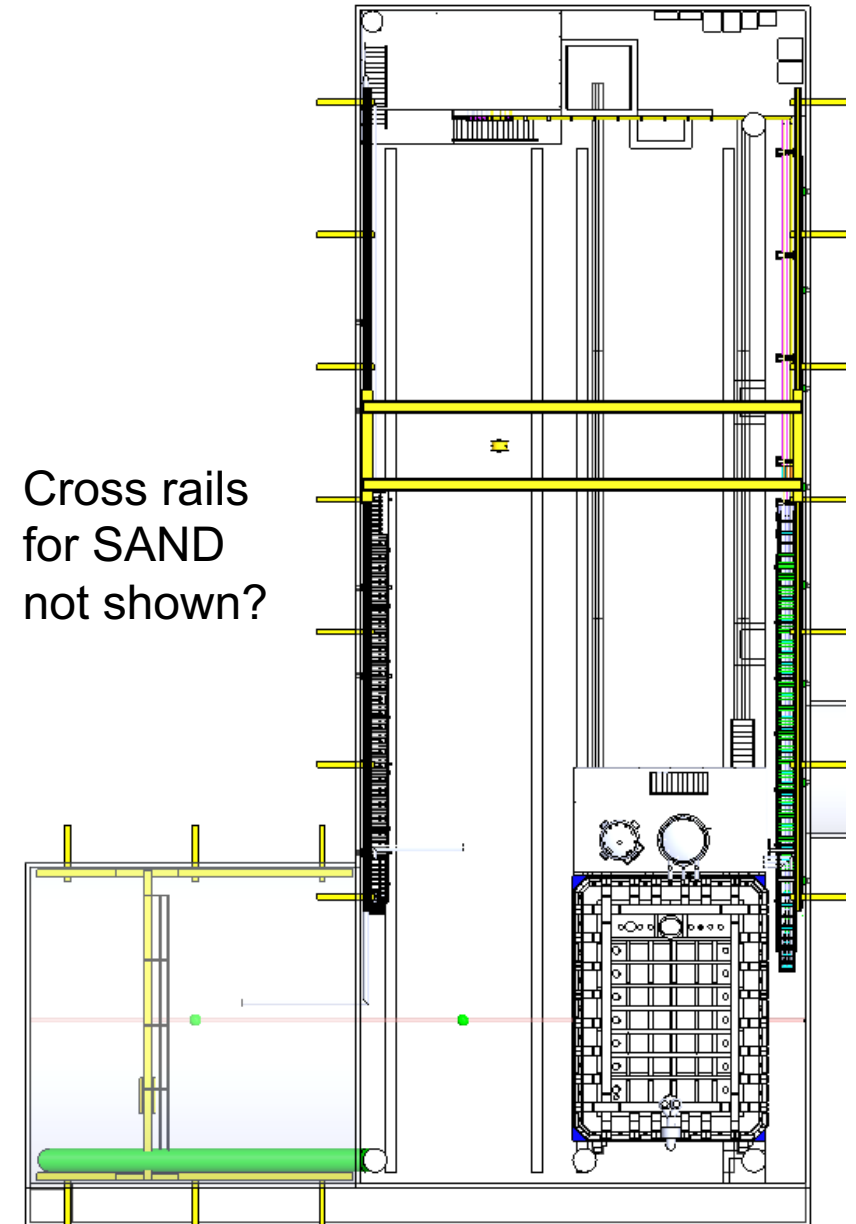


DUNE-PRISM Interfaces

Mike Wilking

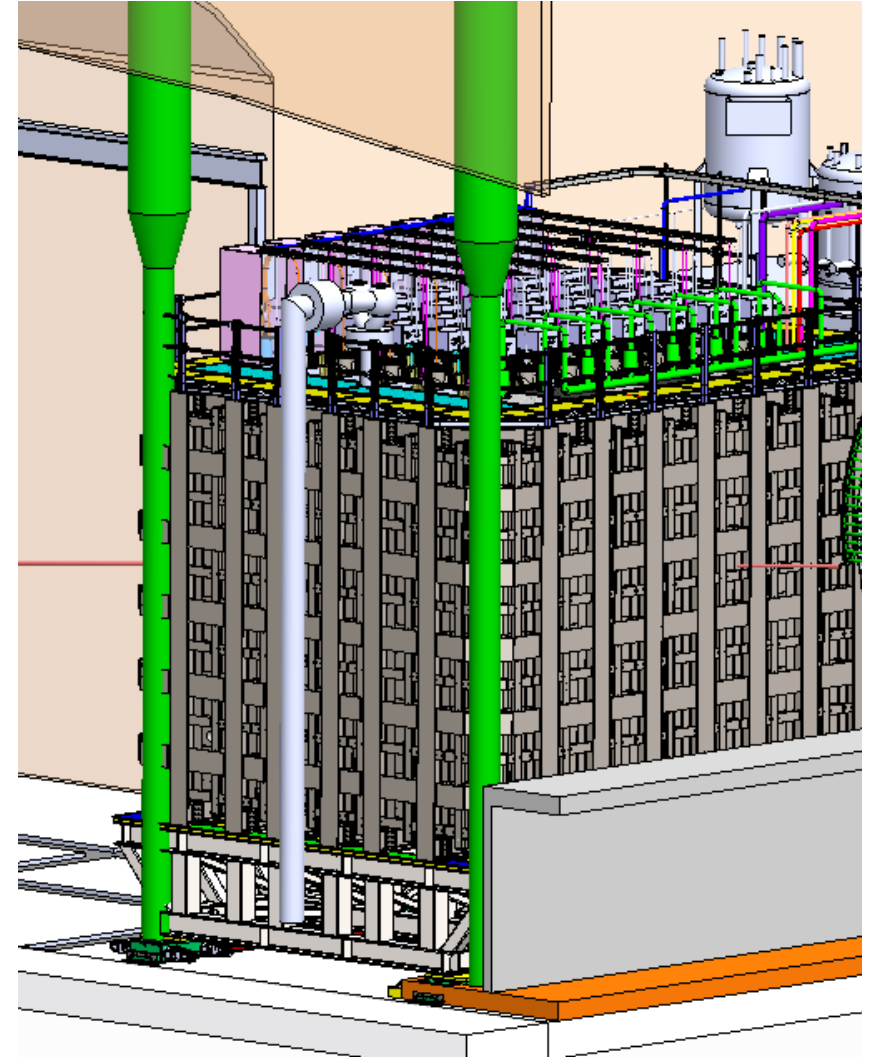
Rails

- All rails are in PRISM scope
- Interface to I&I (or ND conventional facilities)
- “Hilman epoxy grout” is currently in PRISM drill down, but nothing else to secure rails to the floor
 - Who is responsible for purchasing and installing anchor bolts?
- No interfaces between rails and detectors



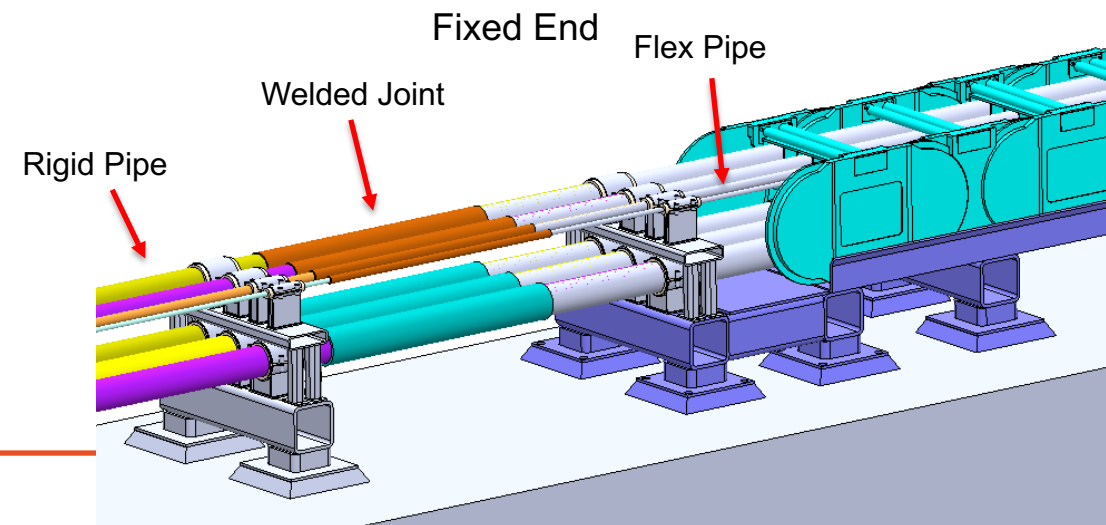
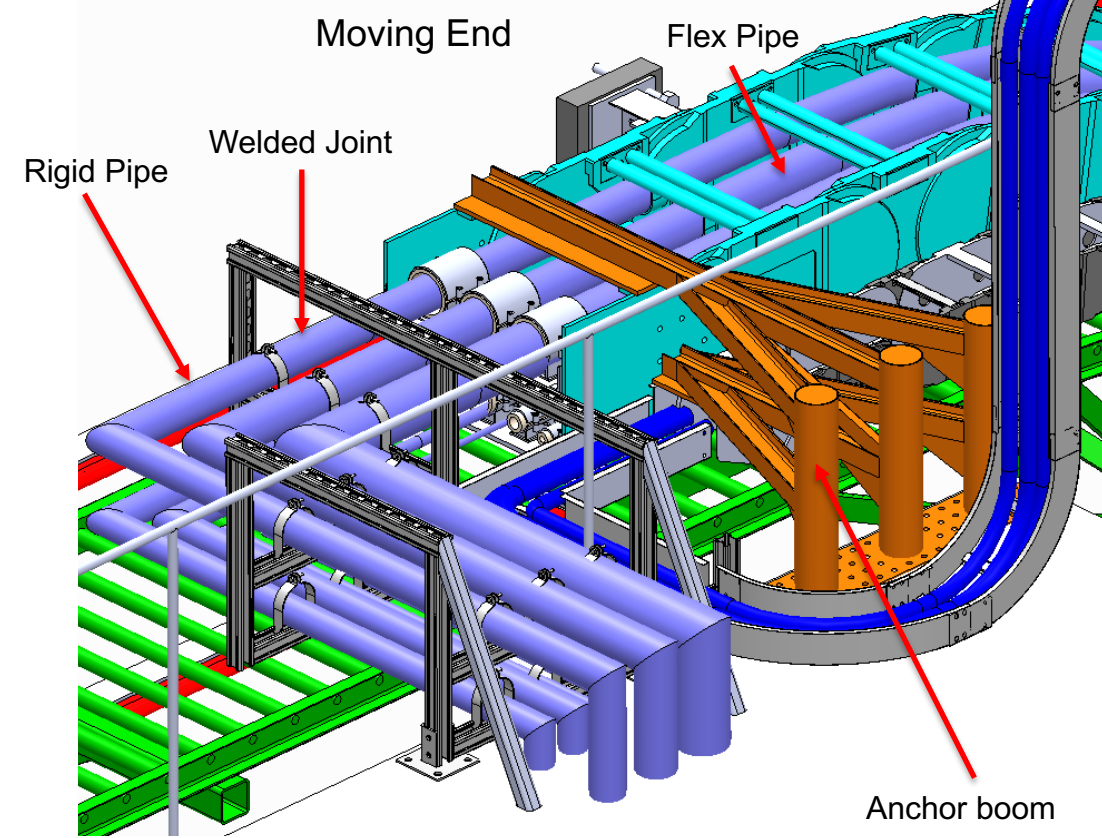
Rollers

- Hilman rollers interface with both TMS and ND-LAR detector platforms
 - Platforms must conform to the specified roller spacing
- Who owns that ND-LAR platform? I&I? ND-LAR? “Cryostat”?

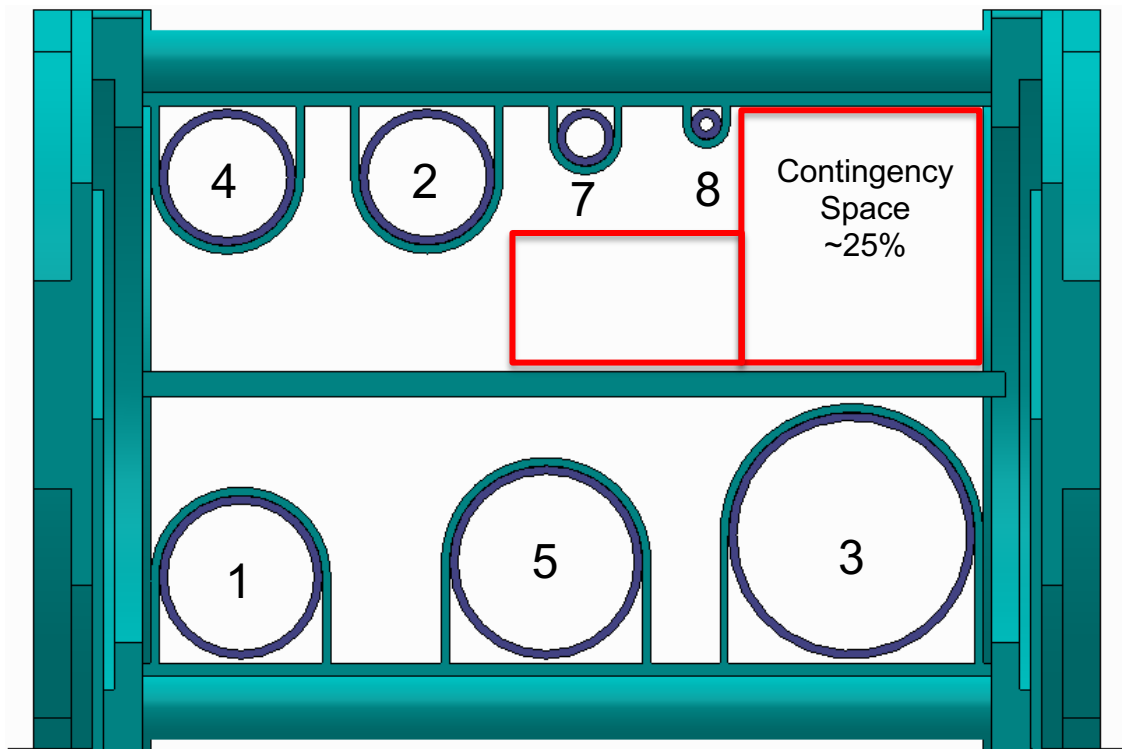


Energy Chains

- 4 total: power & utilities (e.g. cryo) to both TMS and ND-LAr
 - All include interfaces to I&I for securing the energy chains to the cavern
- ND-LAr utilities
 - Interface to cryo: they supply lines, and handle connections at both ends of the energy chain (including on top of ND-LAr)
 - Interface to ND-LAr to secure energy chain to detector (e.g. anchor boom)
- ND-LAr power
 - Interface to ND-LAr: includes power supply and data connection for all systems connected to ND-LAr (incl. cryo, PRISM, DAQ)
 - Interface to I&I: routing of cables after they leave the energy chain
 - Is I&I responsible for providing power and data cables?
- TMS power (same as ND-LAr power, but for TMS)
 - Interfaces to TMS and I&I
- TMS utilities
 - Interfaces to TMS and I&I (although I have not seen details of the utilities required for the TMS)



ND-LAr Utilities Energy Chain



Model: IGUS E4-350-500
 Internal Width: 350mm
 Internal Height: 500mm
 Weight: 65.7 kg/m

Name	Function	Flexible Line External Diameter	Manufacturer /Model	Mass per unit length	Max Pressure	Max Manuf. Length	Comment
1	LAr line - 2" - 10 barg (flexible VJP)	Ø 98.2 mm (DN80/40)	Nexans HIGHFLEX	7,0 kg/m	20 barg	25m	
2	LN2 line - 2" - 10 barg (flexible VJP)	Ø 81.4 mm (DN65/32)		5,3 kg/m	10 barg		
3	GN2 exhaust 2 ½" - 1barg (flexible VJP)	Ø 148.2 mm (DN125/65)		9,0 kg/m	10 barg		
4	GAr supply - 2" - 10barg	Ø 82 mm	Witzenmann HYDRA RS330	1,67 kg/m	30 barg	100 m	
5	GAr exhaust - 4" - 1 barg	Ø 116 mm		2,5 kg/m	10 barg	20 m	
6	Cryostat Relief Exhaust - 12" - 0,2 barg	Ø 340 mm	Witzenmann HYDRA RS430	22 kg/m	4 barg	3 m	Removed.
7	Instrument Air - 1" - 10 barg	Ø 34 mm	Witzenmann HYDRA RS330	0,79 kg/m	65 barg	100 m	
8	GN2 - ½" - 10 barg	Ø 18 mm		0,25 kg/m	75 barg	100 m	Supply of insulation purge gas
9	Cryogenics LV, UPS and Network by I&I	n/a	Configuration and installation by I&I				

Table 1. Energy chain piping list, preliminary design rough order of magnitude dimensions.

(20% spare required at preliminary design stage)

EDMS: **2385478**

Page: **6 of 17**

*Final sizing and layout of lines TBD

The only interface is to cryo?

Additional Interfaces

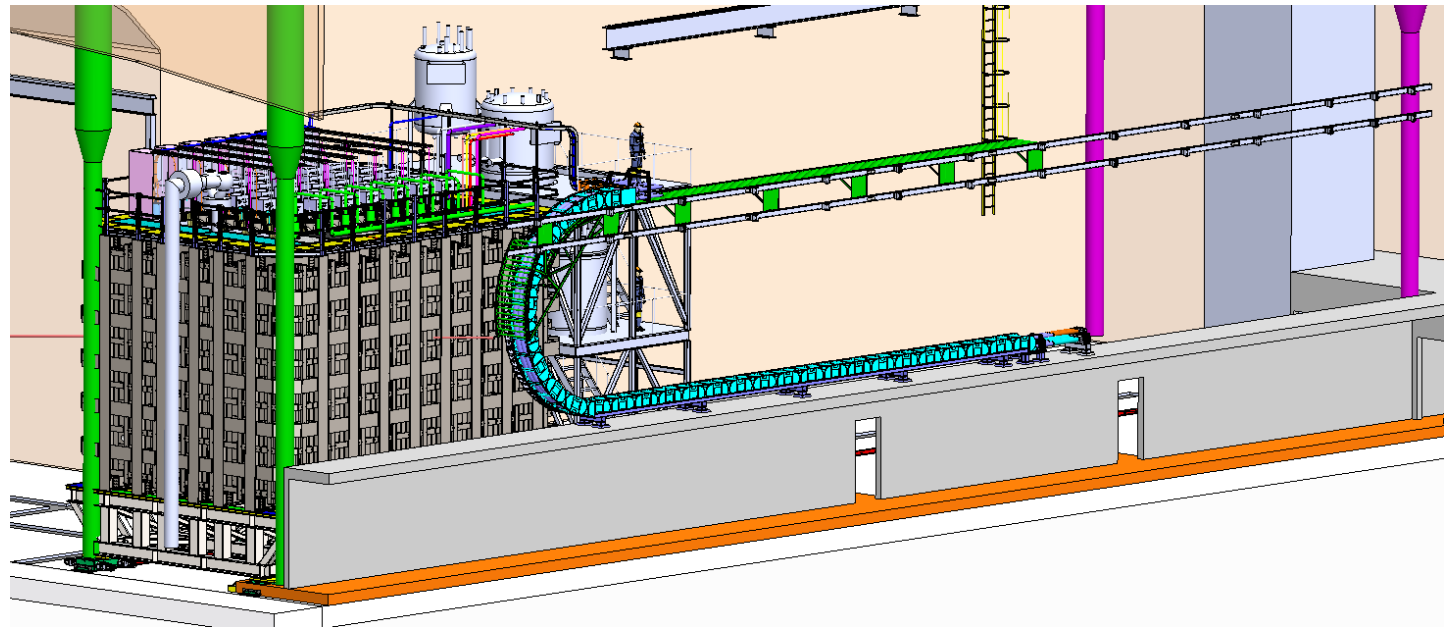
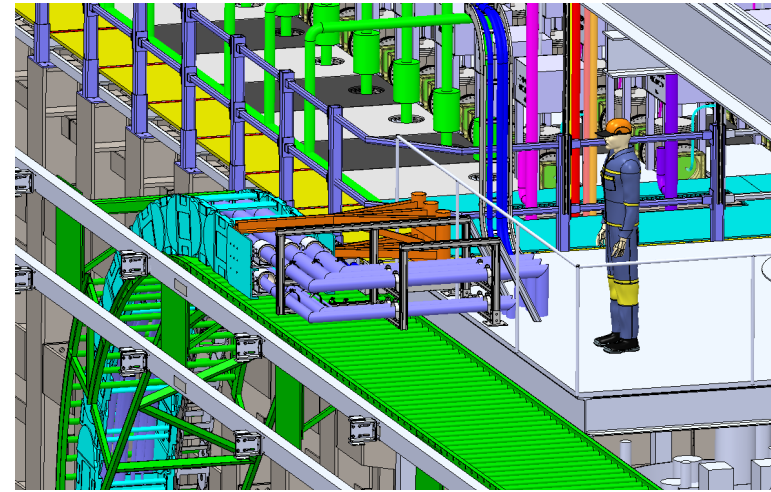
- Interfaces to ND-LAr
 - PRISM control box must be mounted somewhere on the detector
 - Power and data cabling must be provided by ND-LAr for control box and for the rollers
 - The laser positioning system and accelerometer/vibration monitors must be mounted to ND-LAr
 - Power and data cabling must be provided by ND-LAr to monitoring systems (laser positioning, accelerometers / vibration monitors)
- Interfaces to TMS
 - Same as for ND-LAr (but for TMS)

Backup (from talk by Andrew Lawrence)

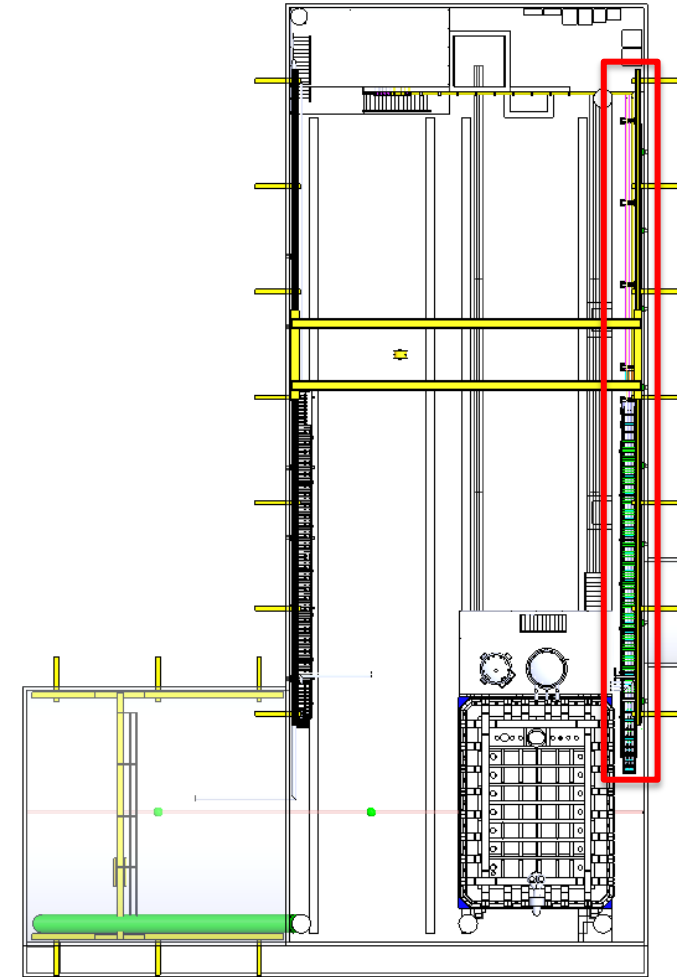
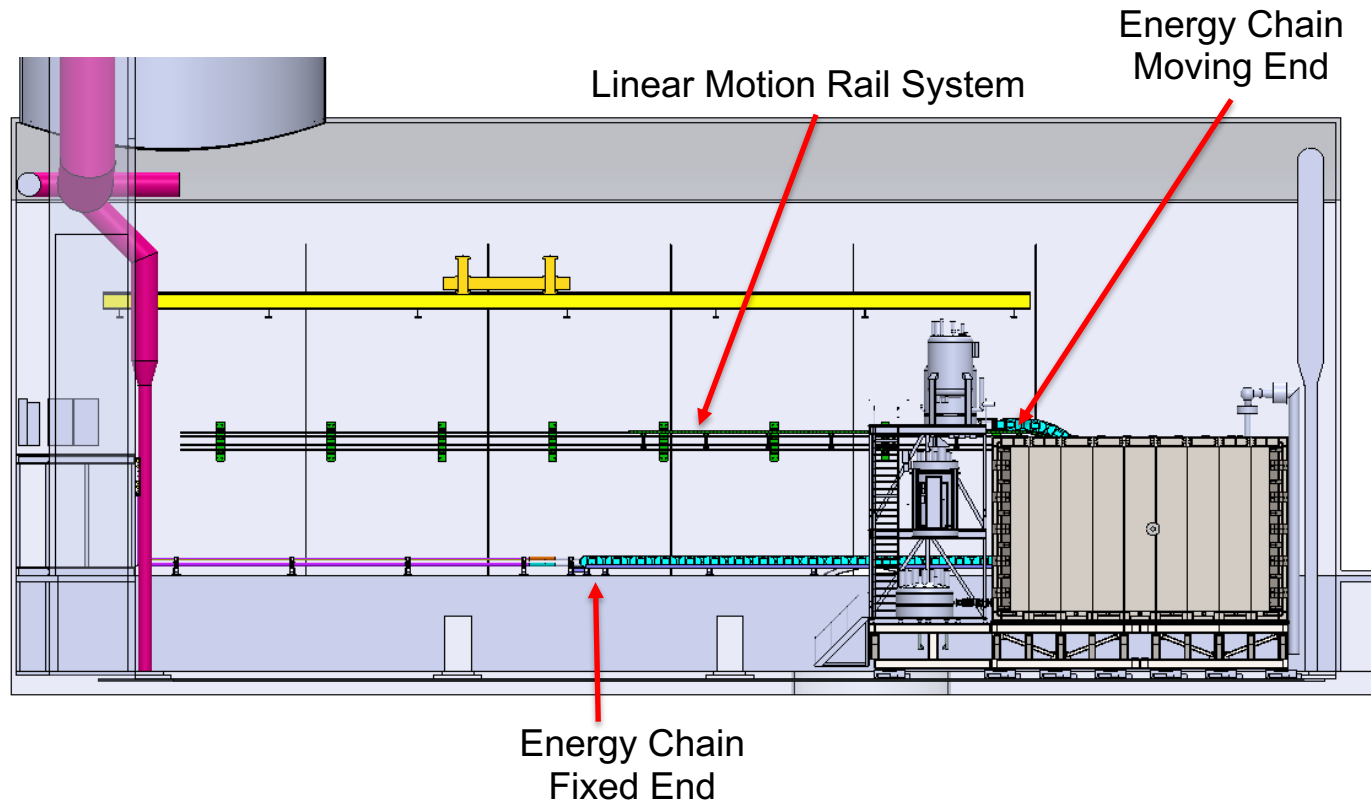
LAr Energy Chain Overview

Two parallel chains will deliver utilities along stride of PRISM System

- LAr Cryogen Supply Chain
- Power Supply/Controls/Data Chain
- Linear Motion Support Conveyor
- PRISM Anchor via Cryogen Mezzanine

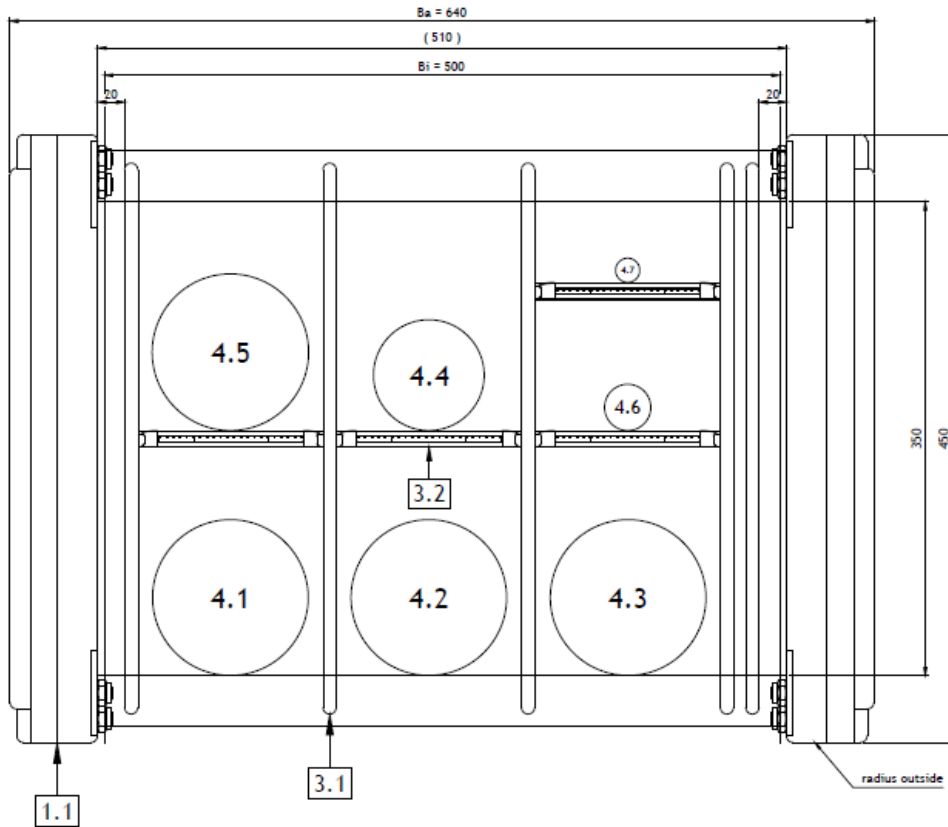


Energy Chain Interface with Cavern



*Quantity and spacing of mounts will be determined based on method and individual load capacity

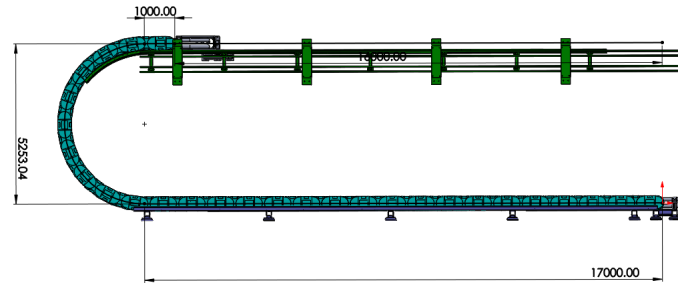
Igus Shelving and Proposed Pipe Layout



E-Chain Data			
E-Chain Part Number (ITEM 1.1):	E4.350.500.2000.0		
Lowered Mounting Height:	No		
LMH DWG:	-	Links to Flip:	-
Moving End Bracket (ITEM 2.1):	E4.350100.1		
Fixed End Bracket (ITEM 2.2):	E4.350100.2		
Tiewrap (ITEM 2.3):	-	QTY (PCS):	-
Bracket Configuration:	-		
E-Chain Length without MB:	25850 mm		
Quantity of Regular Links:	55	pitch:	0 mm
Interior Separation in Every:	2nd	Link	
Starting on the:	1st	Link	
Item	Part Number	QTY/Link	Total
3.1	E4.351.1F	4	108
3.2	450.13	4	108
Project Technical Data			
Travel Length:	31.60 m		
Speed:	0.05 m/s		
Acceleration:	0.10 m/s ²		
Deceleration:	0.10 m/s ²		
Application Type:	-		
Operational Area / Environment	-		
Country / Place:	-		
Temperature: (-°C ... +°C):	-	-	-
Humidity (%):	-		
Wind Speed:	-		
In Operation:	-		
Out of Operation:	-		
Cycles Per Year:	N/A		

Cryogenic Energy Chain Load Values

Length of energy chain: 26.25 meters
 -16 m for necessary travel
 -8.25 m in energy chain bend
 -1 m relief at both ends



Line	Volume (m3)	Material Density kg/m	Material Mass kg	Pipe Weight kg	Total Weight kg
L. Argon	0.05321	1430	76.08685	105	181.1
L. Nitrogen	0.05321	804	42.77890	105	147.8
G. Nitrogen	0.08314	1.2	0.09976	105	105.1
G. Argon supply	0.05321	17.8	0.94709	43.8375	44.8
G. Argon exhaust	0.21283	1.65	0.35117	65.625	66.0
Instrument Air	0.01330	1.23	0.01636	20.7375	20.8
G. Nitrogen (purge gas)	0.00333	12.4	0.04124	6.5625	6.6
Total					572.1

Weight of Energy Chain

Cryogenic Piping(filled): 572.1 kg

Igus Chain(65.7kg/m): 1,724.6 kg

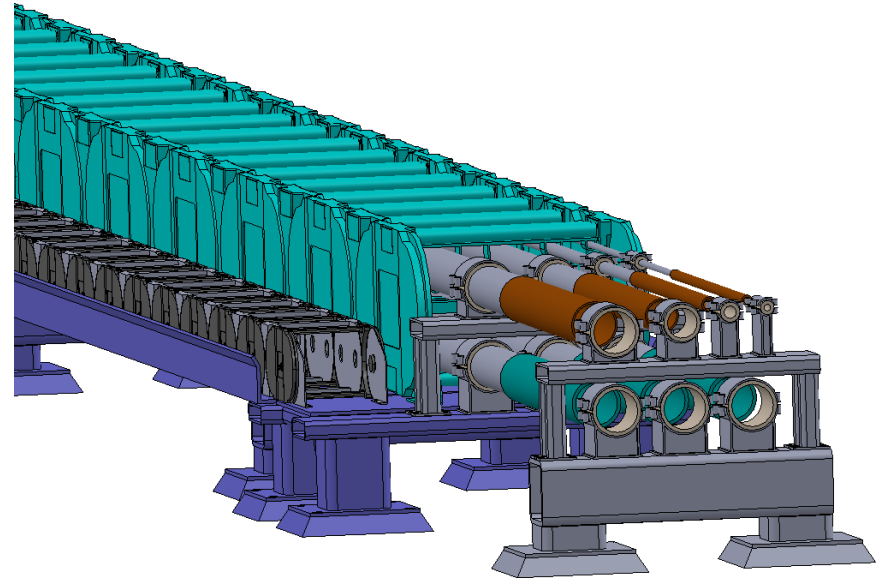
Total Weight: 2,296.7 kg

Power Supply Energy Chain

IGUS chain model for power and data

- Inner Height: 162mm
- Inner Width: 200mm

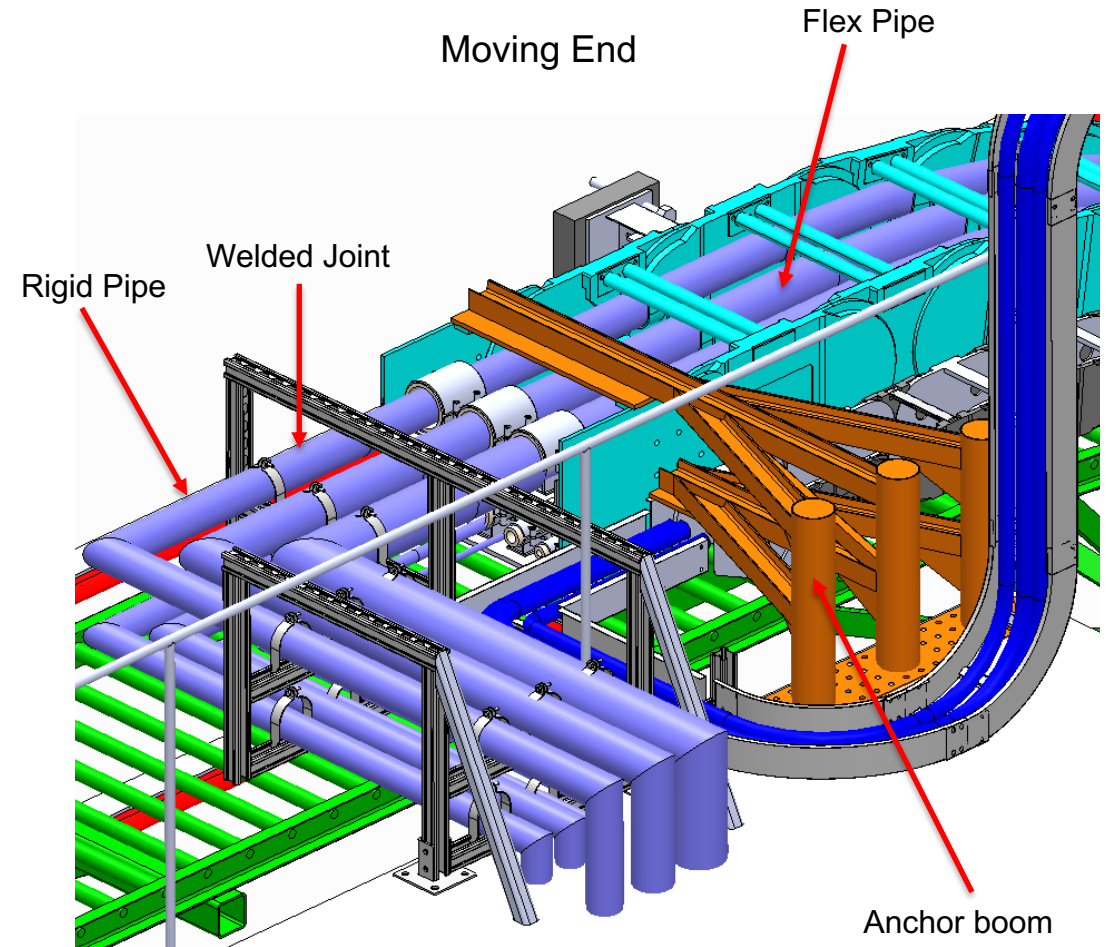
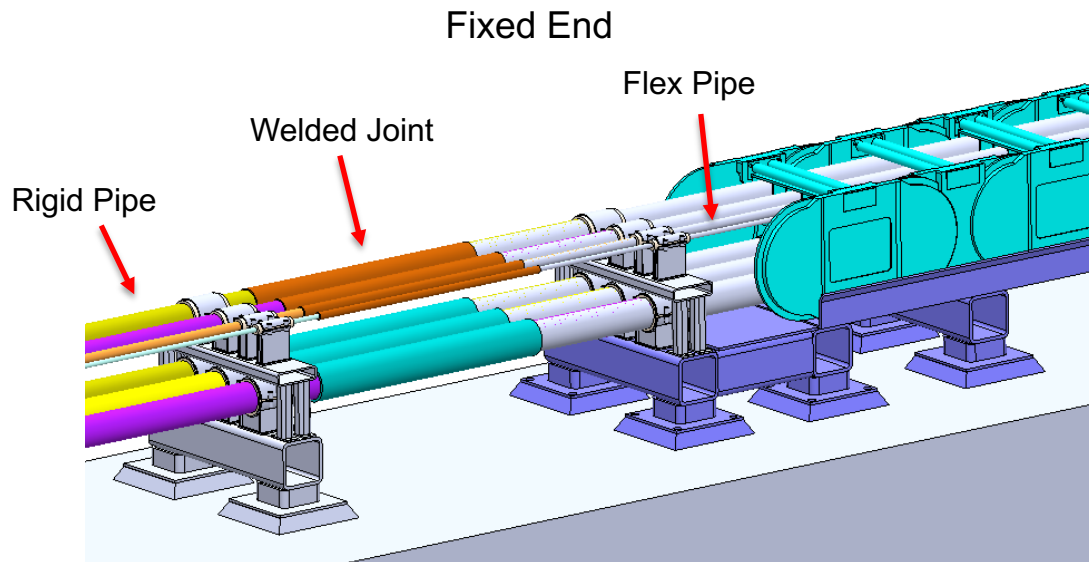
*chain selection to chain per volume requirements



End Connections

Rigid piping from cryoplant and surface transfer lines will connect via welded connections

90 degree turn at end of chain to mate with LAr cryogenic mezzanine

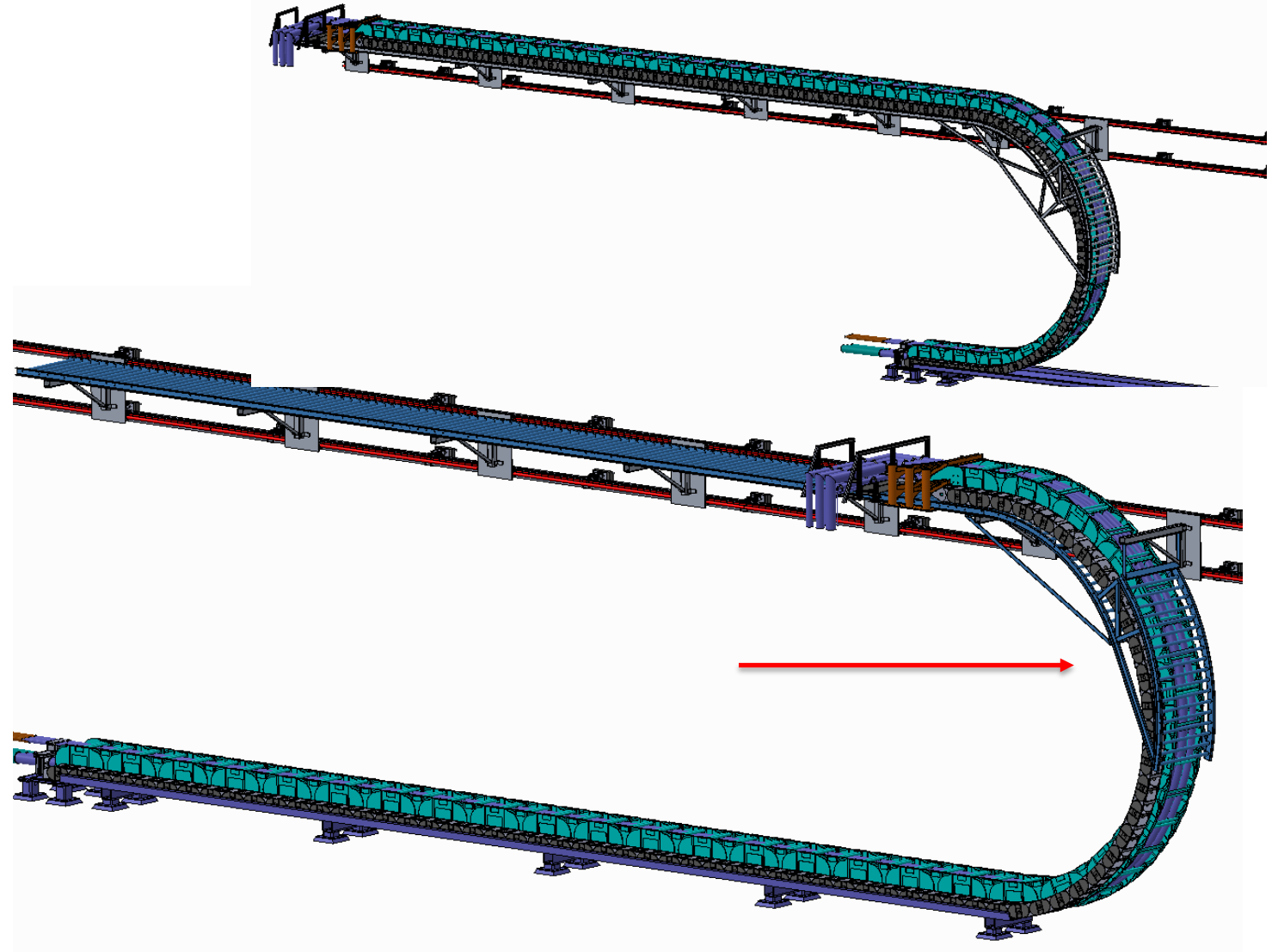


Conveyor Shelf

Energy chain traveling support needs to return with energy chain

Can this be accomplished without another powered motion system?

Added a concentric conveyor to guide travel support back to starting position



Commercially Available Conveyor

Model RS19U/G-31-6, 10'

Rollers Max Load: 8,757kg

15m(49.21ft) of straight conveyor results in 99 rollers

99x195lb= 19,305lb (8,757kg) max load

Frame max load:

10ft separated supports: 49.21ft x 120lb/ft = 5,905lb(2,678kg)

5ft separated supports: 49.21ft x 660lb/ft = 32,478lb(14,732kg)

*We will have to fabricate custom transfer module at end

Working with custom conveyor vendor CSE for a custom conveyor with wall-mounted rollers

RS19

GRAVITY ROLLER CONVEYOR
(1.9 in. dia. x 16 ga. rollers)

Gravity roller conveyor is ideal for conveying light or medium weight packages. They are useful for assembly, warehousing, or shipping applications.

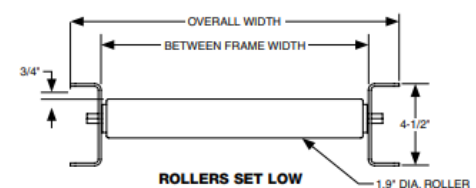
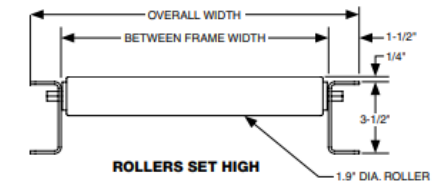
- 12 widths
- 4 roller centers
- Powder coated steel frames

ULTIMATION



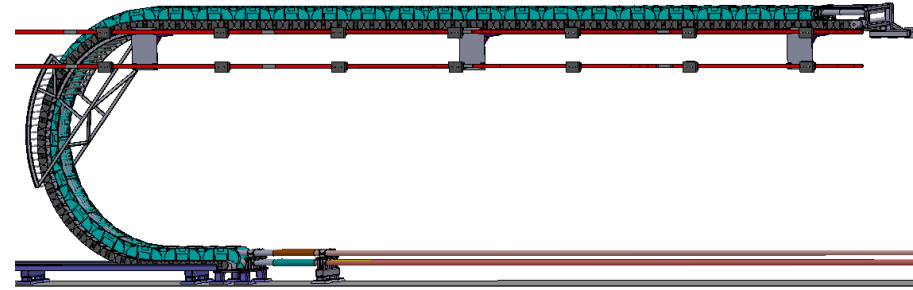
BETWEEN FRAME WIDTH	OVERALL WIDTH	MODEL NO.		ROLLER CENTERS	WT. (LBS.)	
		1.9" X 16 GA.			5'	10'
		UNPLATED	GALVANIZED			
31"	34"	RS19U-31-2.25	RS19G-31-2.25	2 1/4"	169	340
		RS19U-31-3	RS19G-31-3	3"	146	278
		RS19U-31-4.5	RS19G-31-4.5	4 1/2"	112	214
		RS19U-31-6	RS19G-31-6	6"	97	179

FRAME CAPACITY		ROLLER CAPACITY		
SUPPORT CENTERS	MAX. DISTRIBUTED LIVE LOAD PER FOOT (LBS.)	BETWEEN FRAMES	MAX. STATIC LOAD PER ROLLER (LBS.)	
			1.9 X 16 GA.	1.9 x 9 GA.
5'	660	13"-29"	265	290
10'	120	31"-45"	195	165
		47"-60"	100	80



Wall Mounting of Chain Support Conveyor

Travel support conveyor needs linear motion system to span travel distance of cryostat



Load Breakdown on linear motion system

Energy Chains: ~2,405 kg

Cryogenic Chain w/ VJP's, 24.55m at max travel (16.3m on conveyor, 8.25m in bend): ~2,148 kg

Power Supply Chain: 24.55m at max (10.45kg/m) ~257 kg

Travel Support Conveyor: ~1,085 kg

Conveyor: 987 kg

Support Shelves: 97.12 kg , 12.14 kg per unit

Load on linear bearings(max): ~3,490 kg

Linear Bearing Selection

Introduced Thomson linear bearings into model.

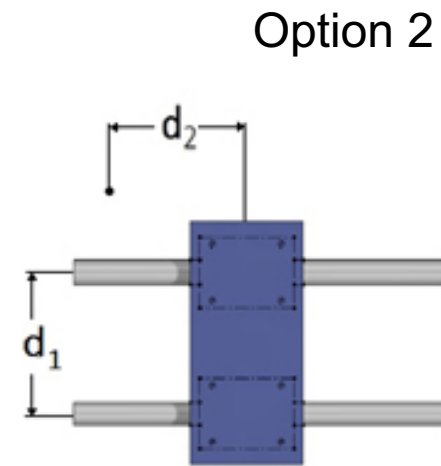
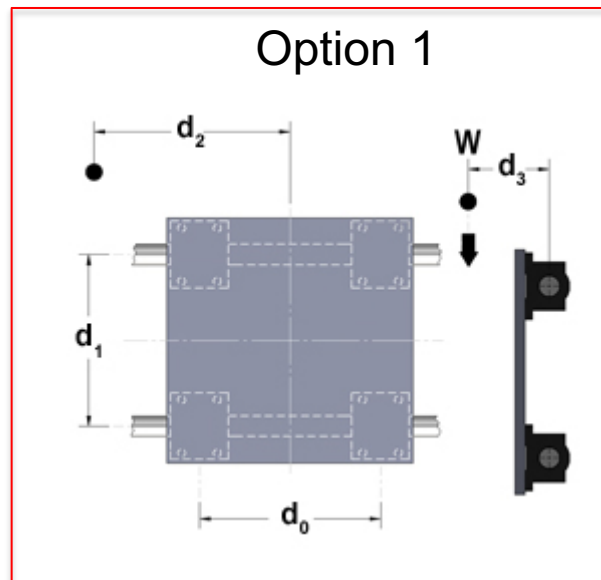
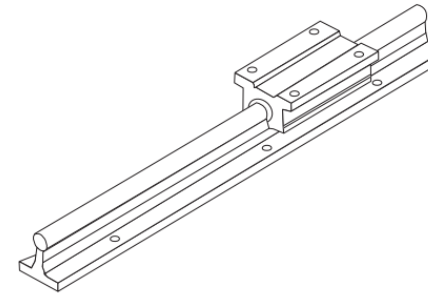
Two preferred options given for layout:

2 or 4 bearing per mounting pad



FluoroNyliner® Linear Guides

Corrosion resistant, smooth, quiet,
industry standard envelope



Conveyor Support

Specs:

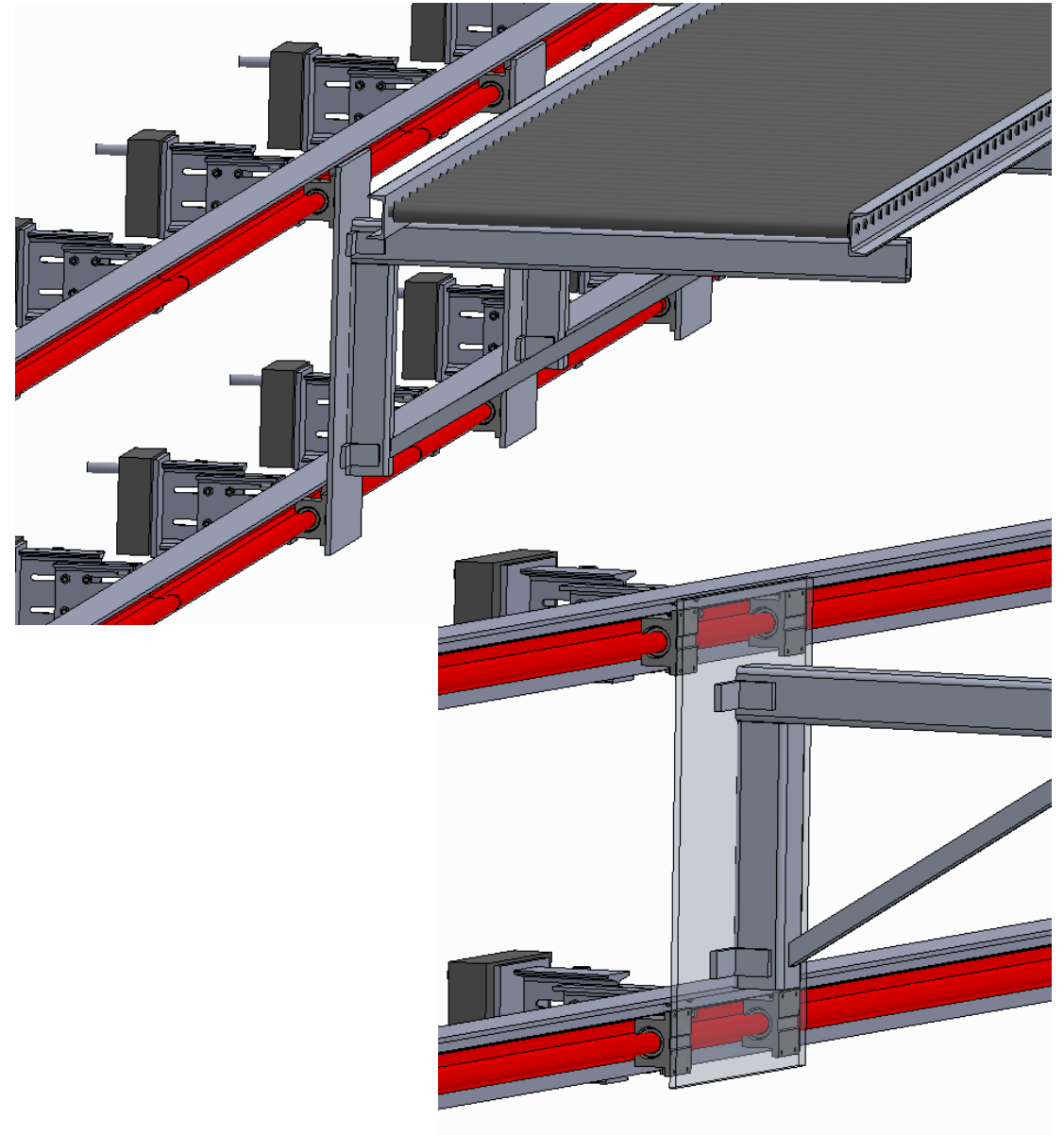
Rail Diameter: 1.5 inch

Bearing Max Load(per): 7000 lbf, or 3175kg

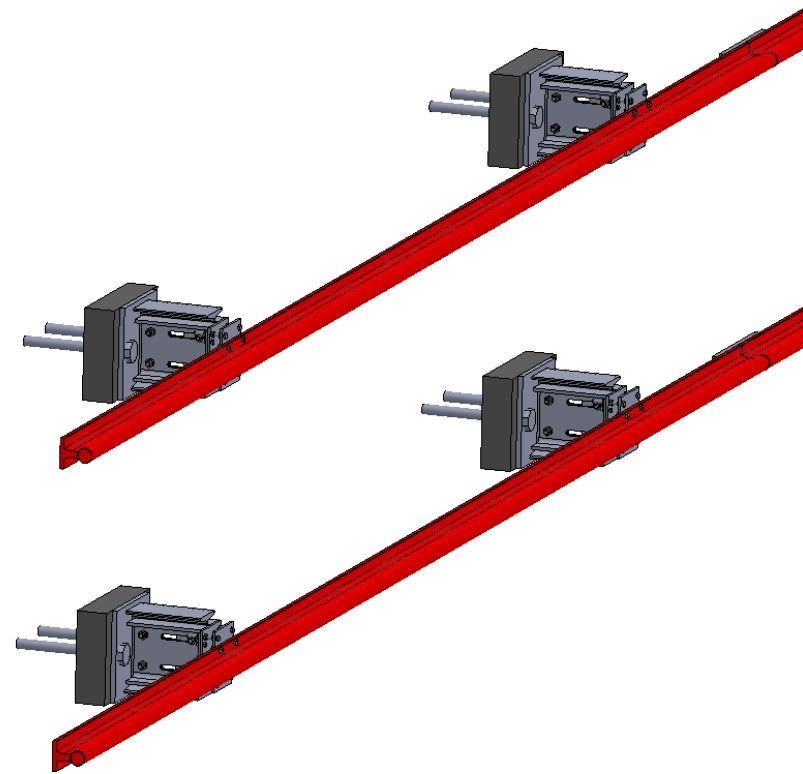
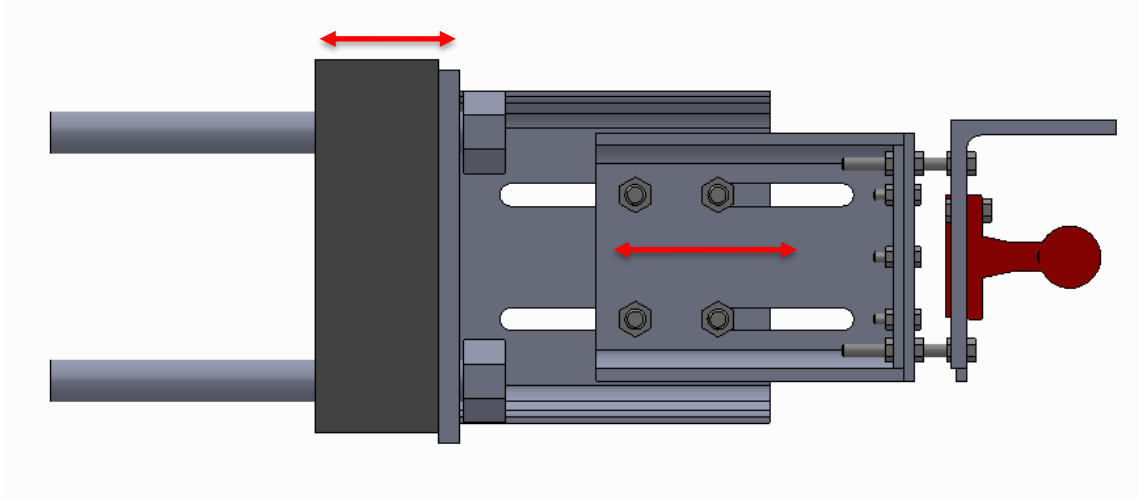
Max Load per support unit: 12,700 kg

3+ support units mounted along conveyor

Total bearing max load capacity: 38,100 kg



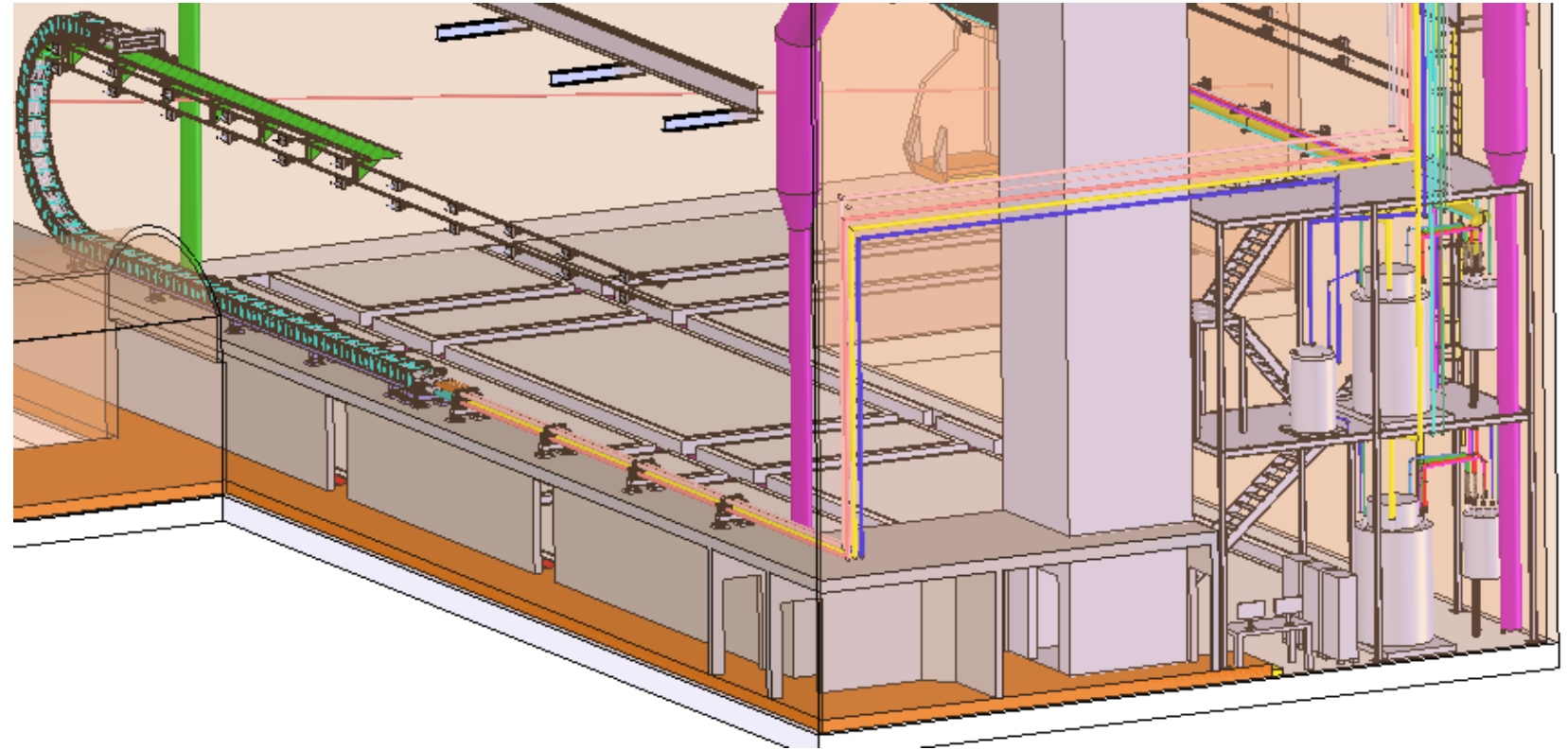
Rail Mounting



Slotted beam mounted to grout pad/shotcrete surface

3" slot + grout pad thickness (0 to 3+ inches) can overcome
6"+ variability in cavern wall surface.

Cryogen Pipe Routing in Cavern



Preliminary routing along rear wall of cavern and down to egress surface.

Concerns: Equipment placement along desired path, Interference with current ventilation model and power distribution equipment