

NCSX Facility Systems

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Princeton University Workshop on NCSX Cost and Schedule

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Scope

- WBS 6.1.3 Vacuum System Cooling Water
- WBS 6.3 Utility Gas Systems
 - Air
 - Vent to ambient
- WBS 6.4 VV Bakeout System

Basis for Cost & Schedule Estimates

- Prior experience from NSTX
 - Used to size utility systems
- Means Cost Estimating Guides
- Vendor quotes / estimates for equipment
- Catalog prices

6.1.3 Vacuum Pumping System Water

- Requirements:
 - Load: 5-10 gpm
 - Fluid: Treated Water
 - Pressure: 140 psig
 - Temperature: Ambient
- Estimate
 - Means cost guide

6.1.3 Vacuum Pumping System Cooling Water

- Provide a small loop <10 gpm
 - Includes design, fabrication and installation
 - Instrumentation and add backflow preventer
 - Heat exchanger & pump
- Work performed by PPPL Techs / Engineers
 - EMEM: 84 mhrs
 - EASB: 80 mhrs
 - EMTB: 167 mhrs
 - M&S: \$ 2,970

6.1.3 Materials and Installation

	M&S (\$)	EMEM (hrs)	EMTB (hrs)
Installation		20	
3/4" Cu Pipe x 50 ft	250		8
Solder Joints (25)			15
Valves	100		8
Elbows	10		8
Tees	10		8
New Instrumentation	1500	20	80
Backflow preventer	500	8	16
Heat Exchanger	500	8	16
Pump	100	8	8

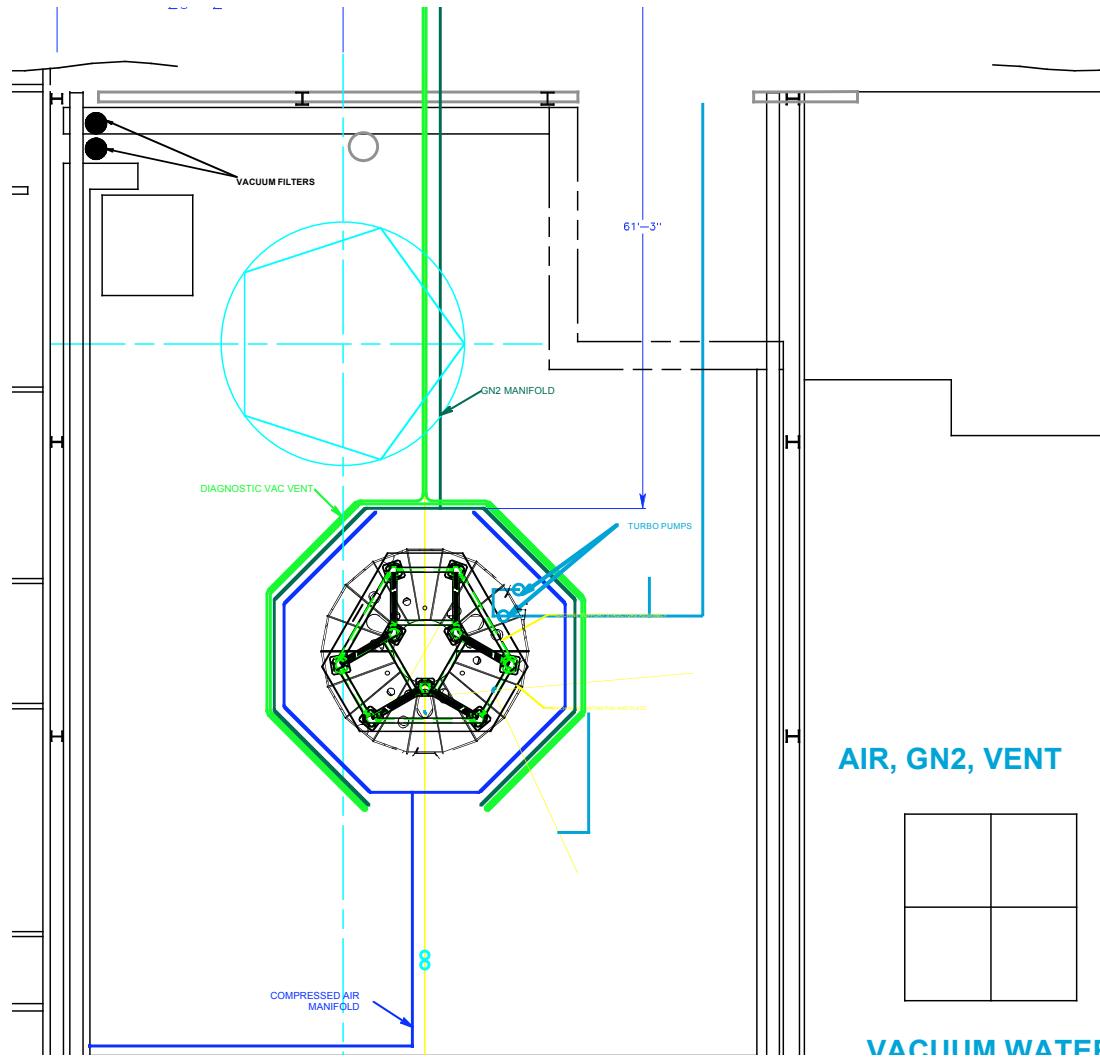
6.3 Utility Gas Systems

- Requirements:
 - Flavors: Compressed Air, Vac.Vent
 - Pressure: 90 psig , 14.7 psia
 - Design: Copper manifold
- Interface: Manifold around machine
- Estimate: Use past experience on NSTX, Cost Estimating Guide

6.3 Utility Gas Systems

- Provide simple gas manifolds and vent
 - Includes: Design, Fabrication & Installation
- Work performed by PPPL Techs
 - Engineer: 164 mhrs
 - Designer: 200 mhrs
 - Technician: 410 mhrs
 - M&S: \$22,188

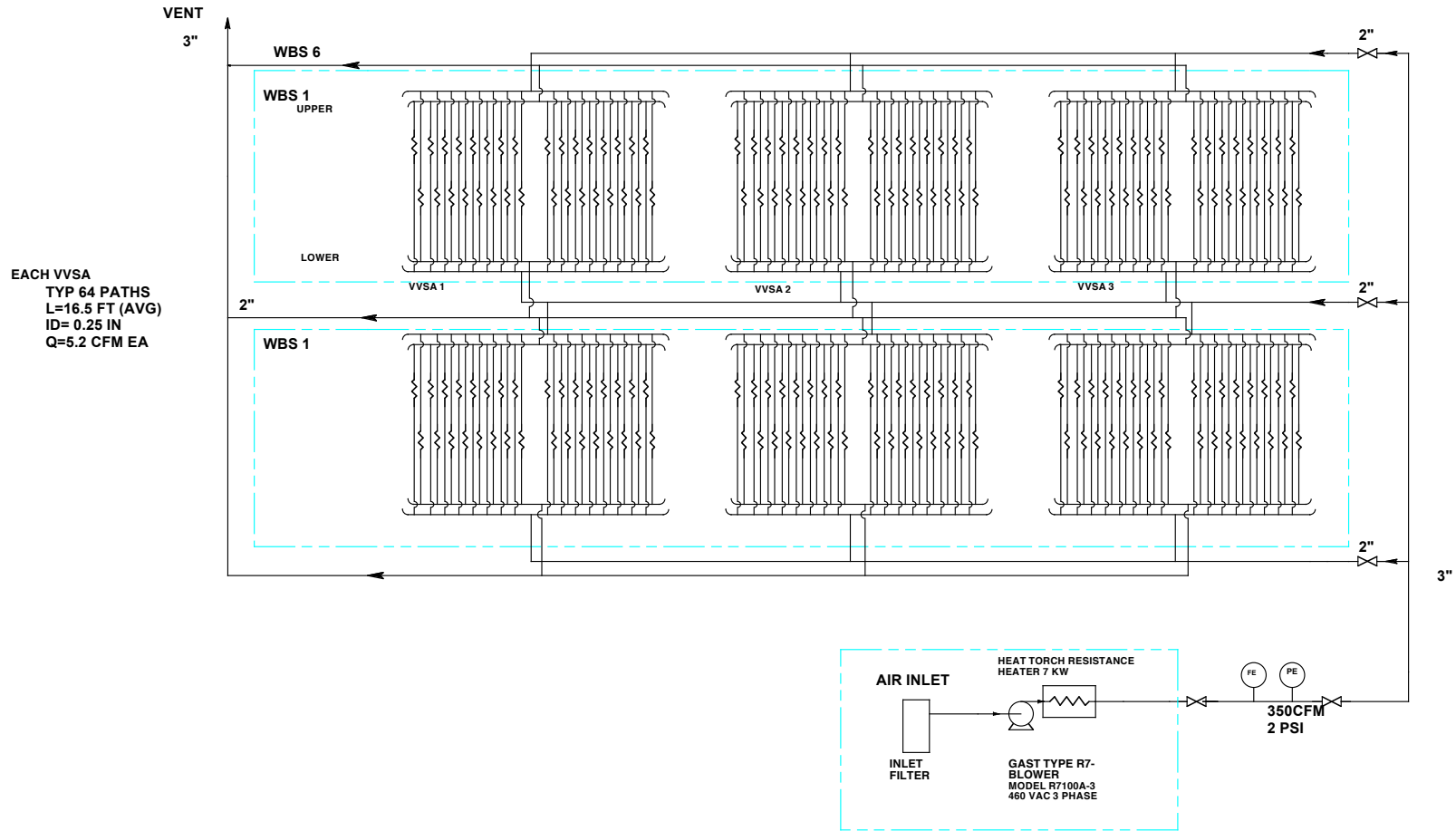
Utility Arrangement



6.4 VV Bakeout System

- VV Bakeout Requirements
 - Steady State Load: 7 kW
 - Flow: 350 CFM
 - Pressure: ~2 psig (once through to atmosphere vent)
 - Temp: 150 C Vessel
- Once through compressed air “dryer” type system
- Interface: Outside cryostat

6.4 VV Bakeout Flow Diagram



6.4 Bakeout Estimate



	A	B	C	F	G	N	Q	R	S	A	AD
5					FY07\$K						
6					1308	156.5	78.33	180.79	116.7		9789.08
7	Task ID		TASK DESCRIPTION	Start Date	4IMS (\$K)	EMEM	EMTB	EAEM	EASB		Rough Estimate Total (in FY07\$)
8											
9											
10	1		Design								\$0
11	2		Requirements definition			80					\$12,520
12	3		Preliminary Design & Review			160			120		\$39,044
13	4		Final Design & Review			160			120		\$39,044
14	5		EA or ORNL VV Analysis to confirm					160			\$28,926
15	6		ACC Review			40	40				\$9,393
17	8										\$0
18	9		Procurement & Installation								\$0
19	10		Piping and Equipment (See Piping Estimate Tab for Detail)		\$140		1830				\$326,937
20	11		480 VAC Power Service		\$5		80				\$12,806
21	12		Local Controls		\$3		80				\$10,190
22	13						20				\$1,567
36	27		PTP Testing			40	120				\$15,660
37	28										\$0
38	29										\$0
39	30										\$0
40	31										\$0
41											
42				TOTAL	148.354053	560	2170.1	160	240		\$508,607
43											\$508,607
44											
45											
46											

6.4 Piping Estimate



Size	304 SS	Labor Manhours	Material Cost (\$)	Total Labor (Mhours)	M&S (\$) (in 2002 \$)
Sch10 with Clevis hangers					
	Linear Feet				
	1"	0.160	\$8	0	\$0
	1-1/4"	0.176	\$10	0	\$0
	1-1/2"	0.193	\$11	0	\$0
	2" 200	0.239	\$14	48	\$2,700
	2-1/2"	0.314	\$17	0	\$0
	3" 500	0.348	\$21	174	\$10,250
Sch 5 and 10 NO. JOINTS					
	1"	1.000		0	\$0
	1-1/4"	1.250		0	\$0
	1-1/2"	1.500		0	\$0
	2" 30	2.000		60	\$0
	2-1/2"	2.500		0	\$0
	3" 30	3.000		90	\$0
ELBOWS					
	Quantity				
	1"	1.070	\$12	0	\$0
	1-1/4"	1.140	\$18	0	\$0
	1-1/2"	1.230	\$14	0	\$0
	2" 30	1.450	\$19	44	\$555
	2-1/2"	2.000	\$40	0	\$0
	3" 10	2.670	\$48	27	\$475
TEES					
	Quantity				
	1"	1.600	\$33	0	\$0
	1-1/4"	1.780	\$63	0	\$0
	1-1/2"	2.000	\$36	0	\$0
	2" 10	2.290	\$37	23	\$370
	1-1/2"	3.200	\$116	0	\$0
	3" 5	4.000	\$81	20	\$405
Adders					
	Elevated Installation 15%	72.735		73	
	Ceramic Breaks (Fab and Install) 6	8.000	\$2,000	48	\$12,000
	Insulation 10%	48.490	\$1,476	48	\$1,476
VALVES					
	3" Backpressure control valve 1	8.000	\$8,000	8	\$8,000
	2" Ballancing Valvs 6	8.000	\$800	48	\$4,800
	16"	16.000	\$800	0	\$0
	3" Ceramic Breaks 24	6.000	\$1,200	144	\$28,800
	3" Bellows 24	6.000	\$135	144	\$3,240
	Gast Blower 1	32.000	\$4,000	32	\$4,000
	Instll Htr 1	40.000	\$6,000	40	\$6,000
	Install Instru	16.000	\$200	0	\$0
	Install Pwr 1	120.000	\$5,000	120	\$5,000
	Install Tank	96.000	\$5,000	0	\$0
	Piping Support Towers 4	160.000	\$3,000	640	\$12,000
TOTAL				1830	\$100,071
ManWeeks				45.75	

6.4 Bakeout Schedule

Activity Name	Duration (Work Days)	Start Date	Finish Date	2007				2008							
				Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	
Requirements Definitioin	10.00	10/1/07	10/12/07		■										
Preliminary Design	20.00	10/15/07	11/9/07		■	■									
<i>EA Analysis</i>	<i>10.00</i>	<i>11/12/07</i>	<i>11/23/07</i>			■									
Final Design	40.00	11/26/07	1/18/08				■	■							
FDR	5.00	1/21/08	1/25/08						■						
Procurements and Instalation	80.00	1/28/08	5/16/08						■	■	■	■	■		
ACC Review	10.00	5/19/08	5/30/08										■		
PTP	10.00	6/2/08	6/13/08										■		
				Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	

Contingency

Product Maturity

<p><u>High</u> Conceptual design point. Assembly concepts</p>	<p>[WBS 61, 63] [WBS 2] [WBS 16] [WBS 13 PF & trim coils]</p>	<p>[WBS 64] [WBS 17 Cryostat] [WBS 62]</p>	<p>[WBS 18 Job1810] [WBS 7] [WBS 18 Job 1803 & 1805]</p>
<p><u>Medium</u> Preliminary design point. Assembly prototyping and/or prototyping underway</p>	<p>[WBS 4] [WBS 31] [WBS 36] [WBS 5] [WBS 14 Job 1431] [WBS 172]</p>	<p>[WBS 823,824] [WBS 38*] [WBS 19] [WBS 15]</p>	<p>[WBS 825] [WBS 181]</p>
<p><u>Low</u> Final design point. Assembly drawings issued, Procedures drafted. Production/fabrication underway</p>	<p>[WBS 81, 821, 822, 826] [WBS 39] [WBS 18 Job 1802] [WBS 12 Job 1204] [WBS 13 Job 1361 TF coil fabr]</p>	<p>[WBS 85]</p>	<p>[WBS 14 Job 1451 & 1459]</p>

<p><u>Low</u> Good experience bases. Does not require metrology. Prior experience using standard techniques and operations.</p>	<p><u>Medium</u> Critical assembly sequences. No specific metrology equip required. Limited experience with similar tasks.</p>	<p><u>High</u> Challenging tolerances requiring use of metrology equip and "back-office" staff. Little experience base to draw from.</p>
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Complexity