



HBPI Cryogenic Options

Option 1:

Transfer line to Meson Cryogenic Center

Option 2:

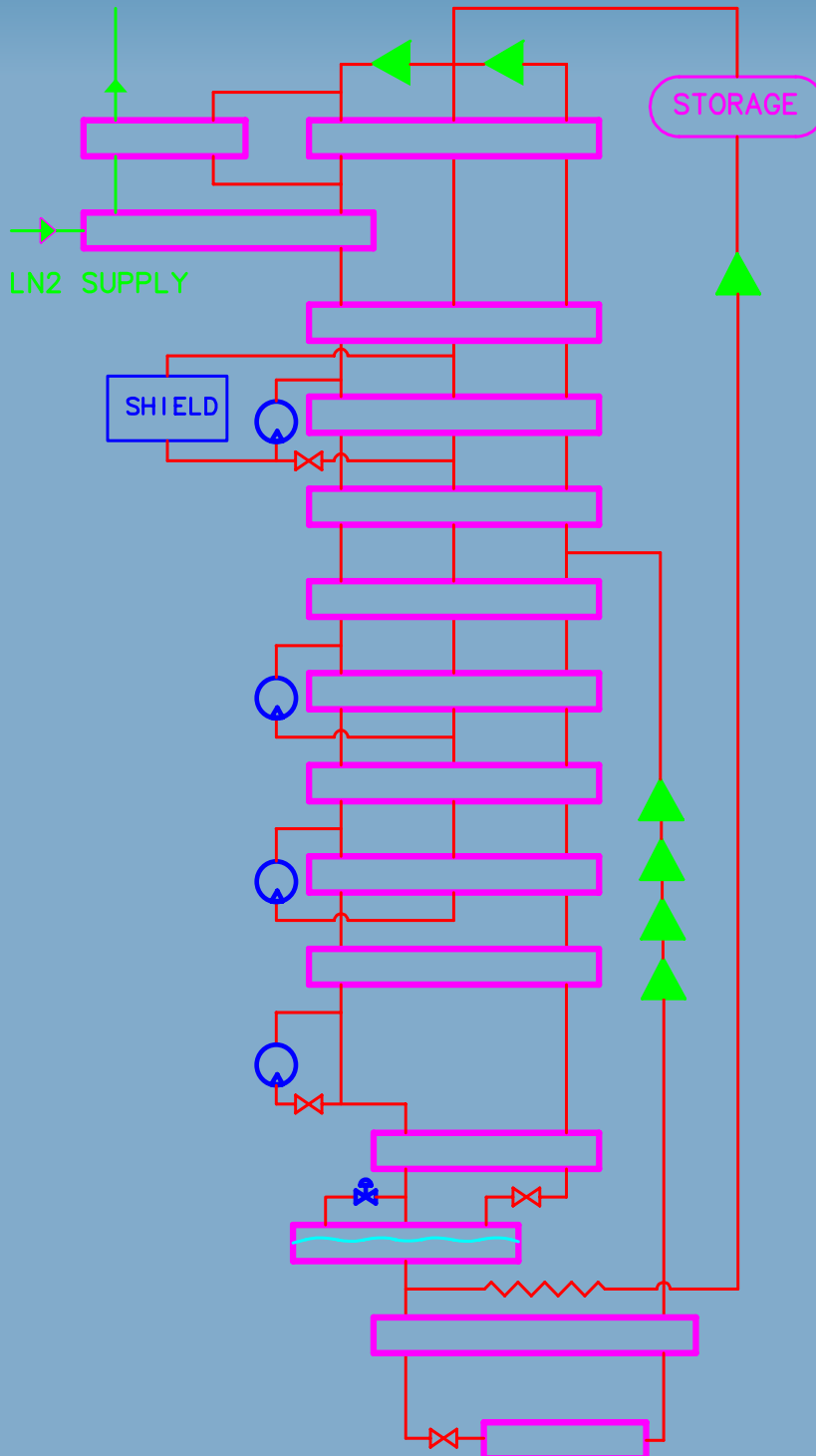
Relocate Meson Cryogenics to HBPI area

Option 3:

Purchase new cryogenic system



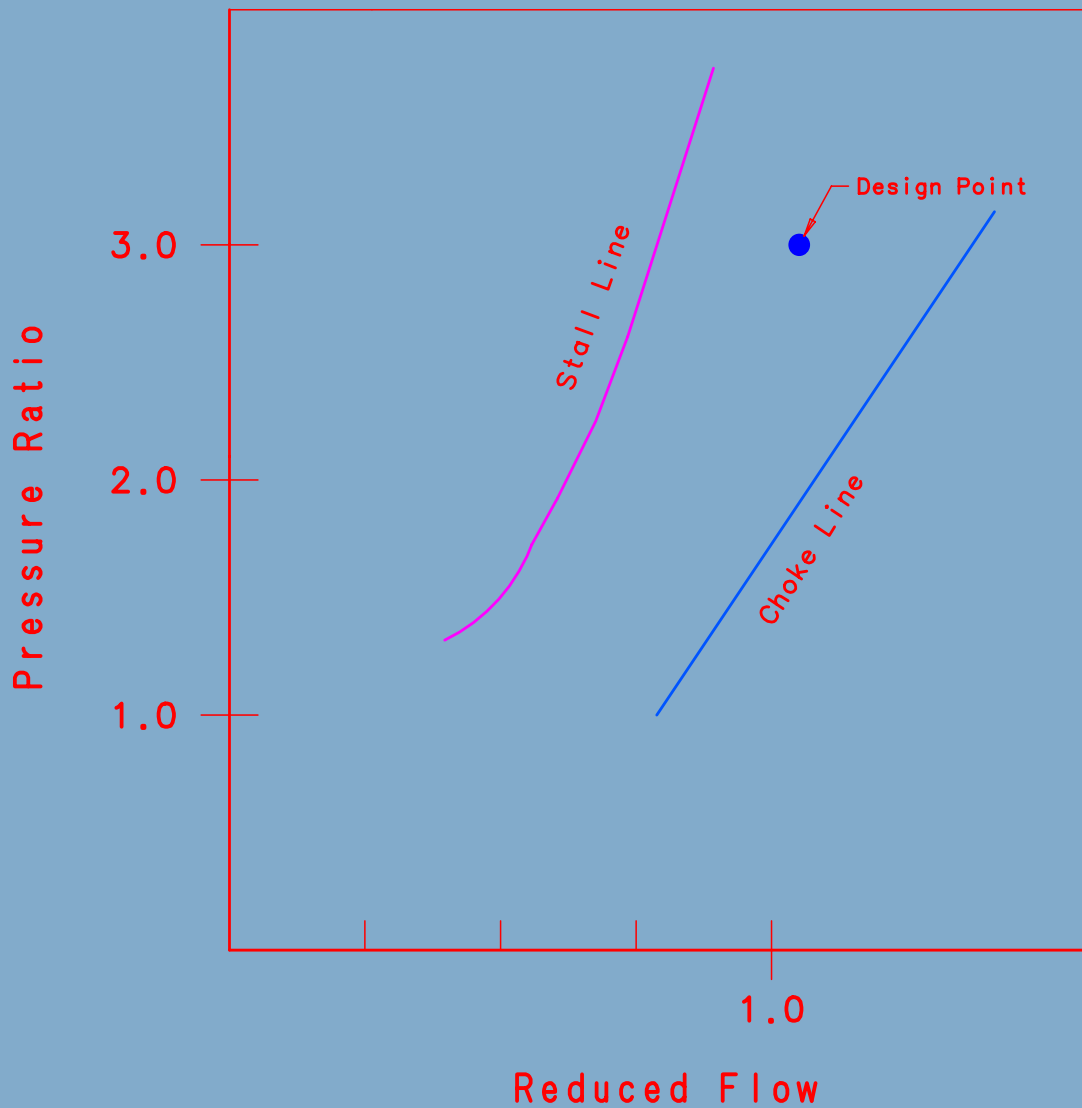
Cold Compressor Cycle





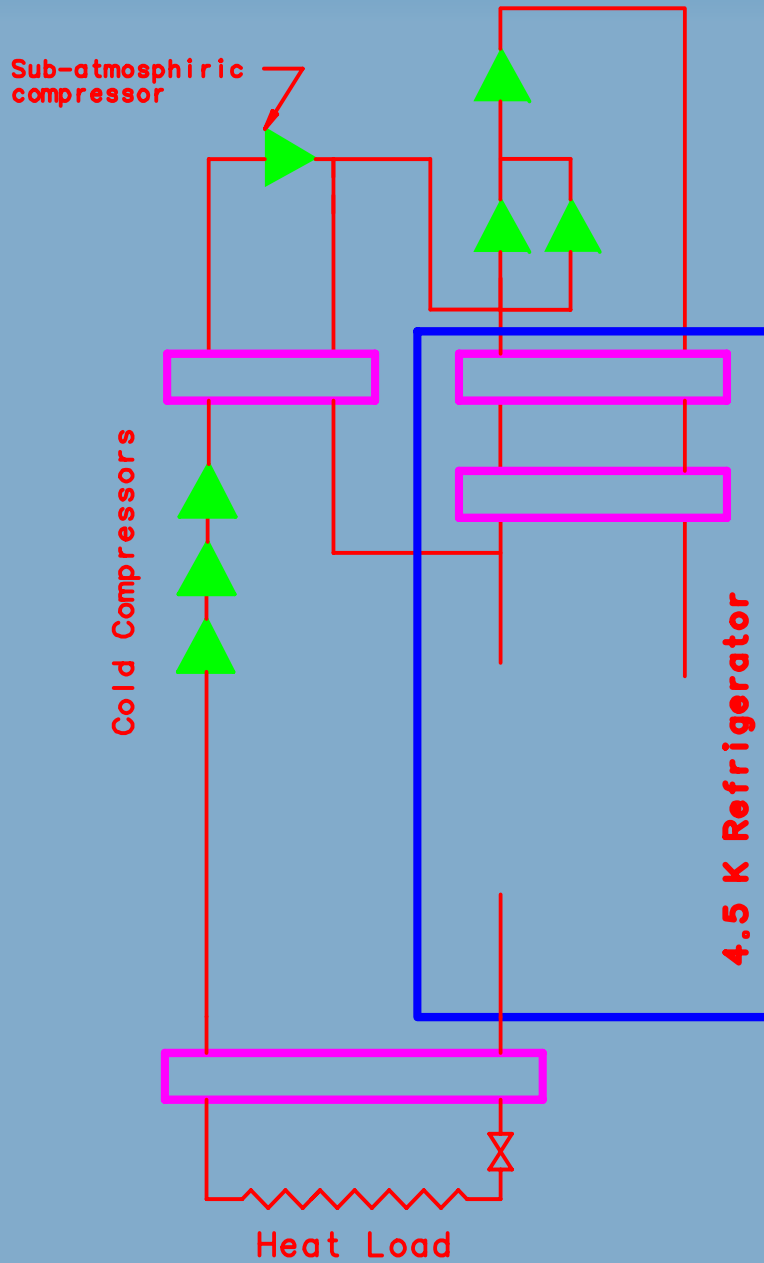
Cold Compressor

Typical Pressure Field for Hydrodynamic Compressor





Hybrid Cycle





Heat Load

HBPI Module 1	75 K - 85 K	4.5 K	2.0 K
Warm to Cold Transition (W)	13.0	0.0	1.6
One 8-cavity TTF cryomodule (W)	175.0	27.3	16.0
Supports and thermal radiation (W)	90.0	23.0	6.0
Dynamic heating (W)	85.0	4.3	10.0
Feed box (W)	150.0	20.0	5.0
Warm to Cold Transition (W)	13.0	0.0	1.6
Total Heat Load	351.0	47.3	24.2
Helium flow rate (g/s)	7.5	2.6	1.2
HBPI Module 2	75 K - 85 K	4.5 K	2.0 K
Warm to Cold Transition (W)	13.0	0.0	1.6
One 8-cavity TTF cryomodule (W)	175.0	27.3	16.0
Supports and thermal radiation (W)	90.0	23.0	6.0
Dynamic heating (W)	85.0	4.3	10.0
Feed box (W)	150.0	20.0	5.0
Warm to Cold Transition (W)	13.0	0.0	1.6
Total Heat Load	351.0	47.3	24.2
Helium flow rate (g/s)	7.5	2.6	1.2
HBPI 3rd Harmonic Module	75 K - 85 K	4.5 K	1.8 K
Warm to Cold Transition (W)	13.0	0.0	1.6
One 3.9 GHz cryomodule (W)	42.5	2.4	6.0
Supports and thermal radiation (W)	34.0	2.0	5.0
Dynamic heating (W)	8.5	0.4	1.0
Feed box (W)	50.0	7.0	1.0
Warm to Cold Transition (W)	13.0	0.0	1.6
Total Heat Load	118.5	9.4	10.2
Helium flow rate (g/s)	2.5	0.5	0.5



New Cryogenic System Cost

Identifier	Item description	basis	HBPI Cryogenics		
			No. of units	FY01 \$ per unit	Total M&S \$
	Location Summary				\$ 4,900,156
1	4.5 Refrigeration system	1	1	\$ 998,199	\$ 998,199
2	Cold Box, 2K	1	1	\$ 244,940	\$ 244,940
3	Cold Compressor	1	2	\$ 117,723	\$ 235,445
4	Ancillary Equipment	2	1	\$ 845,000	\$ 845,000
5	Refrigerator Controls	1	1	\$ 144,251	\$ 144,251
6	Warm Header, 6"IPS	3	600	\$ 60	\$ 36,000
7	Feed box, feed caps and vac. support	4	1	\$ 500,000	\$ 500,000
8A	Surface Transfer Line	2,5	250	\$ 2,100	\$ 525,000
8B	Bayonet, anchor and expansion cans	5	2	\$ 30,000	\$ 60,000
9	Tunnel Transfer Line	2,5	100	\$ 2,013	\$ 201,320
10	System installation contracts	1	1	\$ 170,000	\$ 170,000
11	Misc. (ODH sys, instrument air, etc)	1,4,5	1	\$ 50,000	\$ 50,000
12	Cryogenic Buildings	6	2400	\$ 250	\$ 600,000
13A	Road Construction trench	6	0	\$ 10,000	\$ -
13B	Road Construction elevation	6	1	\$ 40,000	\$ 40,000
14	Moving Expenses	5	1	\$ 250,000	\$ 250,000
Notes					
a	Shipping charge of 6% is included in all appropriate items				
b	Ancillary equipment includes				
	30,000 gallon GHe tanks [quantity 6/3, \$40k ea]				
	20,000 gallon LN2 dewar [quantity 1/1, \$200k ea]				
	10,000 gallon LHe dewar [quantity 1/1, \$250k ea]				
	purifier including compressor [quantity 1/1, \$90k ea]				
	cooling tower system [quantity 1/1, \$90k]				
	Inst. Air (\$5k), arc cells (\$45/\$30) and hygrometers (\$10)				
	Piping contract [\$50]				
c	No G&A is included				

Cost Model Verification

Item description	SNS costs						HBPI		
	Predicted			Actual			Predicted		
	per unit	No. of units	M&S	per unit	No. of units	M&S	per unit	No. of units	M&S
4.5K Refrigeration system									
4.5 Cold Box	\$ 6,937,969	1	\$ 6,937,969	\$ 3,688,740	1	\$ 3,688,740	\$ 998,199	1	\$ 998,199
Warm Compressors	\$ -	-	\$ -	\$ 3,190,200	1	\$ 3,190,200	\$ -	-	\$ -
2K Refrigeration system¹									
Cold Box, 2K	\$ 1,425,062	1	\$ 1,425,062	\$ 398,005	1	\$ 398,005	\$ 244,940	1	\$ 244,940
Cold Compressor	\$ 217,781	4	\$ 871,124	\$ 536,368	4	\$ 2,145,470	\$ 117,723	2	\$ 235,445
Ancillary Equipment									
30,000 gallon GHe tanks	\$ 40,000	6	\$ 240,000	\$ 44,652	6	\$ 267,912	\$ 40,000	3	\$ 120,000
20,000 gallon LN2 dewar	\$ 200,000	1	\$ 200,000	\$ 162,000	1	\$ 162,000	\$ 200,000	1	\$ 200,000
10,000 gallon LHe dewar	\$ 250,000	1	\$ 250,000	\$ 50,000	1	\$ 50,000	\$ 250,000	1	\$ 250,000
purifier including compressor	\$ 90,000	2	\$ 180,000		2	\$ -	\$ 90,000	1	\$ 90,000
cooling tower system	\$ 90,000	1	\$ 90,000		1	\$ -	\$ 90,000	1	\$ 90,000
Instrumentation air	\$ 5,000	2	\$ 10,000		2	\$ -	\$ 5,000	1	\$ 5,000
Arc cells	\$ 30,000	1	\$ 30,000	\$ 16,438	1	\$ 16,438	\$ 30,000	1	\$ 30,000
Hygrometers	\$ 10,000	1	\$ 10,000	\$ 16,020	1	\$ 16,020	\$ 10,000	1	\$ 10,000
Piping contract							\$ 50,000	1	\$ 50,000
Oil Removal System									
Refrigerator Controls²									
Piping									
Warm Header, 6"IPS, [\$/ft]	\$ 60	960	\$ 3,530,272			\$ 4,085,690			\$ 1,300,620
Feed box, feed caps and vac. support	\$ 1,000,000	1	\$ 1,000,000	\$ -	960	\$ -	\$ 60	600	\$ 36,000
Surface Transfer Line, [\$/ft]	\$ 2,013	960	\$ 1,932,672	\$ 4,256	960	\$ 4,085,690	\$ 2,013	250	\$ 503,300
Bayonet, anchor and expansion cans	\$ 30,000	18	\$ 540,000	\$ -	18	\$ -	\$ 30,000	2	\$ 60,000
Tunnel Transfer Line, [\$/ft]	\$ 2,013		\$ -	\$ -		\$ -	\$ 2,013	100	\$ 201,320
Misc. (ODH sys, instrument air, etc)									
			\$ 208,139			\$ 206,368			\$ 50,000
System installation contracts									
			\$ 923,415			\$ 942,242			\$ 150,000
Total			\$ 14,905,981			\$ 15,169,085			\$ 3,824,204



Cryogenic Costs

