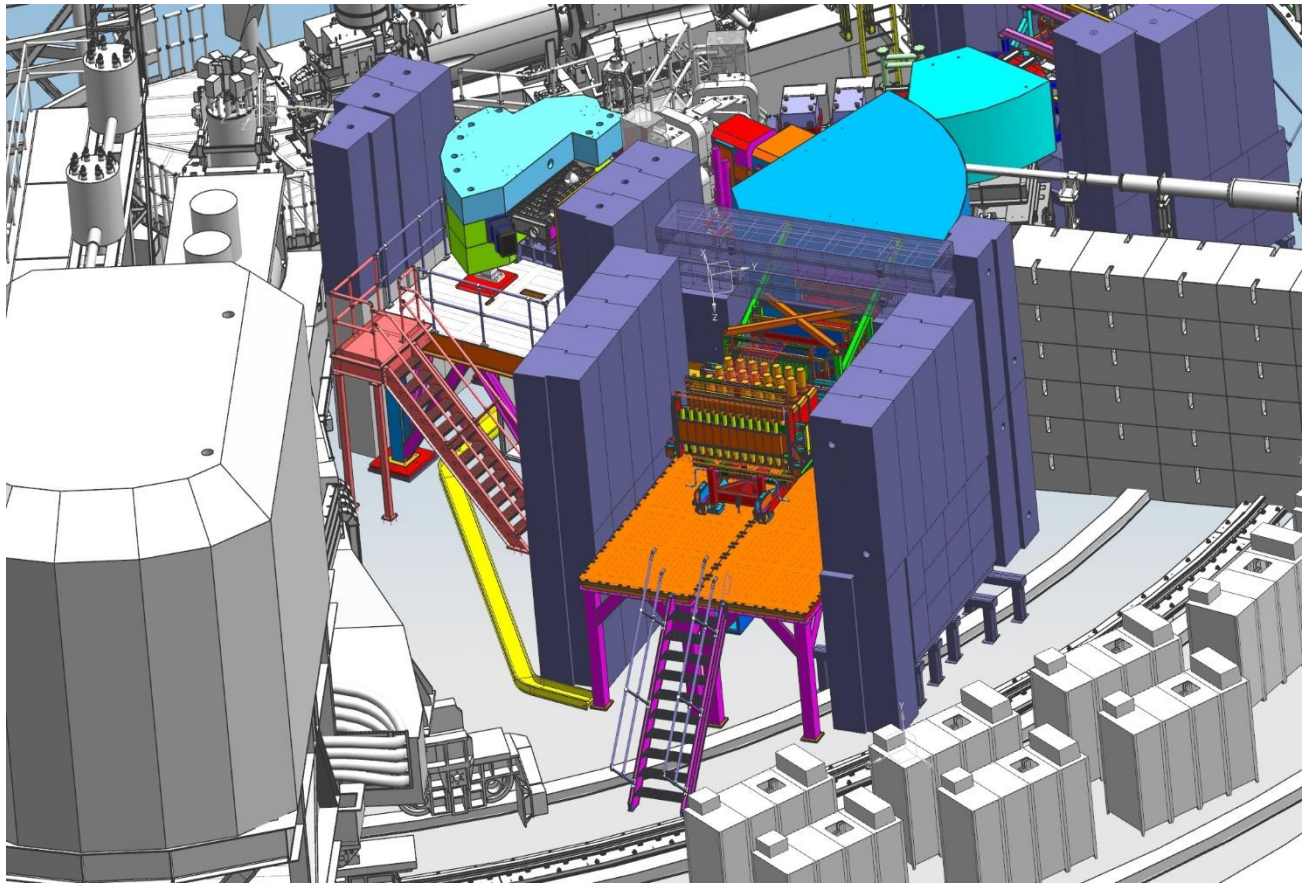




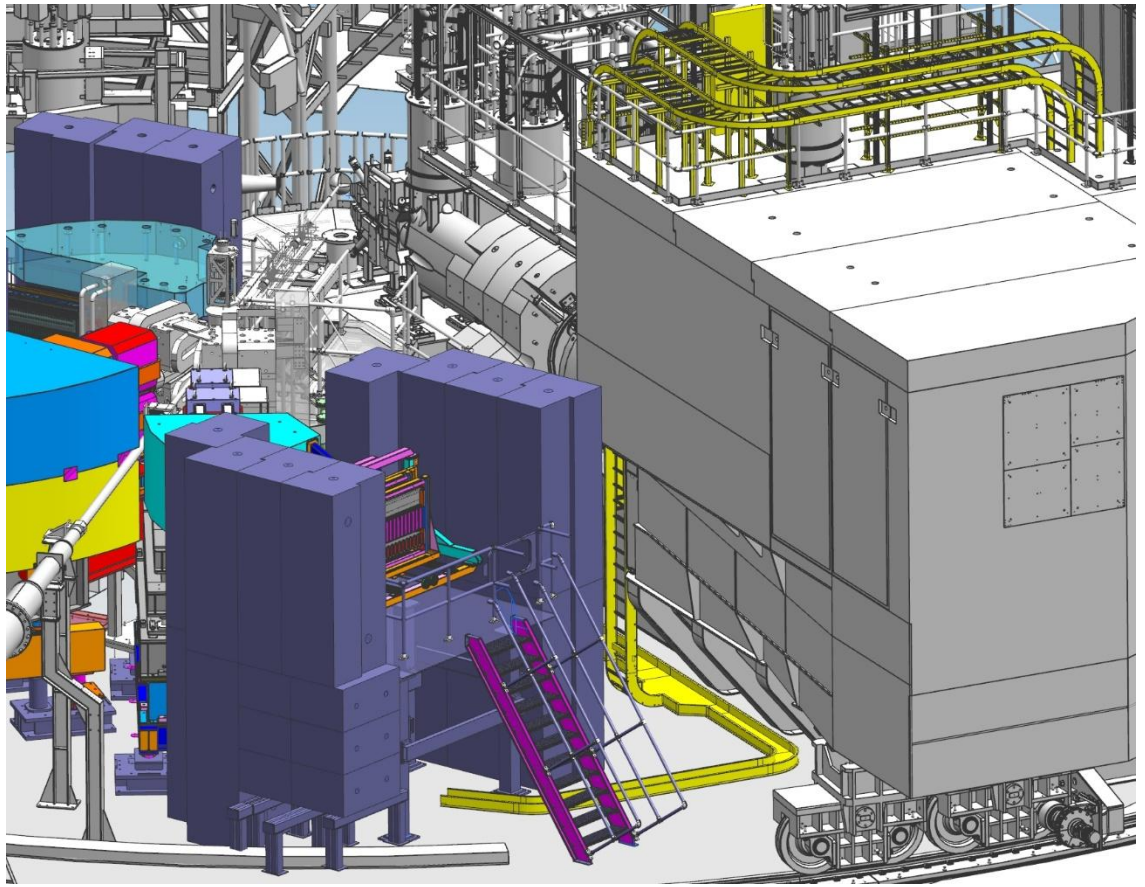
CABLE TRAY LAYOUT FROM SUPER HMS(YELLOW)

HYPER NUCLEAR – DATA CABLE ROUTING

HKS

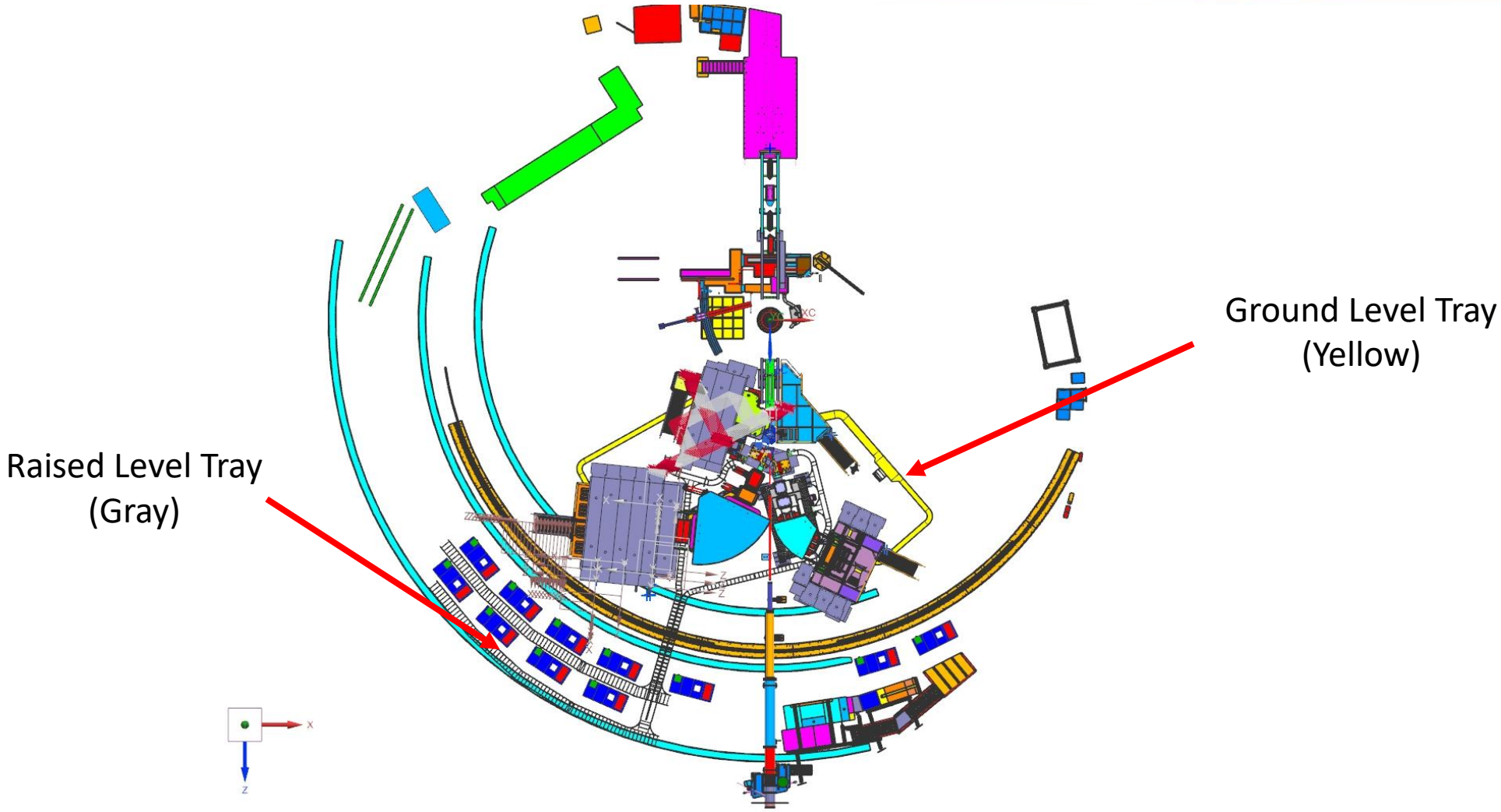


HES



CABLE TRAY LAYOUT FROM SUPER HMS(YELLOW)

HYPER NUCLEAR – CABLE/HOSE ROUTING



CABLE TRAY LAYOUT

HYPER NUCLEAR – POWER SUPPLY (Estimates)

Magnet	Current (with overhead for MOL) (A)	Voltage (V)	Magnet DC Power kW	Magnet LCW (L/min)	Inductance (H)	Magnet LCW pressure (MPa)	Magnet resistance (not including leads)	PSU – New or existing	PSU Water Flow (L/min) 0.6LPM/kW	PSU DC Power (kW)	Regulation (PPM)
HES E Dipole	1,000	220	220	95	0.820	0.5	0.181/pole	Existing HES PSU	48	220	
HES E Q1	800	110	88	41	0.054	0.5	0.111	Existing BB	48	90	
HES E Q2	800	110	88	41.4	0.056	0.5	0.109	Left Q1 Hall A	48	90	
HKS Dipole	1,140	165	188	135.1	1.95	0.67	0.145	Existing HKS PSU	135	190	
HKS Q1	875	160	140	49.6	No data Use HKS Q2	0.36	0.181	Existing Compton PSU	43	140	
PCS (k)	1,700	106	180	100	2.0 (from vendor report)	0.16	0.06	Existing SBB	100	186	10
PCS (k) corr	1,000	97	97	NA	2.0 (from vendor report)	0.16	0.01	Existing NPS PSU	32	97	10
Corrector magnet	150A			Air cooled		NA		Existing (NPS)	NA		

HYPER NUCLEAR – POWER SUPPLY UNITS (Estimates)

Magnet	Current (with overhead for MOL) (A)	Voltage (V)	Magnet DC Power kW	Magnet LCW (L/min)	Inductance (H)	Magnet LCW pressure (MPa)	Magnet resistance (not including leads)	PSU – New or existing	PSU Water Flow (L/min) 0.6LPM/kW	PSU DC Power (kW)	Regulation (PPM)
PCS (e')	1,800	130	180	100	2.0 (from vendor report)	100	0.06	**PR 451970**	112	186	10
PCS(e') corr	1,100	120	97	NA	2.0 (from vendor report)	100	0.1	**PR 451970**	58	97	10
HKS Q2	500	60	28	17.3	0.36	0.38	0.119	**PR 451970**	15	25	10
ENGE	331	50	100	50	1.59	1.0		**PR 452018**	11	17	10
Sub Totals (both sheets)			**1,406**	**629.4**					**650**	**1,338**	

500^{+}GPM are allotted for Hall C. Preliminary design is ~ 350 GPM

**HYPER NUCLEAR – POWER SUPPLY UNITS (Actuals)

HES D	HES SUPPLY	600 amps	ESC2 panel
HES Q1	Existing BB supply	400 amps	ESC2 panel
HES Q2	Left Q1 Hall A	400 amps	ESC2 panel
HKS D	HKS Supply	800 amps	ESC2 panel
HKS Q1	Compton		ESC Connected
PCS (k)	SBB	1200 AMPS	ESC2 breaker required double space top row
PCS (k)-corr	NPS	300 amps	ESC2 Connected
Corrector	NPS trim		Connected
PCS e’	new	300 amps*	ESC2
PCS e' cor	new	200 amps*	SHMS Panel
HKS Q2	new	30 amps*	SHMS sub panel
ENGE	new	20 amps*	SHMS sub panel

*Estimated current based on 80% power supply efficiency and 20% overhead for continuous use. Can be adjusted once power supplies are in hand.

SHMS sub panel. - I recommend that a distribution panel is run from one of the SHMS main panel spare breakers and used to feed these smaller circuits and any berthas needed to feed other parts of the experiment.

Clean power can be pulled from the SHMS clean power panel or directly from the hall clean power panel whichever is easier. Plug changes on the existing breakers on the ESC2 panel will take care of the smaller feeds. Over 400 amps will require a larger frame braker and the 1200-amp service for PCS k will require a new 2 slot breaker similar to the one feeding the Moeller quads.

*** Chart supplied in email from J Beaufait August 2025 to D. Gaskel and Ellen Becker (Received from J Willoughby)*

HYPER NUCLEAR – LCW (PS-HALLC-26-001)

CHARGE 1F

Submitted PS-1 Form:

Pressure System Code
ASME 31.9

Liquid under 300 psi

Temp braided trunk line and hose for each Individual feed.

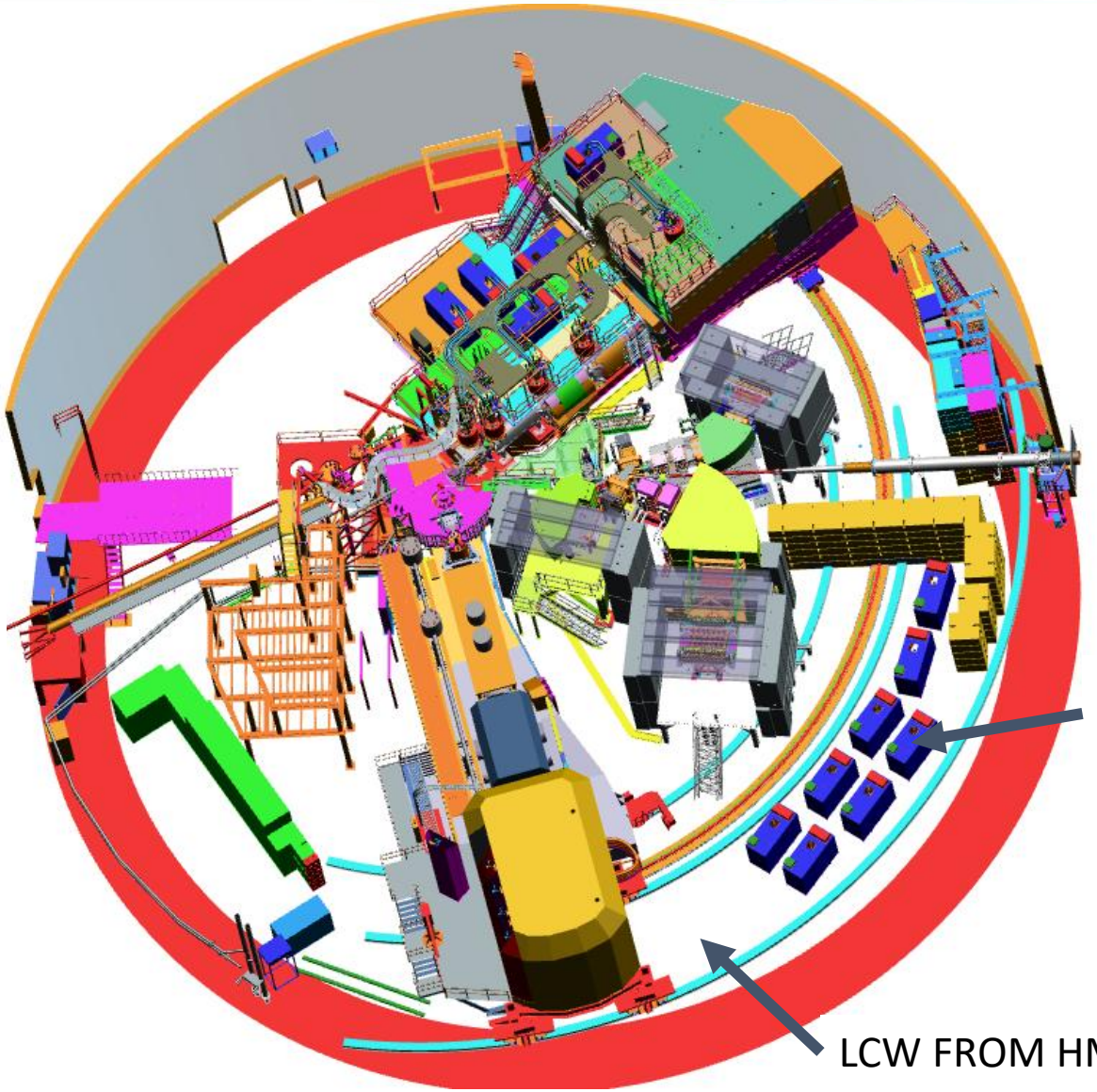
Gorilla®

Application: A premium-quality, multipurpose industrial hose with a wide range of applications in factories, construction, agriculture, quarries, mines, railroads, the oil and gas industry and shipbuilding. All sizes are crush-resistant and rated at 500 psi (3.4 MPa) maximum working pressure. The premium Carbryn™ cover offers the most superior abrasion resistance of air and multipurpose hose. Non-conductive, minimum electrical resistance greater than 1 megohm per inch of hose length at 1000 Volts DC.

- Carbryn™ cover for superior abrasion resistance
- Highest oil resistance in both tube and cover for long life span
- Crush-resistant with aramid reinforcement for durability

Tube: Nitrile synthetic rubber, ARPM Class A (High Oil Resistance)
Cover: Yellow Carbryn™ synthetic rubber, ARPM Class A (High Oil Resistance), MSHA approved
Reinforcement: Spiral aramid yarn, 2" is braided synthetic yarn

Temperature: -20°F to 210°F (-29°C to 99°C)
Couplings: Continental UC Male NPTF
Order Codes:
569-035
536-446 (2")



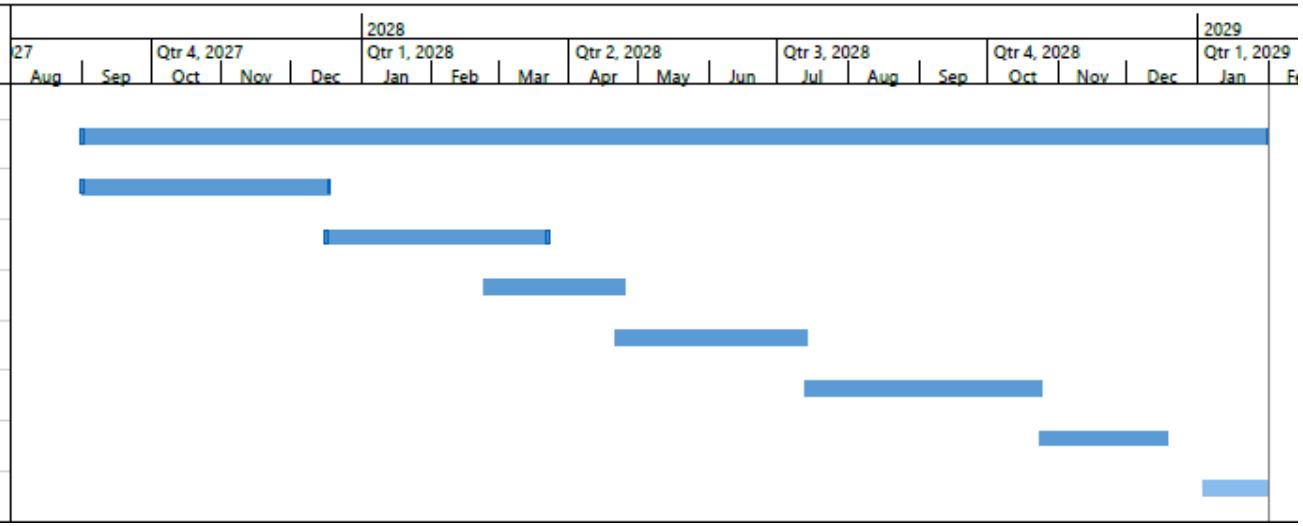
PSU LOCATION
(BLUE)

LCW FROM HMS SIDE OF HALL

HYPER NUCLEAR – SCHEDULE

CHARGE 1A

ID	Task Name	Duration	Start	Finish
1				
2	HyperNuclear Installation	371 days	Wed 9/1/27	Wed 1/31/29
3	SHMS Moved to Beam righ	78 days	Wed 9/1/27	Fri 12/17/27
15	ENGE Installation	69 days	Fri 12/17/27	Wed 3/22/28
36	PCS Magnets Installation	43 days	Thu 2/24/28	Mon 4/24/28
46	HES Arm	60 days	Fri 4/21/28	Thu 7/13/28
59	HKS Arm	74 days	Thu 7/13/28	Tue 10/24/28
77	LCW lines (around magnets)	40 days	Tue 10/24/28	Mon 12/18/28
82	Tune and Calibration	21 days	Wed 1/3/29	Wed 1/31/29



HYPER NUCLEAR – SCHEDULE

SHMS Moved to Beam right	**78 days**	**Wed 9/1/27**	**Fri 12/17/27**
Anaconda Support Fixture	**78 days**	**Wed 9/1/27**	**Fri 12/17/27**
Design	30 days	Wed 9/1/27	Tue 10/12/27
Fabricate	30 days	Wed 10/13/27	Tue 11/23/27
Install	5 days	Wed 11/24/27	Tue 11/30/27
Disconnect Anaconda from existing support	2 days	Wed 12/1/27	Thu 12/2/27
Attach to new support	2 days	Fri 12/3/27	Mon 12/6/27
Rotate HMS to largest Angle	1 day	Tue 12/7/27	Tue 12/7/27
Remove Target Chamber	2 days	Wed 12/8/27	Thu 12/9/27
Remove Downstream Beamline	3 days	Fri 12/10/27	Tue 12/14/27
Remove equipment/detectors around pivot	2 days	Wed 12/15/27	Thu 12/16/27
Rotate SHMS to largest Angle BR	1 day	Fri 12/17/27	Fri 12/17/27

HYPER NUCLEAR – SCHEDULE

ENGE Installation	**49 days**	**Fri 12/17/27**	**Wed 2/23/28**
Prep Hall for ENGE magnet	6 days	**Fri 12/17/27**	Fri 12/24/27
Stage HyperNuclear items in ESB	2 days	Mon 12/27/27	Tue 12/28/27
Move ENGE out of ESB	4 days	Wed 12/29/27	Mon 1/3/28
Transfer ENGE to Hall C	3 days	Tue 1/4/28	Thu 1/6/28
Move ENGE around SHMS	6 days	Fri 1/7/28	Fri 1/14/28
Move SHMS to largest Angle	4 days	Mon 1/17/28	Thu 1/20/28
ENGE Shield blocks 13x26x26 (15x) Install (under platform shielding)	4 days	Fri 1/21/28	Wed 1/26/28
Crane in ENGE support frame	3 days	Thu 1/27/28	Mon 1/31/28
Position/Survey/Align/Grout ENGE Support Frame	3 days	Tue 2/1/28	Thu 2/3/28
Bring in Lifting tower	3 days	Fri 2/4/28	Tue 2/8/28
Position ENGE onto Support Frame	3 days	Wed 2/9/28	Fri 2/11/28
Remove lift towers from hall	3 days	Mon 2/14/28	Wed 2/16/28
ENGE detector platform (mounts to magnet)	3 days	Thu 1/27/28	Mon 1/31/28
ENGE detector package	6 days	Tue 2/1/28	Tue 2/8/28
ENGE roof blocks (3x)	3 days	Wed 2/9/28	Fri 2/11/28
ENGE wall blocks (12x)	4 days	Mon 2/14/28	Thu 2/17/28
Enge Detector package	4 days	Fri 2/18/28	Wed 2/23/28
Target support post installation	3 days	Thu 1/13/28	Mon 1/17/28
Target platform installation	3 days	Tue 1/18/28	Thu 1/20/28
Upstream Girder Suport stand installation	25 days	Fri 1/21/28	Thu 2/24/28

HYPER NUCLEAR – SCHEDULE

PCS Magnets Installation	**43 days**	**Thu 2/24/28**	**Mon 4/24/28**
Target chamber installation	10 days	Thu 2/24/28	Wed 3/8/28
Sieve Slits (2x) Installation	5 days	Thu 3/9/28	Mon 3/20/28
First Section of Beamline installation	3 days	Tue 3/21/28	Thu 3/23/28
NPS correction magnet Installation	3 days	Fri 3/24/28	Wed 3/29/28
Install PCS Stand	4 days	Tue 2/8/28	Mon 2/14/28
Install Magnet PCS 1	8 days	Tue 2/15/28	Fri 2/25/28
Install Magnets PCS 2	3 days	Mon 2/28/28	Wed 3/1/28
Install LCW and Elecrical connection	5 days	Mon 3/6/28	Fri 3/17/28
Survey and Alignment	2 days	Mon 3/20/28	Tue 3/21/28

HYPER NUCLEAR – SCHEDULE

HES Arm	60 days	Fri 4/21/28	Thu 7/13/28
HES support frame installation	2 days	Fri 4/21/28	Mon 4/24/28
HES Quad(2x) installation	4 days	Tue 4/25/28	Fri 4/28/28
HES Bellows	2 days	Mon 5/1/28	Tue 5/2/28
HES Dipole	10 days	Wed 5/3/28	Tue 5/16/28
HES Shield blocks 13x26x26 (24x)	4 days	Wed 5/17/28	Mon 5/22/28
HES Detector frame / platform	2 days	Tue 5/23/28	Wed 5/24/28
HES Detector	3 days	Thu 5/25/28	Mon 5/29/28
HES Rail Bridge	2 days	Tue 5/30/28	Wed 5/31/28
HES wall Blocks (14x)	3 days	Thu 6/1/28	Mon 6/5/28
HES Large Shield Blocks (6x)	3 days	Tue 6/6/28	Thu 6/8/28
HES roof blocks (4x)	2 days	Fri 6/9/28	Mon 6/12/28
Survey and Alignment	2 days	Tue 5/30/28	Wed 5/31/28

HYPER NUCLEAR – SCHEDULE

HKS Arm	74 days	Thu 7/13/28	Tue 10/24/28
HKS support frame installation	3 days	Thu 7/13/28	Mon 7/17/28
HKS Quad (2x) installation	4 days	Tue 7/18/28	Fri 7/21/28
HKS Bellows	2 days	Mon 7/24/28	Tue 7/25/28
Shield Block 13x26x26 (28x)	5 days	Wed 7/26/28	Tue 8/1/28
Shield Block 52x52x26 (15)	3 days	Wed 8/2/28	Fri 8/4/28
HK Dipole	12 days	Mon 8/7/28	Tue 8/22/28
HKS Detector	3 days	Wed 8/23/28	Fri 8/25/28
HKS Rail Bridge	2 days	Mon 8/28/28	Tue 8/29/28
HKS Detector frame / platform (2x)	2 days	Wed 8/30/28	Thu 8/31/28
Large Shield Block (15x)	3 days	Fri 9/1/28	Tue 9/5/28
HKS wall blocks (28x)	5 days	Wed 9/6/28	Tue 9/12/28
HKS roof blocks (7x)	4 days	Wed 9/13/28	Mon 9/18/28
Survey and Alignment	2 days	Tue 8/8/28	Wed 8/9/28
Vacuum pumps installation	3 days	Tue 9/19/28	Thu 9/21/28
Downstream beam line installation	3 days	Fri 9/22/28	Tue 9/26/28
Cable trays	10 days	Wed 9/27/28	Tue 10/10/28
DC power cables	10 days	Wed 10/11/28	Tue 10/24/28

HYPER NUCLEAR – SCHEDULE

LCW lines (around magnets)	**40 days**	**Tue 10/24/28**	**Mon 12/18/28**
LCW lines to pivot	5 days	Tue 10/24/28	Mon 10/30/28
DC power supplies (12x)	10 days	Tue 10/31/28	Mon 11/13/28
480 Vac power lines	10 days	Tue 11/14/28	Mon 11/27/28
Power on Power Supplies	14 days	Mon 11/27/28	Thu 12/14/28
Tune and Calibration	21 days	Wed 1/3/29	Wed 1/31/29

HYPER NUCLEAR – MANPOWER

Mechanical Installation

Title	Employee		Allocation
Engineers:	Jamie Shiflett	100%	
	Engineer I (TBD)		100%
Designers:	Paulo Medeiros		100%
	Hunter Garrett		100%
	Designer II (TBD)		100%
	Designer I (TBD)		100%
Tech:	Jerry Nines	100%	
	Larry Carraway		100%
	Mike Bowman		100%
	Phillip Ullman		100%
	Tech II (TBD)	100%	
	Hall A Tech	50%	
	Hall A Tech	50%	

ELECTRICAL INSTALLATION

Title	Employee	Allocation
Engineers:	Ellen Becker	100%
	Engineer I (TBD)	100%
Designers:	Paulo Medeiros	100%
Tech:	Electrical Tech (TBD)	100%
	Accelerator Electrician	60%
	Accelerator Electrician	60%

FUTURE TASKS

- TIMELINE TO CHECKOUT EXISTING POWER SUPPLIES
- TESTING OF PCS MAGNETS AND FIELD MAPPING
- ASSEMBLY INSTALLATION PROCEDURES

RECOGNITIONS

LEGUANG TANG, BILL HENRY, PAULO MEDIEROS, MARK GARRET, JASON CLARK, JERRY NINES, LARRY CARRAWAY, PHILLIP ULLMAN, MICHAEL BOWMAN, ELLEN BECKER,