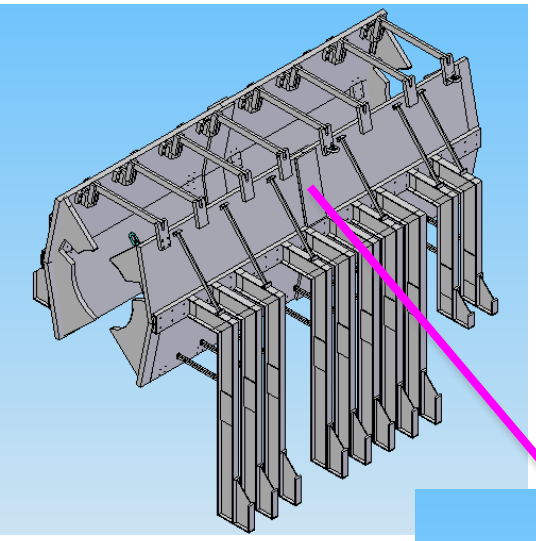
PRY Base - Contents

Jason Tarrant – Integration Engineering

- PRY Support/Base/Platform in the MICE Hall
  - History
  - Requirements
  - Environment
  - Design
  - Structural Integrity
  - Preparation
  - Installation
  - Absorber Change
  - Schedule
  - Conclusion
  - Step V CONCEPT – Initial Look

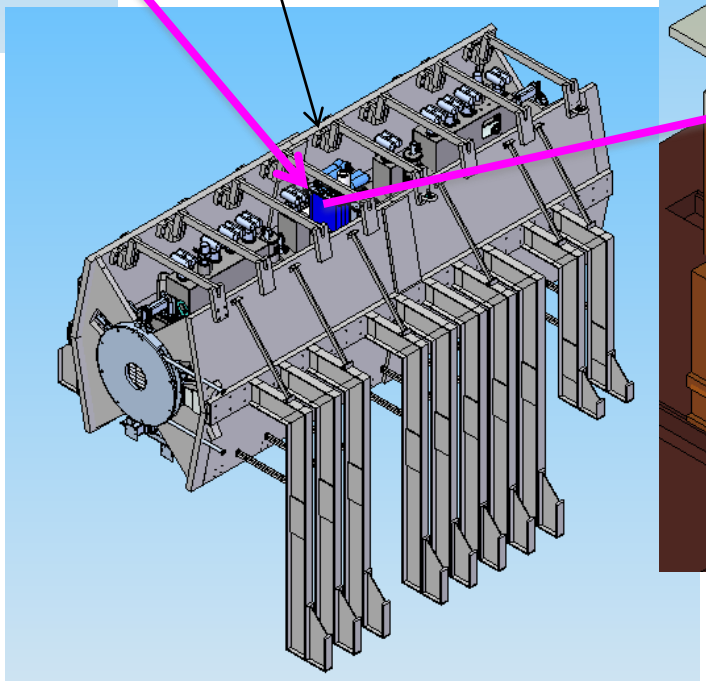
PRY @ Pre-September 2013 Review

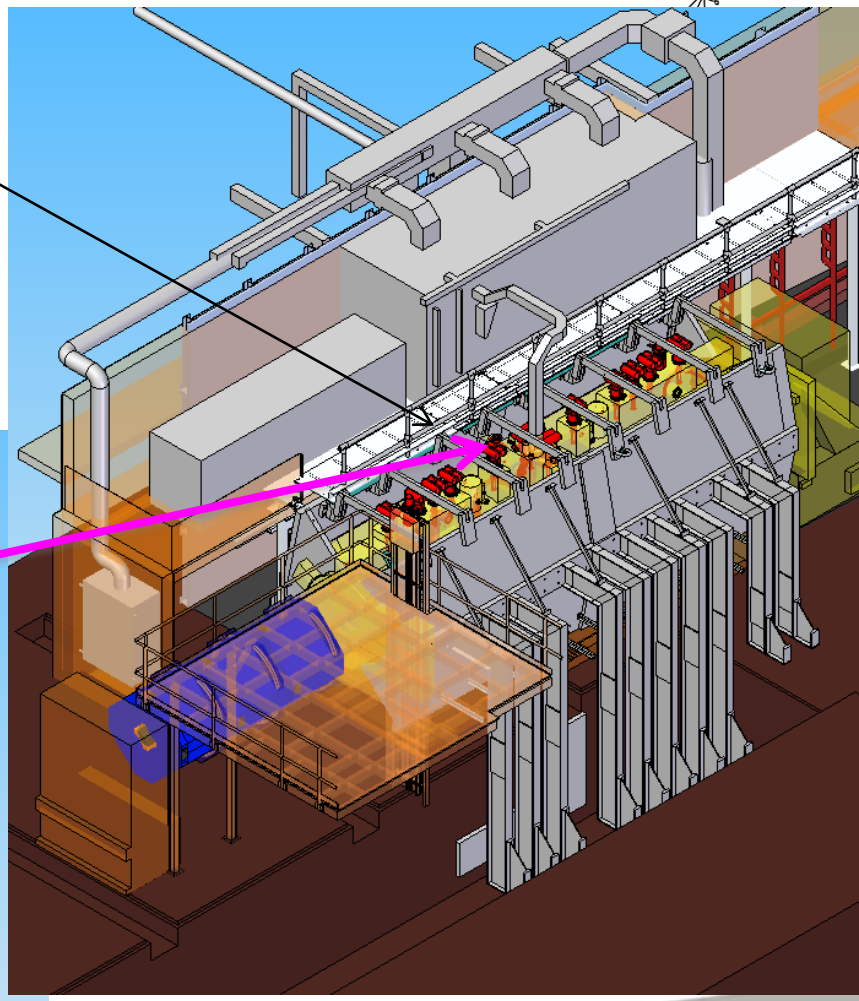


Brookhaven Yoke Design
(H Witte, S Plate)

Integrated into the MICE Hall

Integrated with Step IV Devices

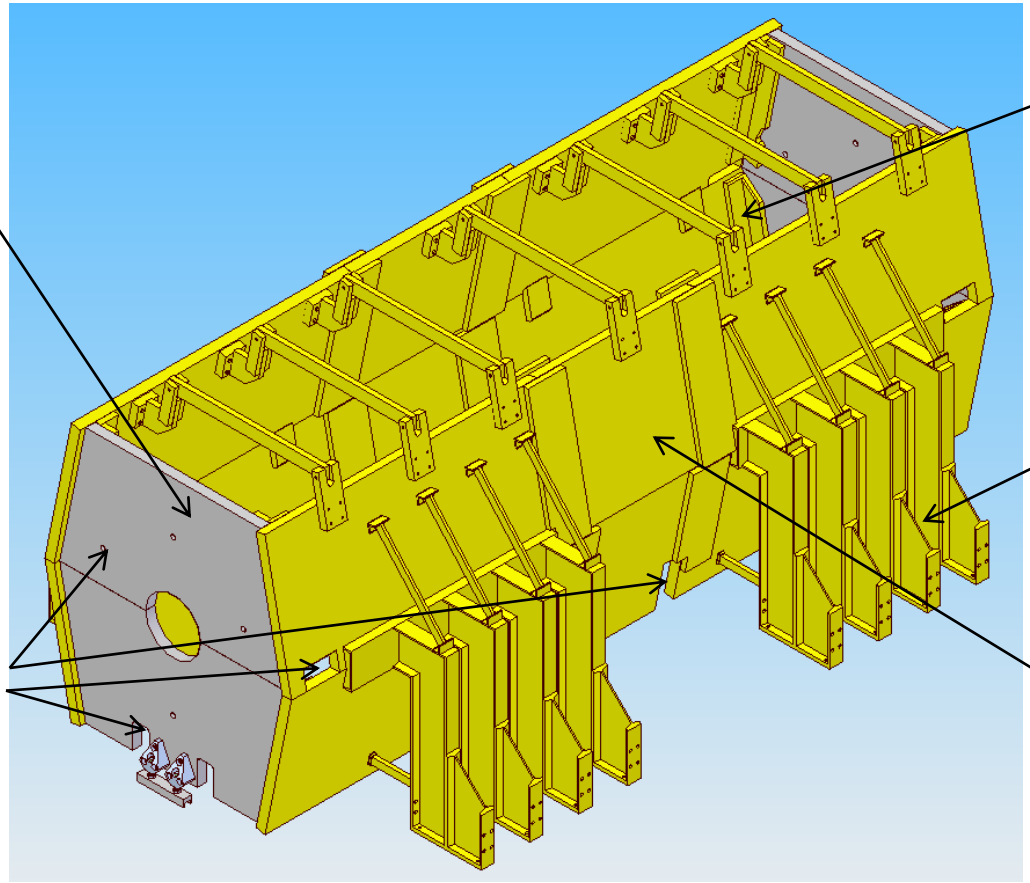




Science & Technology Facilities Council

PRY – April 2014

Brookhaven Yoke Design
(H Witte, S Plate)



Simplified end-plates with improved magnetic field coverage & structural properties

Features for service and environment compatibility added

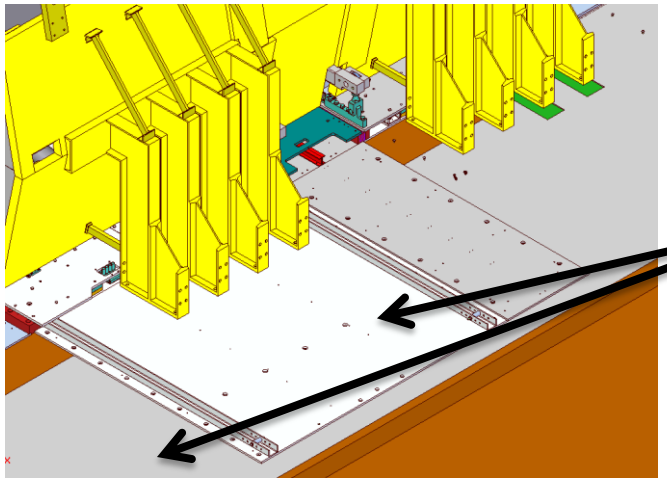
Finalised structural details for full assembly

Reduced number of more compact legs now with symmetry S-N (STFC responsible for platform / base / floor fixing in MICE Hall)

6 Piece Design with central access to AFC for absorber changes

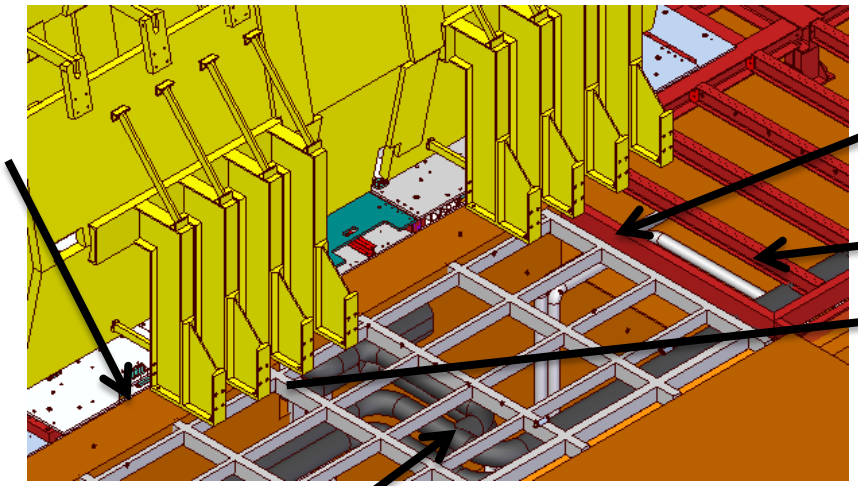
PRY Base - Environment

- Requirements
  – North side



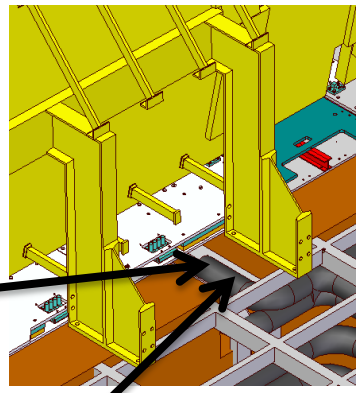
Plates & trench roof on north side

Edge of main concrete floor / trench



Trench ends

False floor

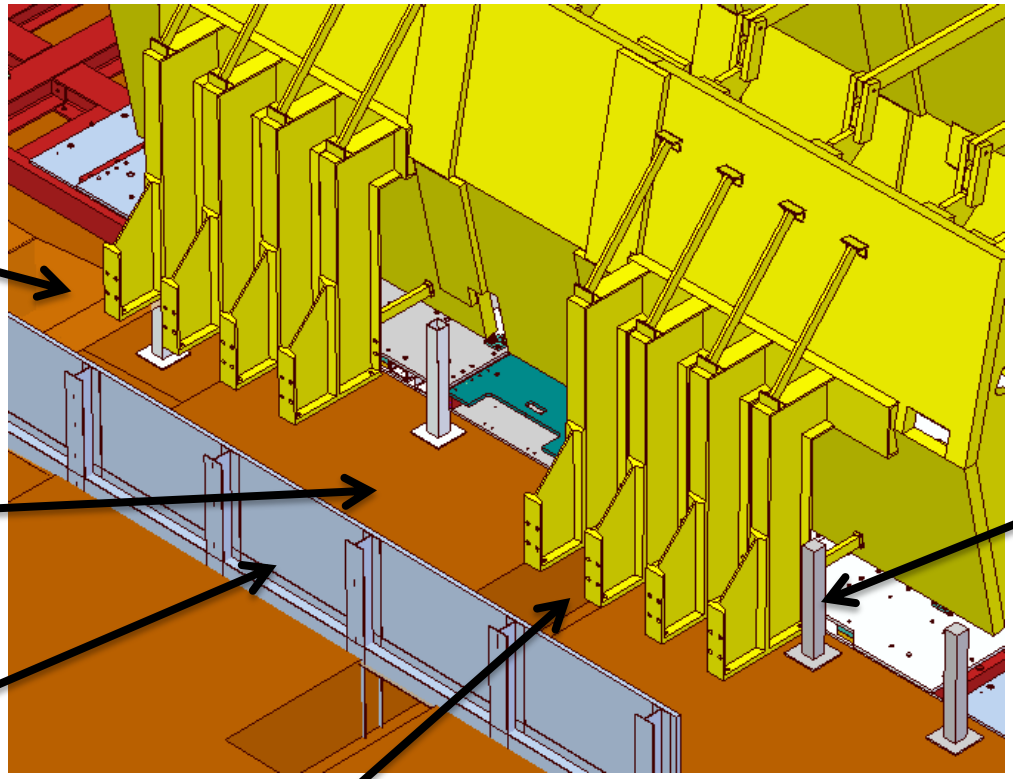


Services trench directly under leg

Services in trench on wall and ceiling

PRY Base - Environment

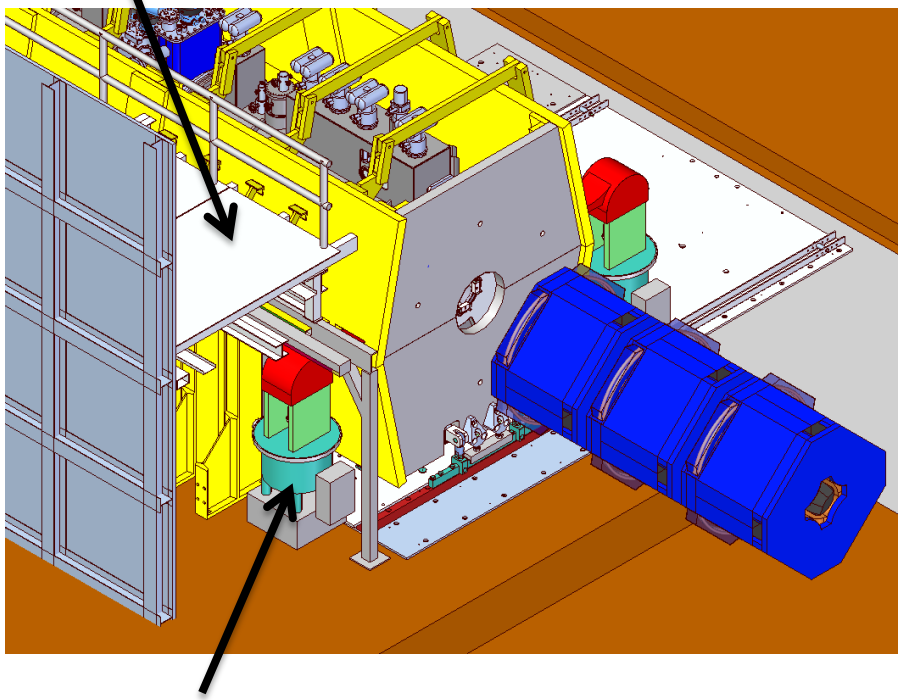
- Requirements
  – South side



PRY Base - Environment

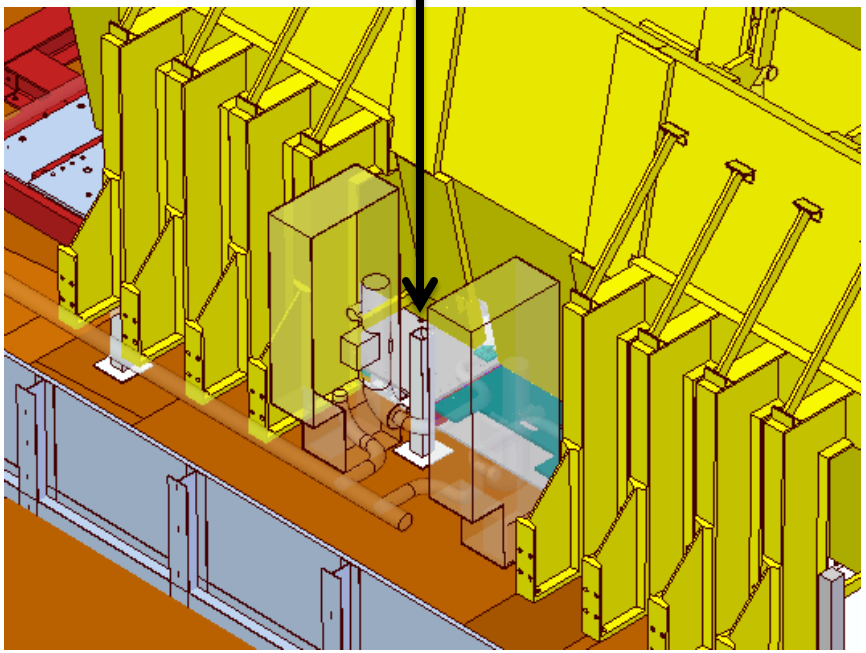
- Requirements
  - Services

South mezzanine



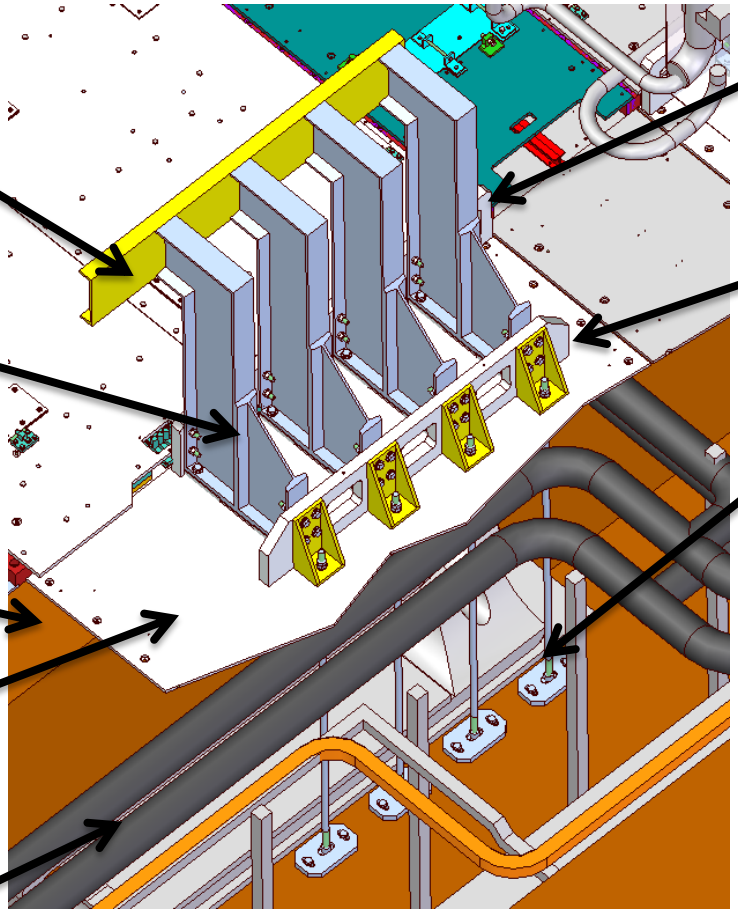
Tracker Cryo

Vacuum system



PRY Base - Design

- TD-1189-2090 - North East Quadrant



PRY Connector

Internal Support Bridge

PRY Legs

External Support Bridge

Tie down bars and bases

Trench edge

Existing Base

Trench & trench services

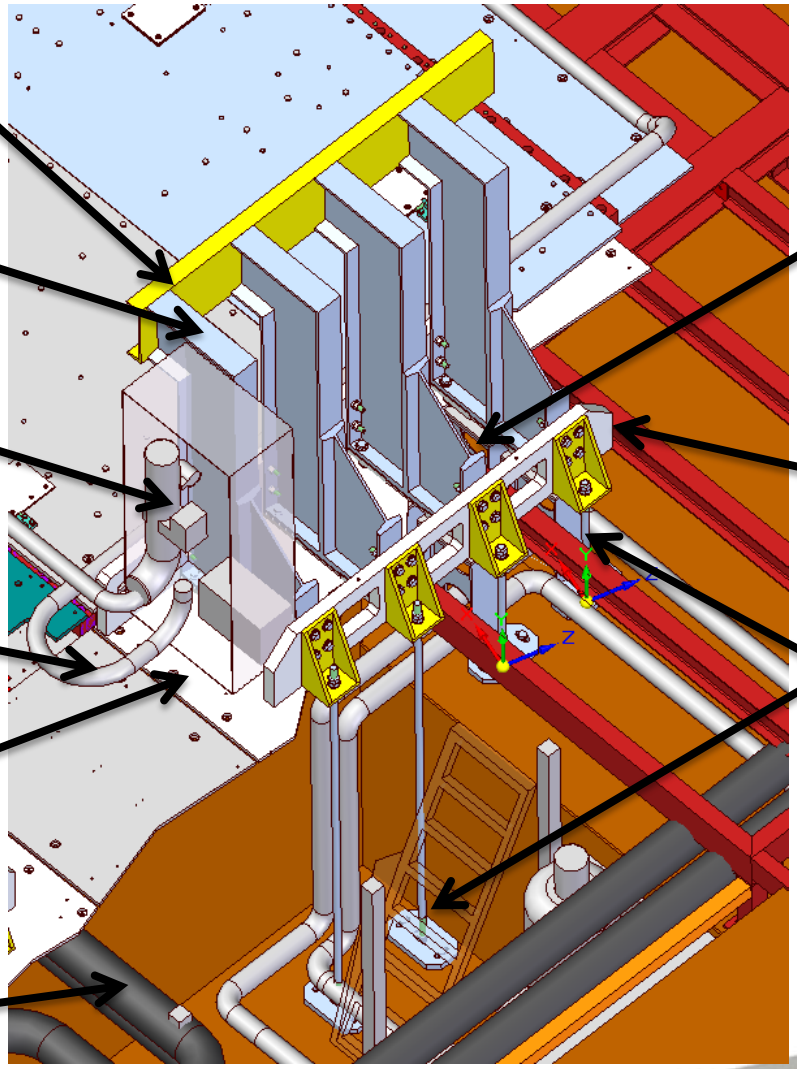
Key

Under tension during main PRY assembly

Under compression

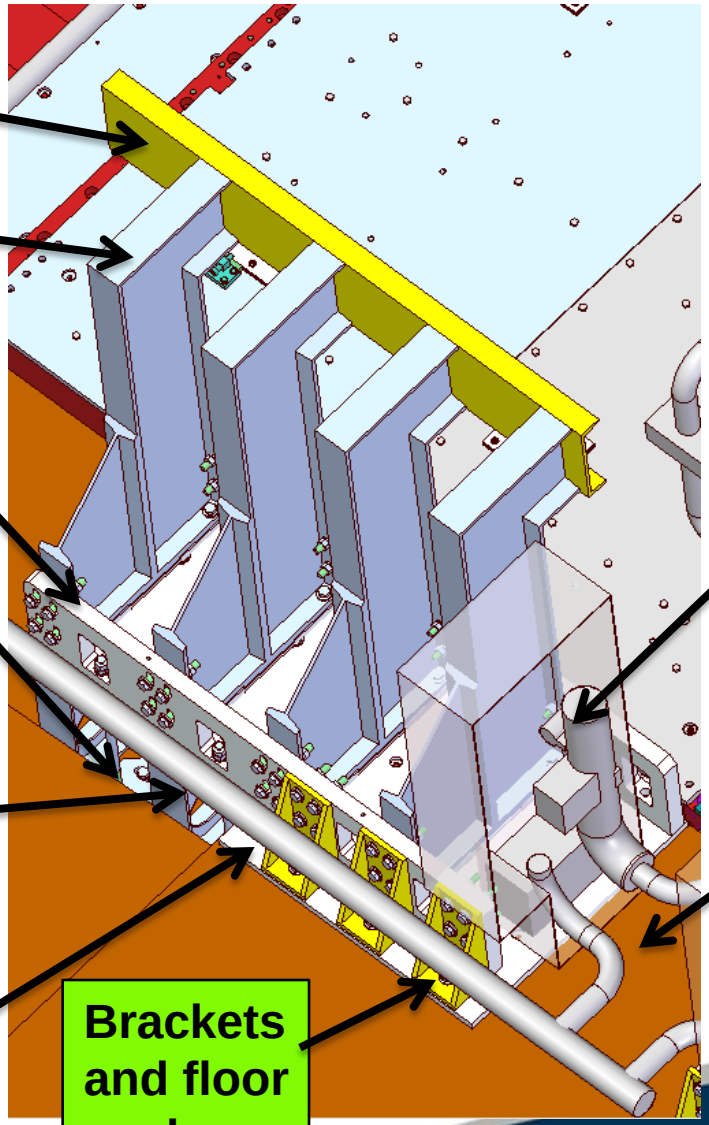
PRY Base - Design

- TD-1189-2090 – North West Quadrant



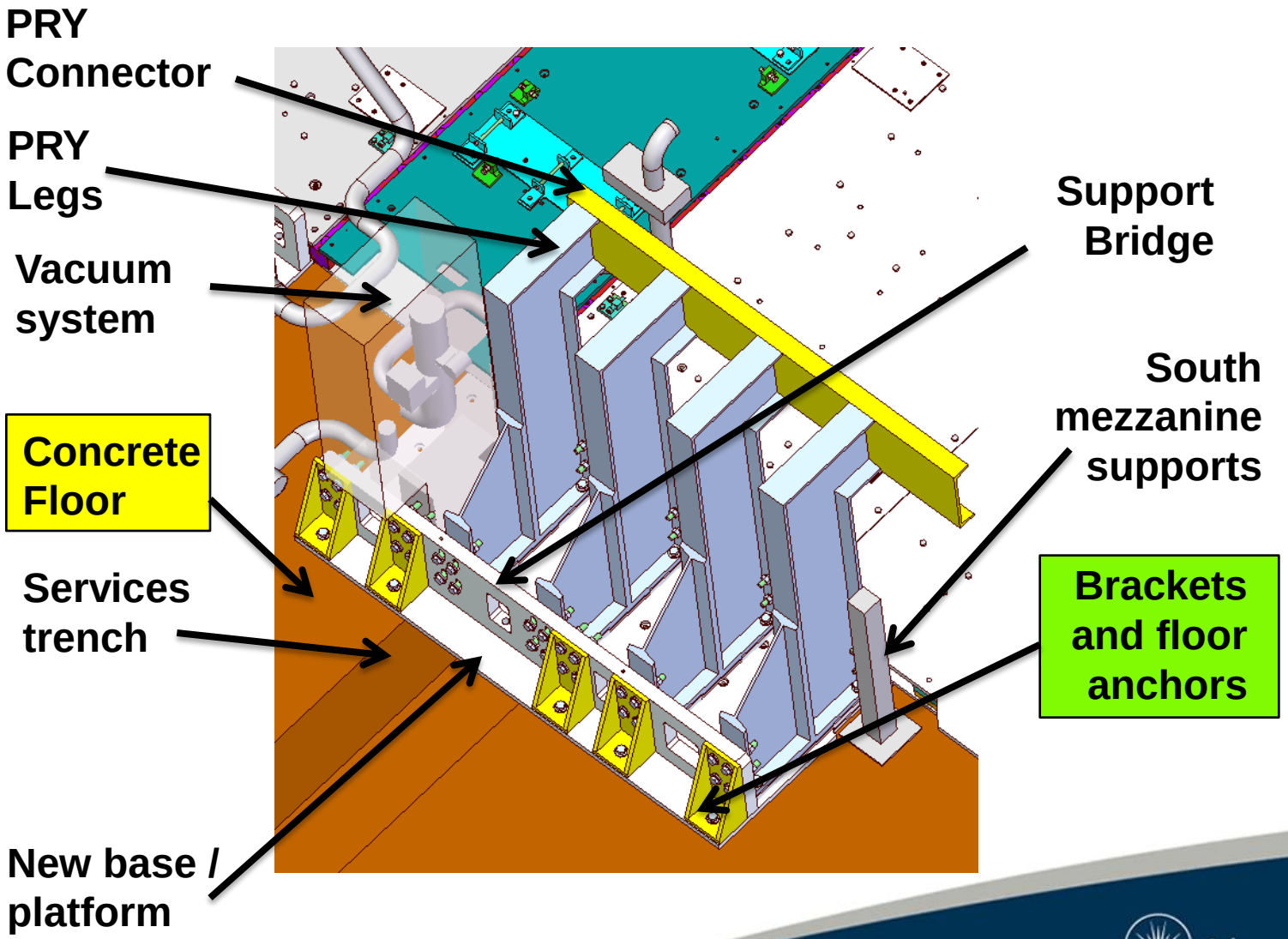
PRY Base - Design

- TD-1189-2090 – South West Quadrant



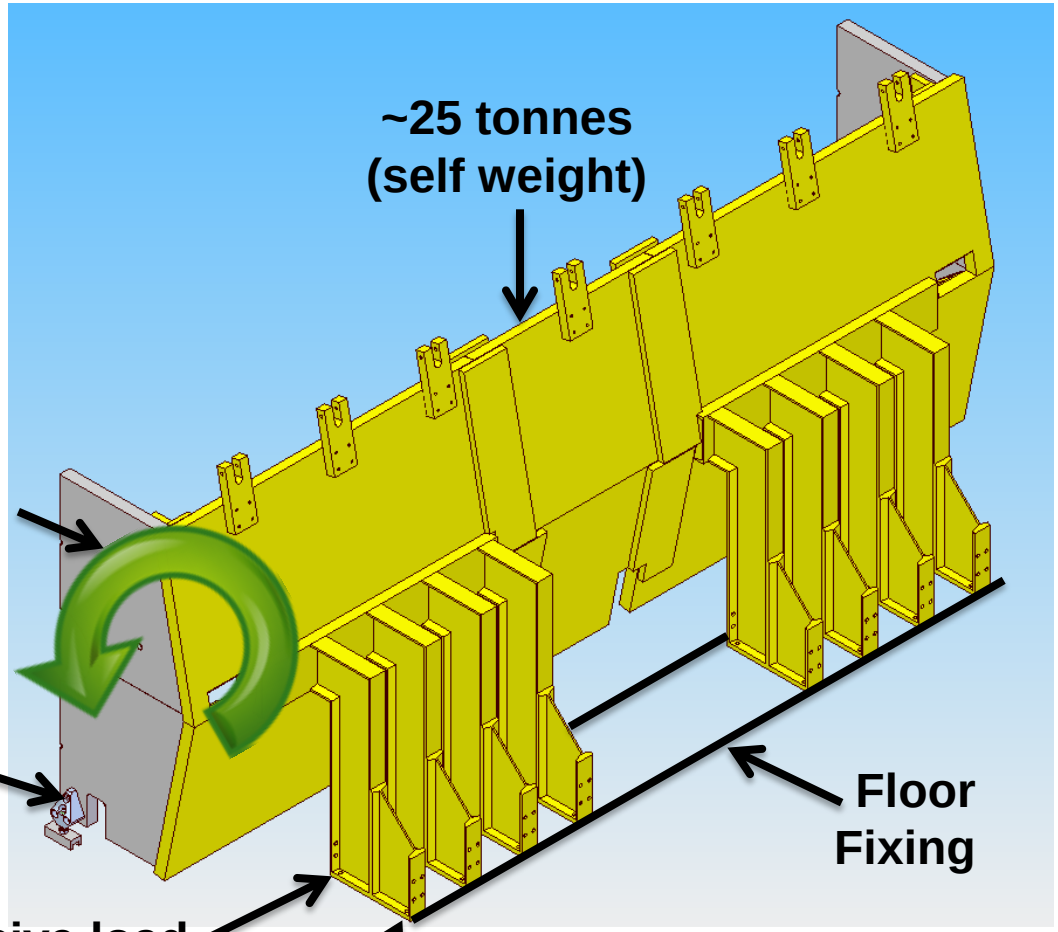
PRY Base - Design

- TD-1189-2090 – South East Quadrant

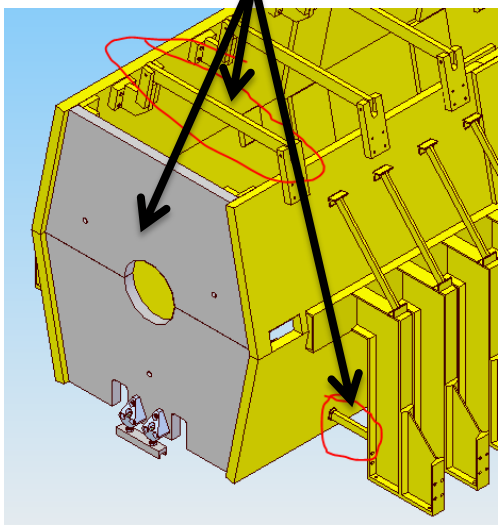


PRY Base - Requirements

- Requirements – Assembly load for floor fixing

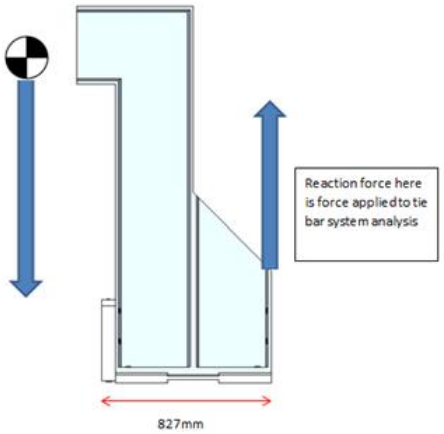


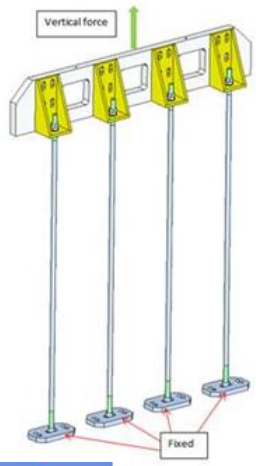
NO CAPACITY FOR SIGNIFICANT MAGNETIC LOAD IN FLOOR FIXING: Cross-bars, leg ties & link plates will take magnetic loads

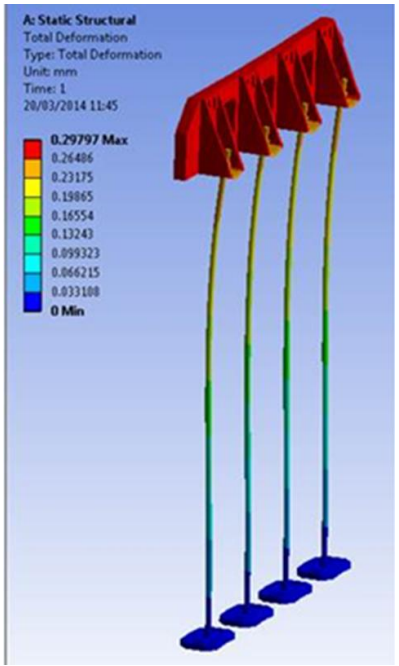


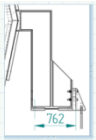
PRY Base – Structural Integrity

- Analysis & calculation









$moment_{frompivot} = (1.808 \cdot 10^5)\ N \cdot m$

$n := 8$ but there are 8 legs so the load can be sudivided

$moment_{perleg} := \frac{moment_{frompivot}}{n} = (2.26 \cdot 10^4)\ N \cdot m$

$Force_{interface} := \frac{moment_{perleg}}{0.762 \cdot m} = (2.966 \cdot 10^4)\ N$

$\mu_{steelalu} := 0.3$ 0.3-0.61 book figures

$Pre_{load} := \frac{Force_{interface}}{\mu_{steelalu}} = (9.887 \cdot 10^4)\ N$

Using yield stress of 660 MPa (high tensile > dia 16)

$\sigma max := 660 \cdot MPa$

$A_{boltfrict} := \frac{Pre_{load}}{\sigma max} = (1.498 \cdot 10^{-4})\ m^2$

$Dia_{boltmineffective} := 2 \cdot \sqrt{\left(\frac{A_{boltfrict}}{\pi}\right)} = 0.014\ m$

$Dia_{boltmineffective} = 13.811\ mm$

Extension of Tie Bars (with actual load as per analysis)

$F2_{nactual} := 24333 \cdot kg \cdot g = (2.386 \cdot 10^5)\ N$

$D2_n := 0.4917 \cdot m$ $D1_n := 0.867\ m$

$F1_n := \frac{F2_{nactual} \cdot D2_n}{D1_n} = (1.353 \cdot 10^5)\ N$

$F1_n = (1.353 \cdot 10^5)\ N$ $Tiebar_{diam} := 30 \cdot 10^{-3} \cdot m$ $N_{tiebars} := 8$

$F_{tiebar} := \frac{F1_n}{N_{tiebars}} = (1.692 \cdot 10^4)\ N$

$L_{tiebar} := 2.31 \cdot m$ Assumes all long as worst case

$E_{tiebar} := 196 \cdot 10^9 \cdot \frac{N}{m^2} = (1.96 \cdot 10^{11})\ Pa$

$A_{tiebar} := \left(\frac{Tiebar_{diam}}{2}\right)^2 \cdot \pi = (7.069 \cdot 10^{-4})\ m^2$

$\sigma_{tiebar} := \frac{F_{tiebar}}{A_{tiebar}} = (2.393 \cdot 10^7)\ Pa$ $E := \frac{\sigma_{tiebar}}{\varepsilon}$

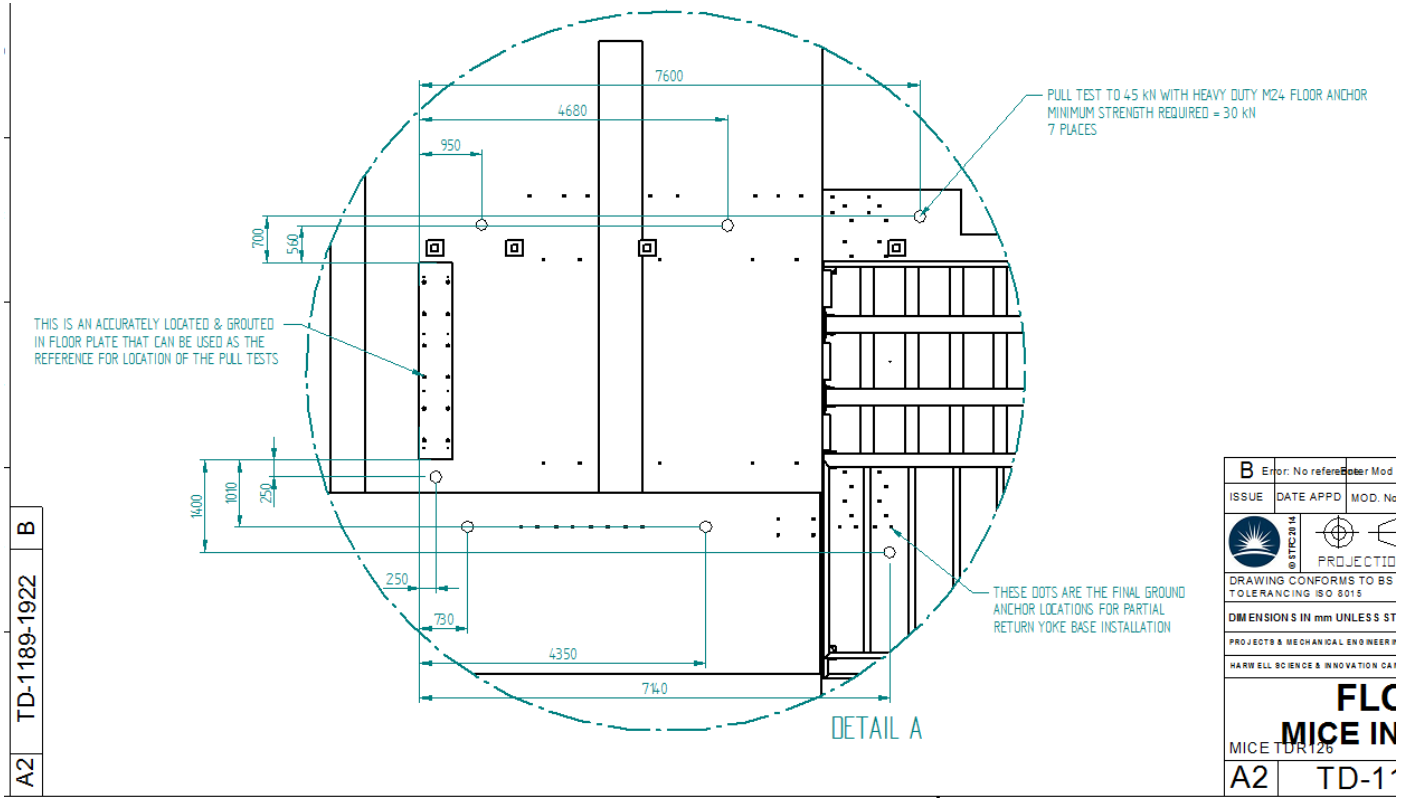
$\varepsilon := \frac{\sigma_{tiebar}}{E_{tiebar}} = 1.221 \cdot 10^{-4}$

$\Delta L := L_{tiebar} \cdot \varepsilon = (2.821 \cdot 10^{-4})\ m$

$\Delta L = 0.282\ mm$

PRY Base – Structural Integrity

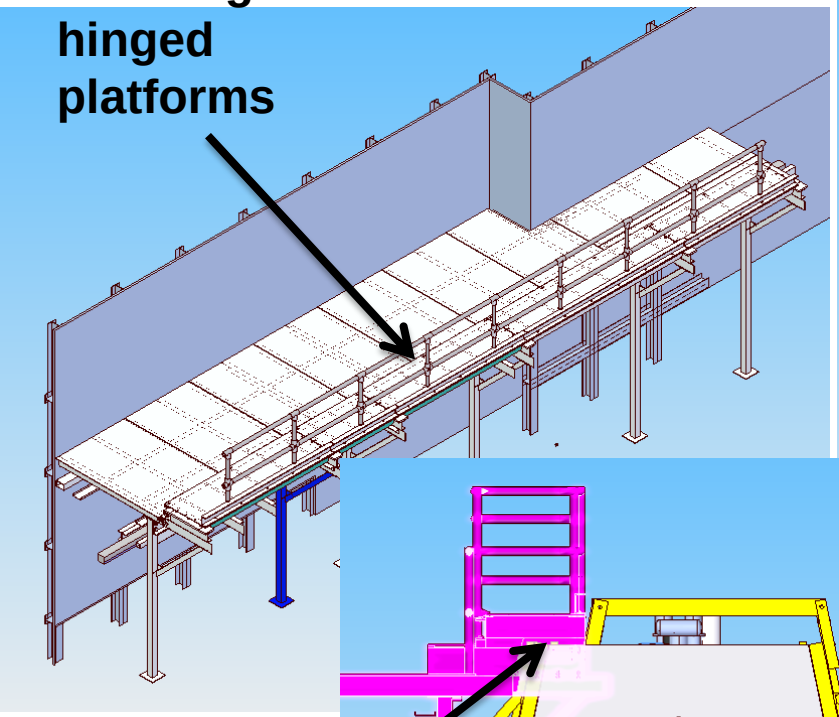
- Testing

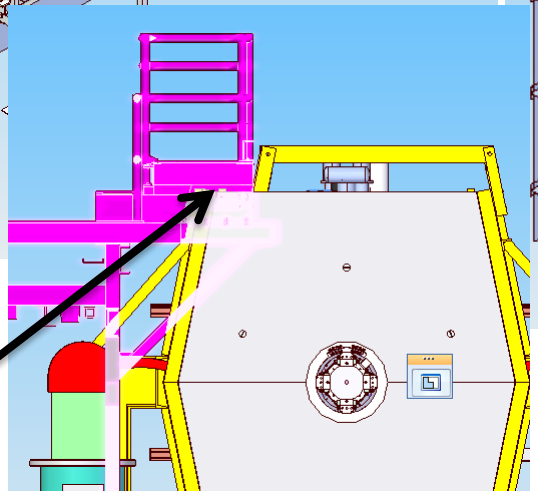


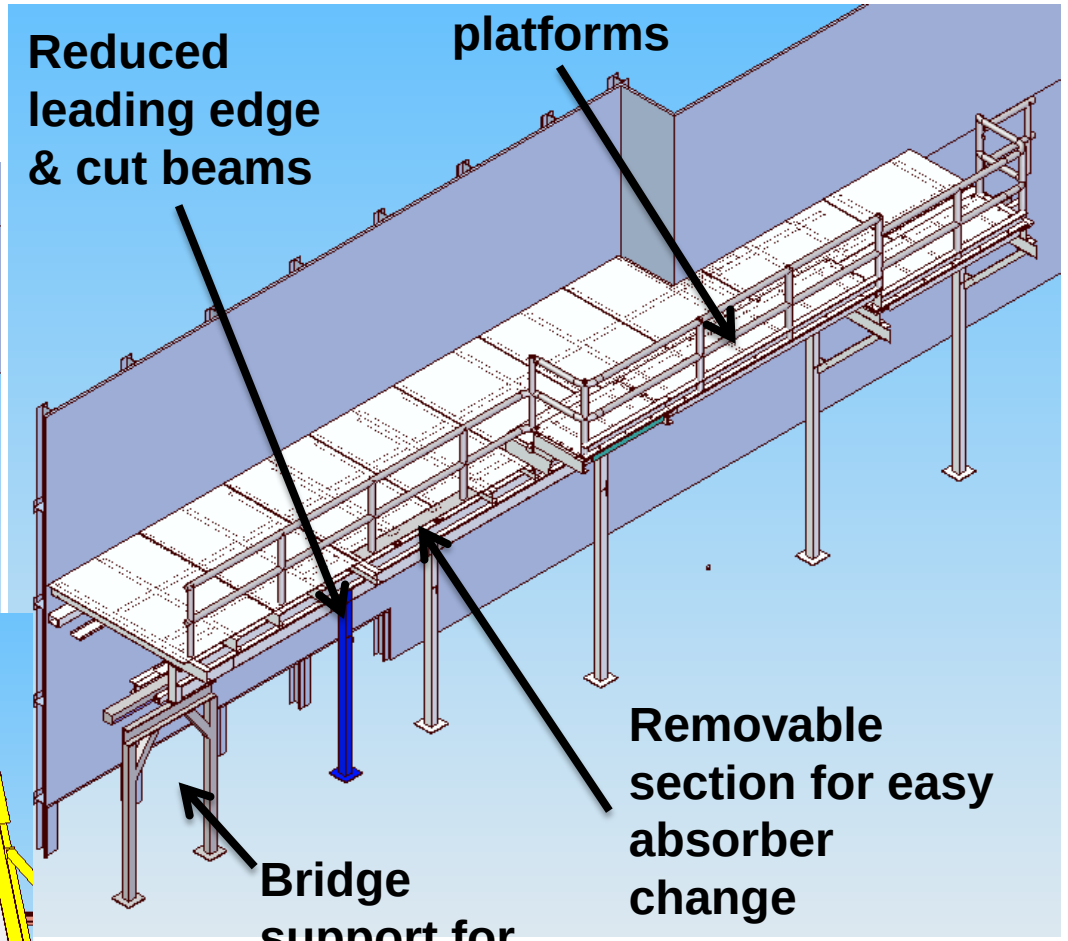
Floor anchor pull out (TD-1189-1922)

PRY Base - Preparation

- South Mezzanine

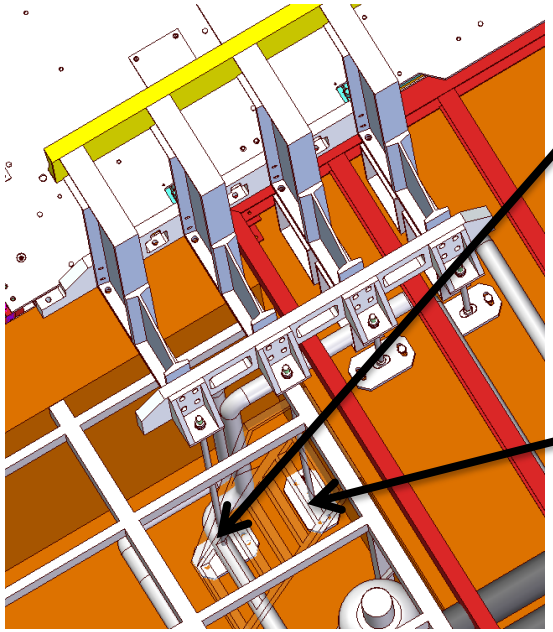






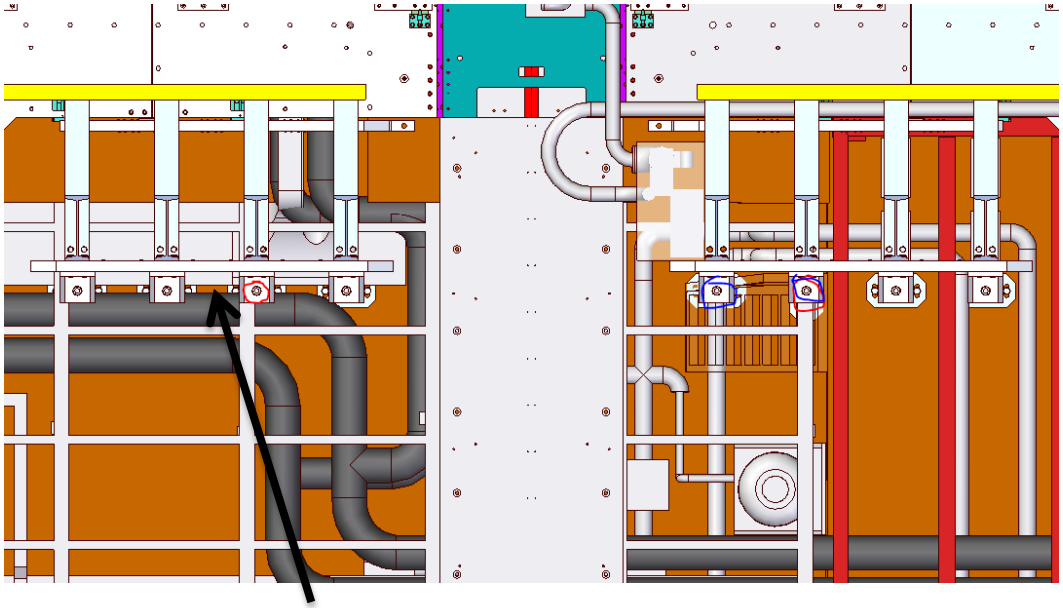
PRY Base - Preparation

- Trench



Water circuit move

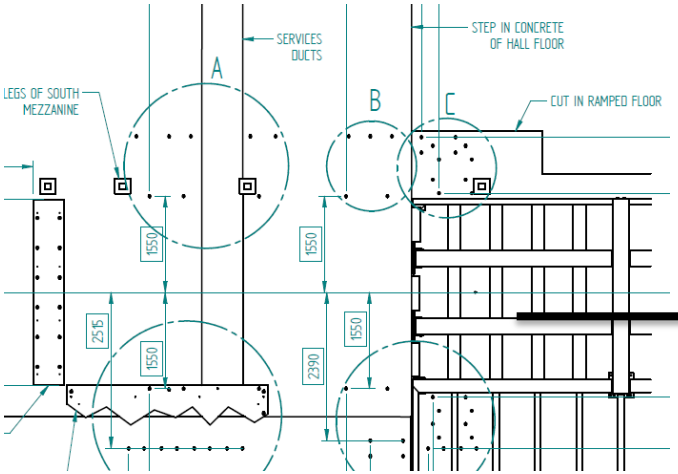
Ladder move and change



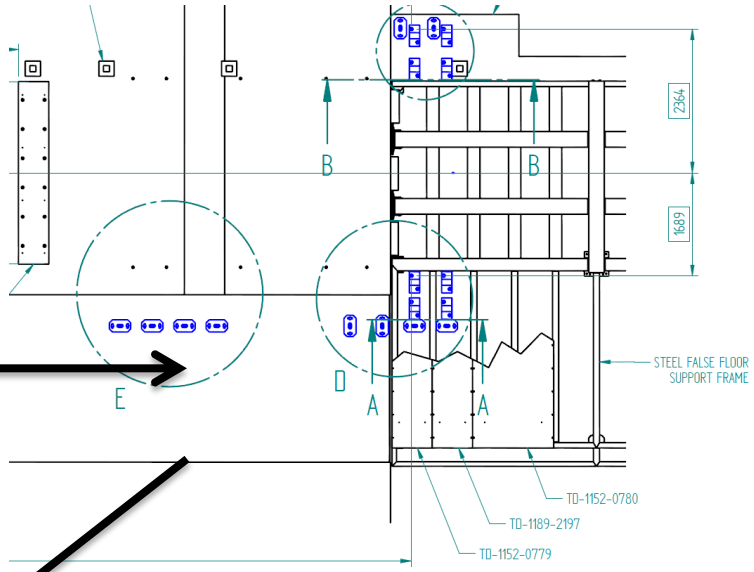
North-east tie bars pass between trench services (water and ISIS cables

PRY Base - Installation

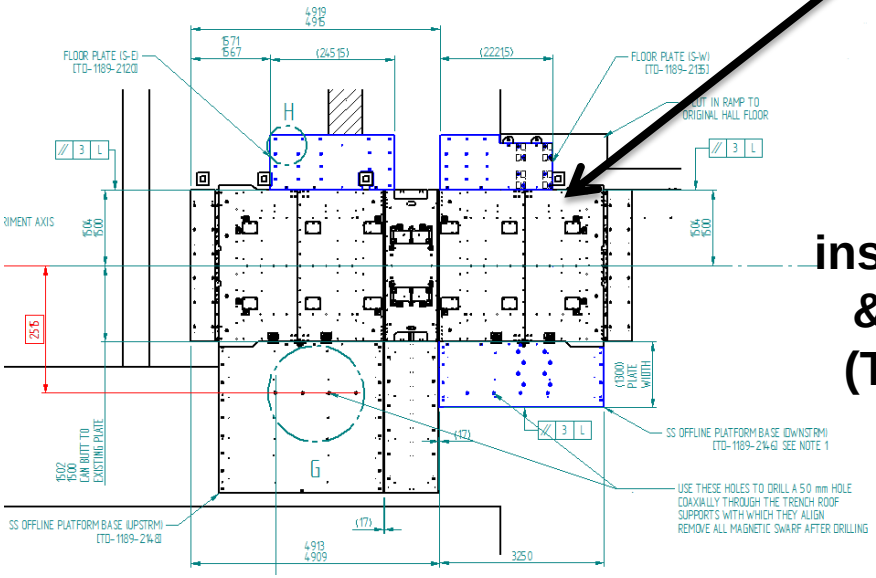
- Installation - Bases



Floor anchors (TD-1189-2152)



Pillars, tie plates (TD-1189-2153)



Top plate installation (blue) & hole drilling (TD-1189-2136)

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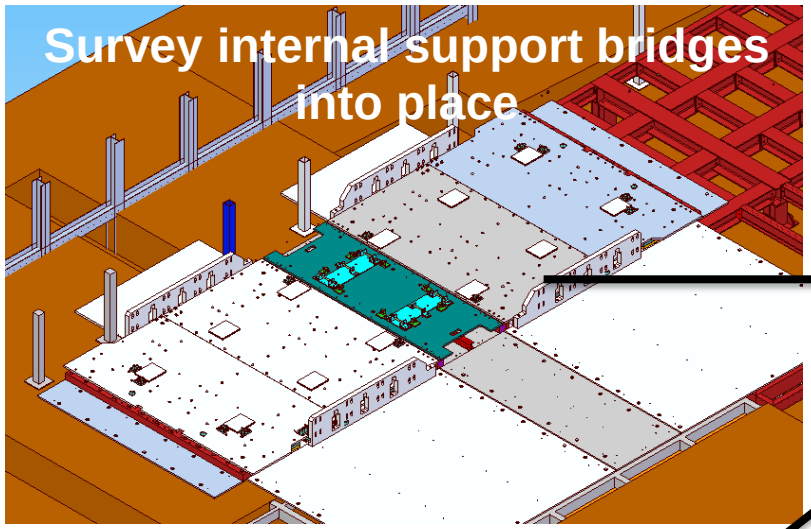
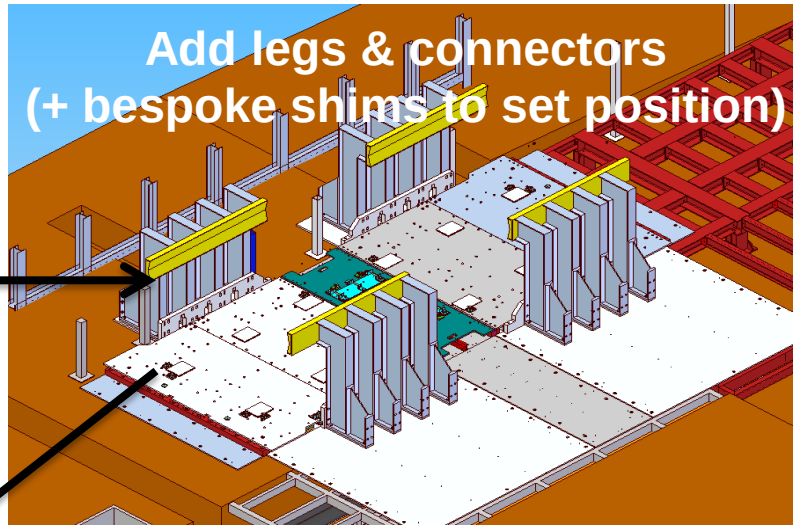
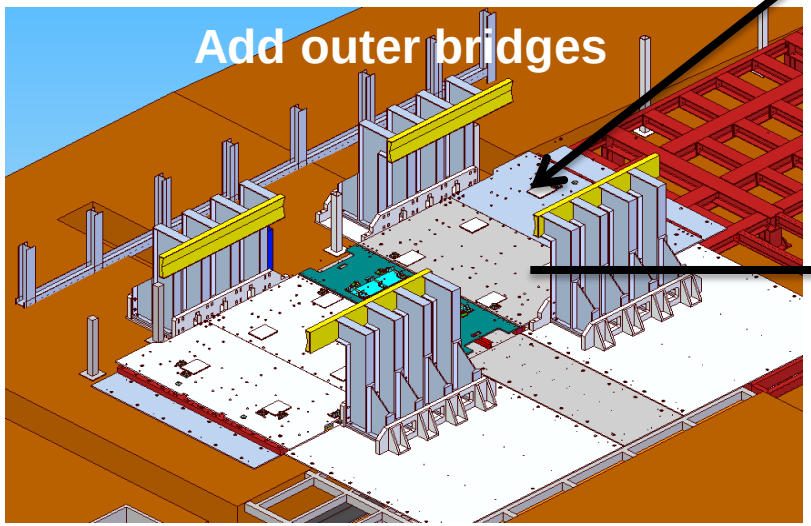
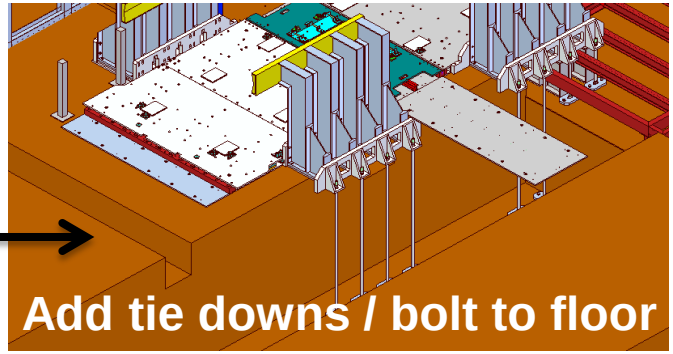
PRY Base - Installation

- Installation – PRY Frame



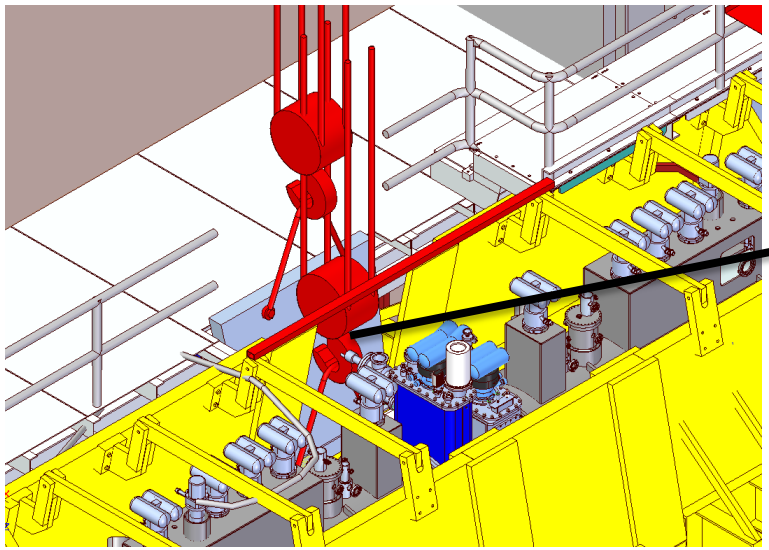


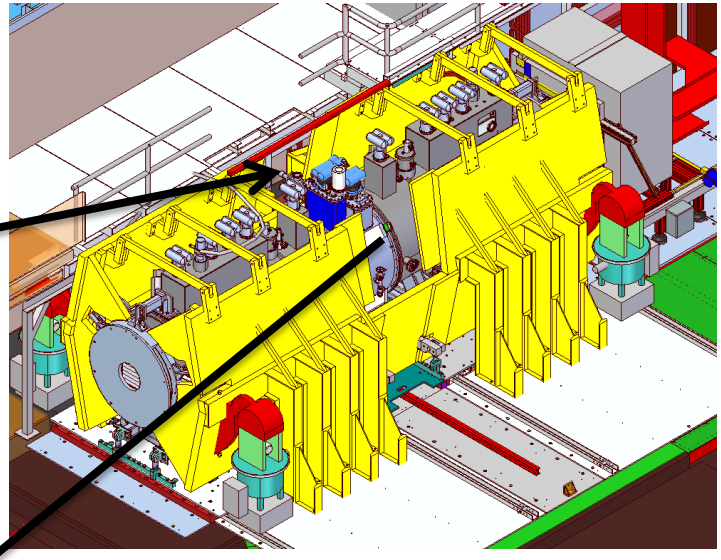


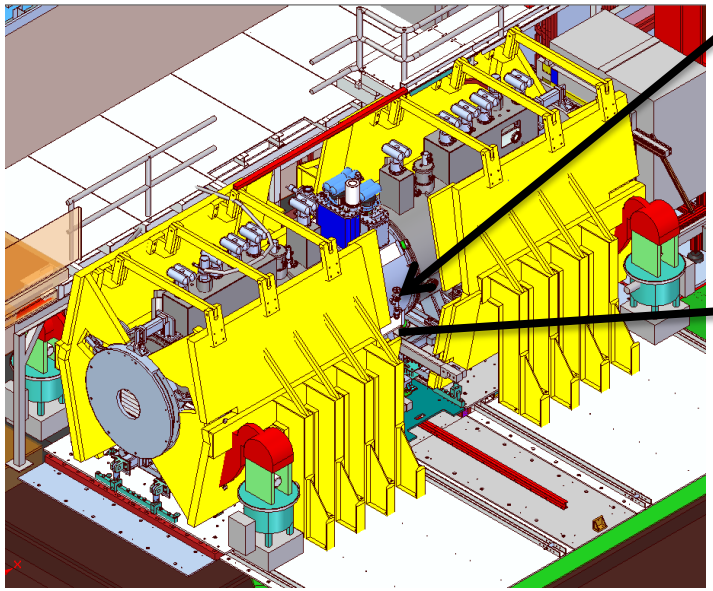


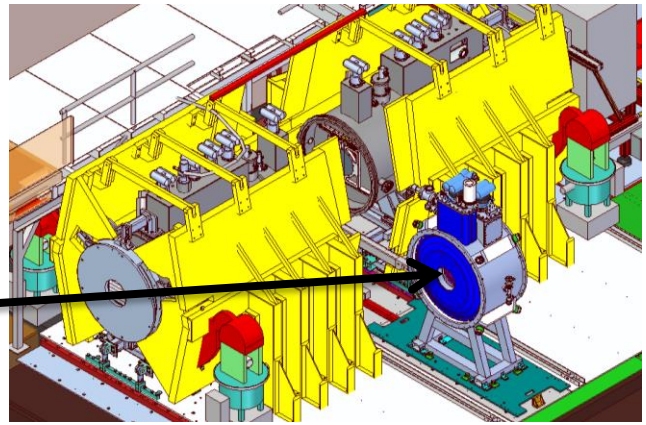
PRY Base – Absorber Change

- Absorber change



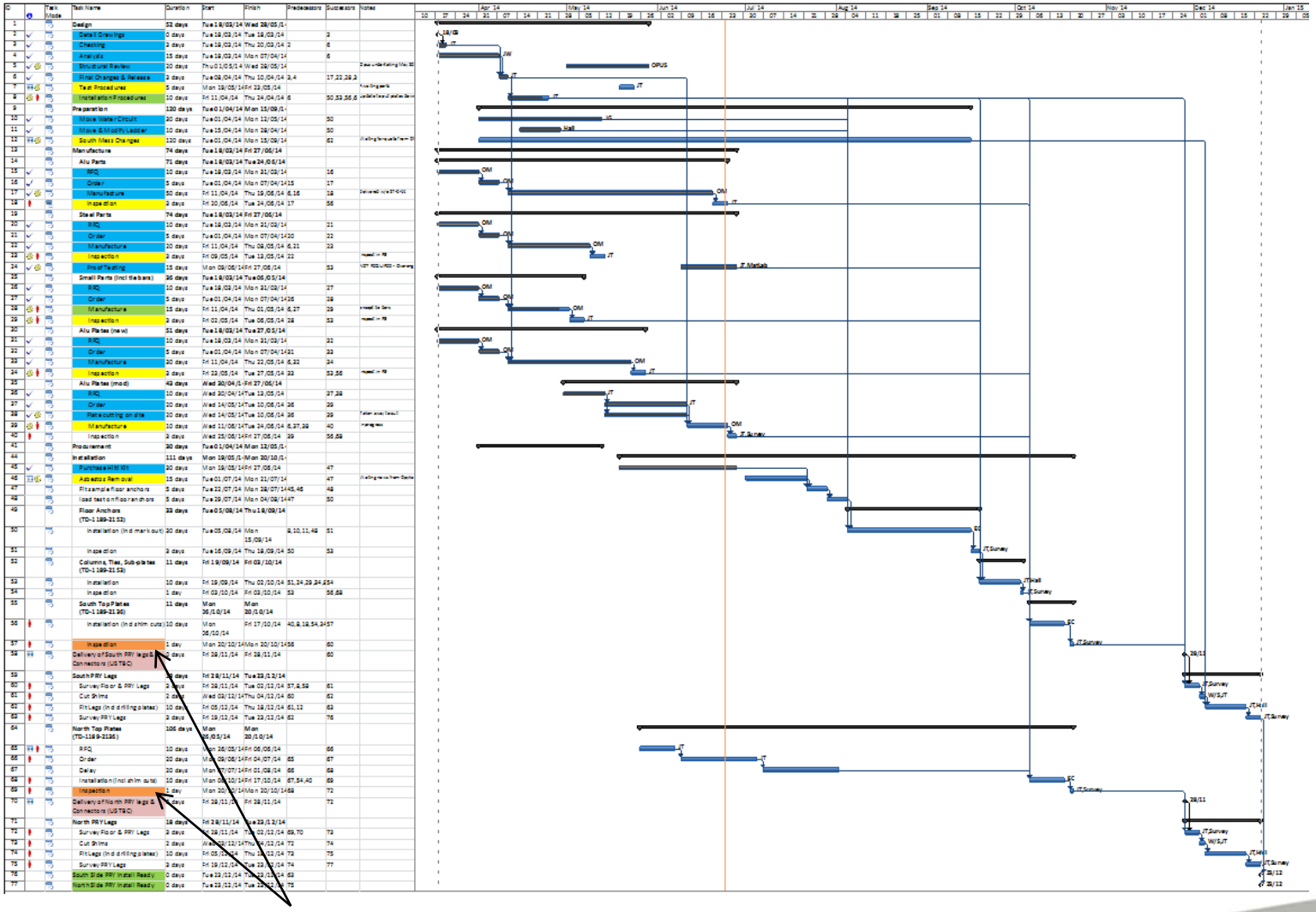






PRY Base – Schedule

- Schedule

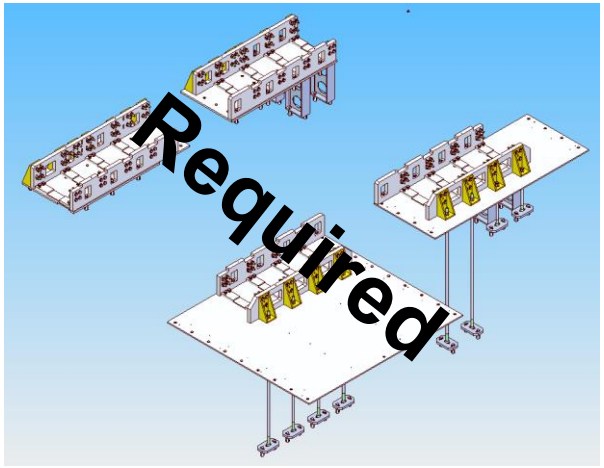


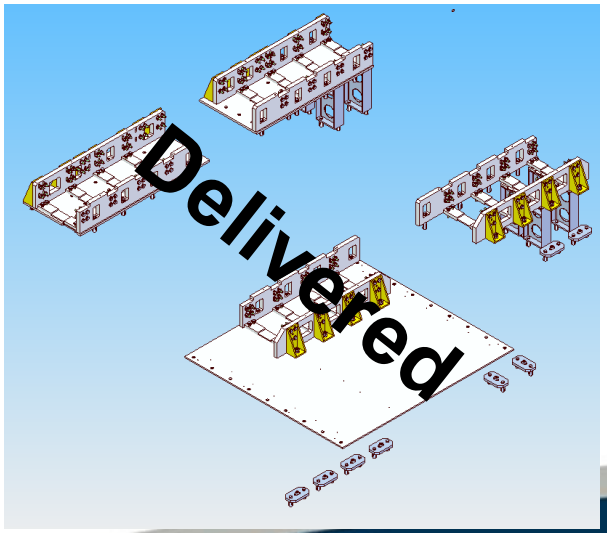
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Successors	Notes
1		Design	32 days	Tue 18/03/14	Wed 30/05/14			
2		Detail Drawings	0 days	Tue 18/03/14	Tue 18/03/14		3	
3		Checking	2 days	Tue 18/03/14	Thu 20/03/14	2	6	
4		Analysis	15 days	Tue 18/03/14	Mon 07/04/14		6	
5		Structural Review	20 days	Thu 01/05/14	Wed 28/05/14			
6		Final Changes & Release	2 days	Tue 28/04/14	Thu 30/04/14	3,4	17,23,29,3	
7		Test Procedures	5 days	Mon 19/05/14	Fri 23/05/14			
8		Installation Procedures	10 days	Fri 11/04/14	Thu 24/04/14	6	50,53,56,6	
9		Preparation	120 days	Tue 01/04/14	Mon 15/09/14			
10		Move Water Circuit	20 days	Tue 01/04/14	Mon 12/05/14		50	
11		Move & Modify Ladder	10 days	Tue 15/04/14	Mon 28/04/14		50	
12		South Mass Changes	120 days	Tue 01/04/14	Mon 15/09/14		62	
13		Manufacture	74 days	Tue 18/03/14	Fri 27/06/14			
14		Alu Parts	71 days	Tue 18/03/14	Tue 24/06/14			
15		RFQ	10 days	Tue 18/03/14	Mon 31/03/14		16	
16		Order	5 days	Tue 01/04/14	Mon 07/04/14	15	17	
17		Manufacture	50 days	Fri 11/04/14	Thu 19/06/14	6,16	18	
18		Inspection	2 days	Fri 20/06/14	Tue 24/06/14	17	56	
19		Steel Parts	74 days	Tue 18/03/14	Fri 27/06/14			
20		RFQ	10 days	Tue 18/03/14	Mon 31/03/14		21	
21		Order	5 days	Tue 01/04/14	Mon 07/04/14	20	22	
22		Manufacture	20 days	Fri 11/04/14	Thu 08/05/14	6,21	23	
23		Inspection	2 days	Fri 09/05/14	Tue 13/05/14	22		
24		Proof Testing	15 days	Mon 09/06/14	Fri 27/06/14		53	
25		Small Parts (Incl Slabars)	36 days	Tue 18/03/14	Tue 06/05/14			
26		RFQ	10 days	Tue 18/03/14	Mon 31/03/14		27	
27		Order	5 days	Tue 01/04/14	Mon 07/04/14	26	28	
28		Manufacture	15 days	Fri 11/04/14	Thu 01/05/14	6,27	29	
29		Inspection	2 days	Fri 02/05/14	Tue 06/05/14	28	53	
30		Alu Plates (new)	31 days	Tue 18/03/14	Tue 27/05/14			
31		RFQ	10 days	Tue 18/03/14	Mon 31/03/14		32	
32		Order	5 days	Tue 01/04/14	Mon 07/04/14	31	33	
33		Manufacture	20 days	Fri 11/04/14	Thu 22/05/14	6,32	34	
34		Inspection	3 days	Fri 23/05/14	Tue 27/05/14	33	53,56	
35		Alu Plates (mod)	42 days	Wed 30/04/14	Fri 27/06/14			
36		RFQ	10 days	Wed 30/04/14	Tue 13/05/14		37,38	
37		Order	20 days	Wed 14/05/14	Tue 10/06/14	36	39	
38		Parts cutting on site	20 days	Wed 14/05/14	Tue 10/06/14	36	39	
39		Manufacture	10 days	Wed 11/06/14	Tue 24/06/14	6,37,38	40	
40		Inspection	3 days	Wed 25/06/14	Fri 27/06/14	39	56,58	
41		Procurement	30 days	Tue 01/04/14	Mon 12/05/14			
44		Installation	111 days	Mon 19/05/14	Mon 20/10/14			
45		Purchase HHI Kit	20 days	Mon 19/05/14	Fri 27/06/14		47	
46		Asbestos Removal	15 days	Tue 01/07/14	Mon 21/07/14		47	
47		Fit example floor anchors	5 days	Tue 22/07/14	Mon 28/07/14	45,46	48	
48		load test on floor anchors	5 days	Tue 29/07/14	Mon 04/08/14	47	50	
49		Floor Anchors (TD-1 189-2152)	22 days	Tue 03/09/14	Thu 18/09/14			
50		Installation (Incl mark out)	30 days	Tue 05/08/14	Mon 15/09/14	9,10,11,48	51	
51		Inspection	2 days	Tue 16/09/14	Thu 18/09/14	50	52	
52		Columns, Ties, Sub-plates (TD-1 189-2152)	11 days	Fri 19/09/14	Fri 03/10/14			
53		Installation	10 days	Fri 19/09/14	Thu 02/10/14	51,14,29,34	54	
54		Inspection	1 day	Fri 03/10/14	Fri 03/10/14	53	56,58	
55		South Top Plates (TD-1 189-2136)	11 days	Mon 06/10/14	Mon 20/10/14			
56		Installation (Incl shim cuts)	10 days	Mon 06/10/14	Fri 17/10/14	40,8,18,54,24	57	
57		Inspection	1 day	Mon 20/10/14	Mon 20/10/14	56	60	
58		Delivery of South PRY legs & Connectors (US T&C)	2 days	Fri 28/11/14	Fri 28/11/14		60	
59		South PRY Legs	18 days	Fri 28/11/14	Tue 23/12/14			
60		Survey Floor & PRY Legs	2 days	Fri 28/11/14	Tue 02/12/14	57,8,58	61	
61		Cut Shims	2 days	Wed 03/12/14	Thu 04/12/14	60	62	
62		Fit Legs (Incl drilling plates)	10 days	Fri 05/12/14	Thu 18/12/14	61,12	63	
63		Survey PRY Legs	3 days	Fri 19/12/14	Tue 23/12/14	62	76	
64		North Top Plates (TD-1189-2136)	105 days	Mon 06/05/14	Mon 20/10/14			
65		RFQ	10 days	Mon 26/05/14	Fri 06/06/14		66	
66		Order	20 days	Mon 09/06/14	Fri 04/07/14	65	67	
67		Delay	20 days	Mon 07/07/14	Fri 01/08/14	66	68	
68		Installation (Incl shim cuts)	10 days	Mon 06/10/14	Fri 17/10/14	67,54,40	69	
69		Inspection	1 day	Mon 20/10/14	Mon 20/10/14	68	72	
70		Delivery of North PRY legs & Connectors (US T&C)	2 days	Fri 28/11/14	Fri 28/11/14		72	
71		North PRY Legs	18 days	Fri 28/11/14	Tue 23/12/14			
72		Survey Floor & PRY Legs	2 days	Fri 28/11/14	Tue 02/12/14	69,70	73	
73		Cut Shims	2 days	Wed 03/12/14	Thu 04/12/14	72	74	
74		Fit Legs (Incl drilling plates)	10 days	Fri 05/12/14	Thu 18/12/14	73	75	
75		Survey PRY Legs	3 days	Fri 19/12/14	Tue 23/12/14	74	77	
76		South Side PRY Install Ready	0 days	Tue 23/12/14	Tue 23/12/14	63		
77		North Side PRY Install Ready	0 days	Tue 23/12/14	Tue 23/12/14	75		

Prep for South & North Bases by October 2014 then await PRY Frames

Conclusion – Step IV PRY Base

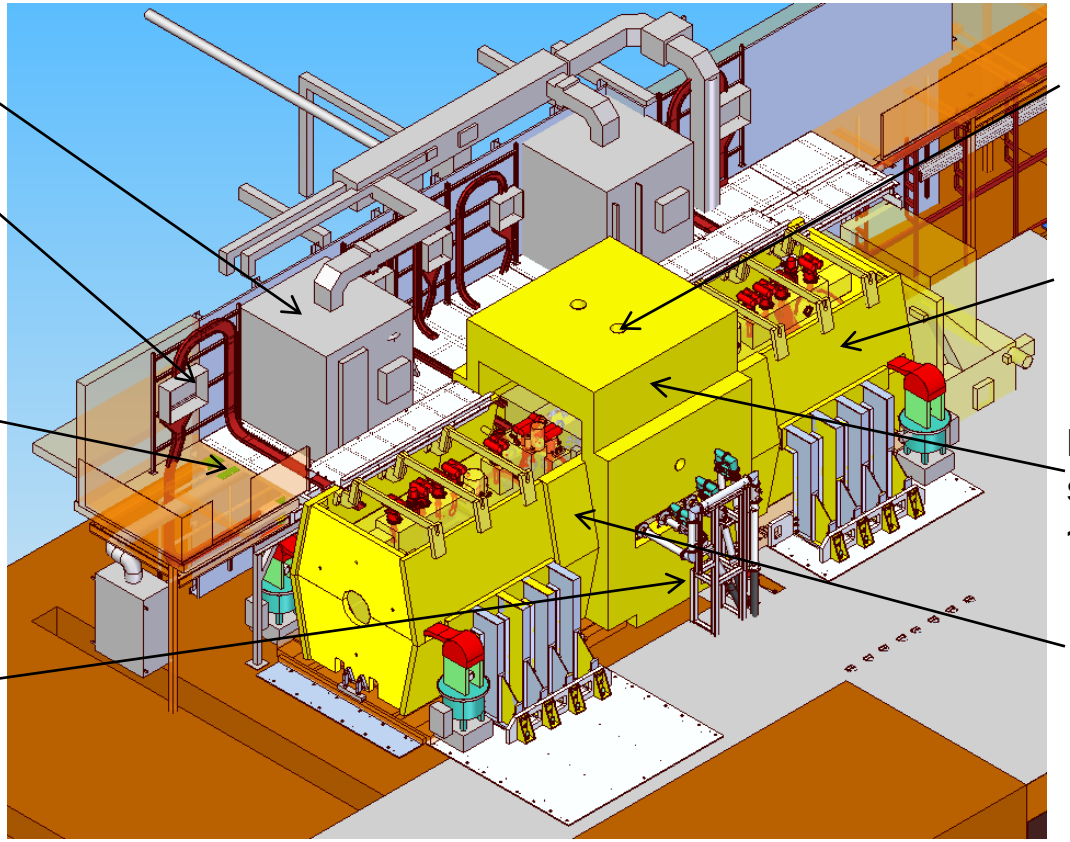
- Production Readiness Review (PRR) for PRY Monday 28th April, all OK to continue.
- Calculation and analysis show design of bases / platforms is OK for self weight during installation (not magnetic load) both stress & strain
- PRY Base / Platform design done & all parts drawings complete & released (top level = TD-1189-2152,2153,2136 & 2090).
- 90% Piece parts have been delivered, remainder imminent.
- Floor anchors and fitting kit delivered.
- South mezzanine structural changes being quoted for.
- Awaiting asbestos removal to start marking out
- Schedule currently predicting manufacture, prep and install of bases ahead of PRY delivery





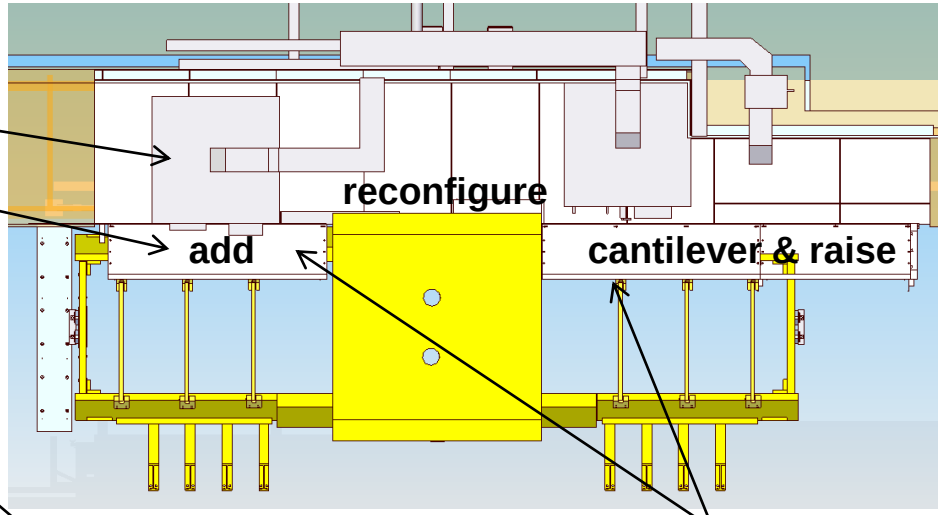
Step V PRY – CONCEPT

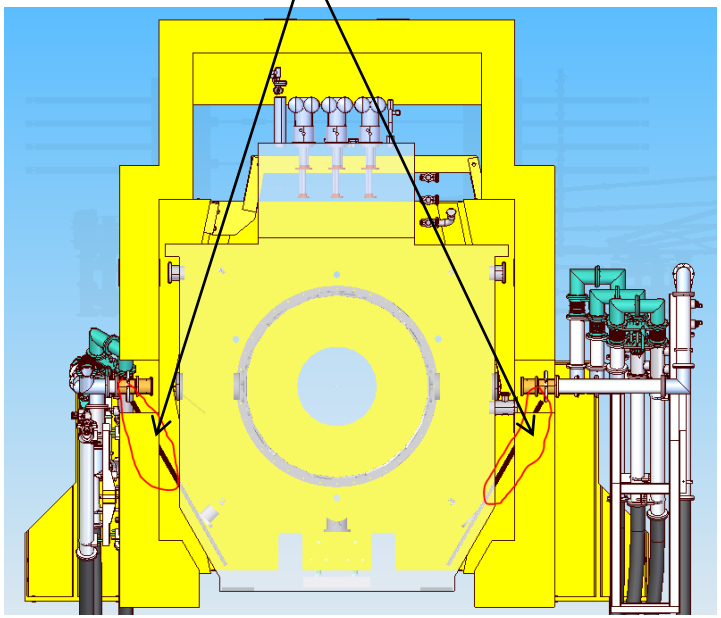
Conceptual Step V Partial Return Yoke
(H Witte, S Plate, J Tarrant)

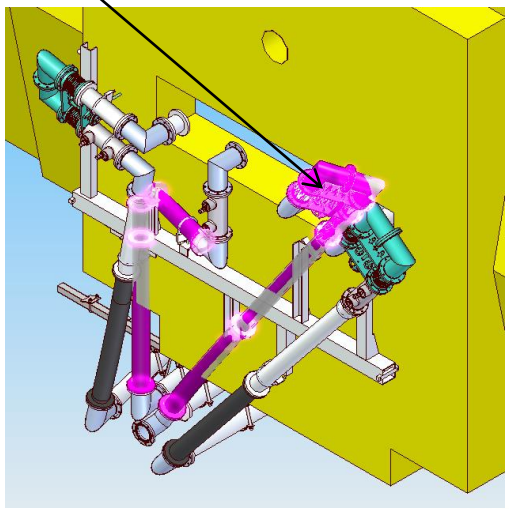


Step V PRY – CONCEPT

- Step V PRY Specific Modifications
  - H2 System
  - South Mezzanine
  - RF Waveguides
  - False floor support
  - RFCC RF supports







H2 system access and Step V PRY configuration will make absorber changes slow!