

nTOF11 Collaboration Meeting

Non-Design Issues for the Mercury Jet Target

P.T. Spampinato V.B. Graves T.A. Gabriel

Princeton University April 29-30, 2005

factor

OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY

Mercury Fill Procedure



- Verify total inventory by weight before and after fill
- Peristaltic or vacuum pump will be used to transfer Hg from standard flasks

– pump is connected to sump tank fill-port

- Up to twelve 2-liter flasks may be shipped to MIT and CERN
 - each flask is in an overpack container
- Hg fill operation occurs in the TT2A tunnel – fill directly from a flask using a steel tube insert
- Secondary containment is open during fill operation
 - local vapor sensing using the portable monitor
 - usual drip precautions ... plastic liner and gauze
 - "spill" clean up kit will be available

OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY



Peristaltic Pump & Standard Flask





Peristaltic Pump Test

Standard 2 Liter Flasks

OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY



Mercury Emptying Procedure



- Peristaltic or vacuum pump used to transfer Hg from primary containment directly into a standard flask
 - accurately monitor amount of Hg transferred into each flask using a scale and visually verify
- Some small quantity of Hg inventory will remain in the primary containment ... 100s ml ??
- Does CERN have the means to dispose of the secondary waste that will be generated
 - PPEs, gauze, plastic sheeting, tape, filters, ... ?





Target Cutaway Showing Fill Port





Peristaltic pump and standard flask ready for Hg fill operation

OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY



Equipment Installation



- The integrated systems test at MIT is practice for the activities to be done at CERN
 - Unpack target and store crates for reuse
 - Move target system, Hg flasks/overpacks, support structure, hydraulic pump and fluid into the lab
 - Place the solenoid onto the common support base structure
 - Install target into the solenoid bore
 - align and elevate the equipment as required
 - Connect electrical and hydraulic services to the target system
 - Operate solenoid, target, and diagnostic

OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY

- Practice for CERN
 experiment operations:
 - installation sequence
 - alignment sequence
 - service connections
 - systems controls magnet/target/diagnostic
 - dismantlement, removal





CERN Decommissioning



- 1 day minimum cool down for limited hands on access (1 wk. pfd.)
- Disconnect services as required
- Move equipment out of the beam line
- Store in TT2A tunnel for 1 month minimum cool down (1 yr. pfd.)
 - drain Hg into flasks in TT2A, and
 - drain hydraulic fluid into drums
 - move to surface facility
 - CERN packs equipment into original crates
 - load into sealand container
 - CERN ships to ORNL





Transport Plan



- Components to be shipped are:
 - Target system secondary/primary containment unit mounted on the "rolling cart" base structure
 - Common base support structure for the target and solenoid
 - Up to 12 overpacks containing Hg flasks
 - Hydraulic tank & fluid (~250 liters) and 20-hp motor
 - Misc. equipment and tools: vapor monitors, spill kit, PPEs, wrenches etc.
 - Satellite accumulation area (55 gal. Drum)
 - OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY

- Target system and hydraulic pump packed in wood crates
 - All crates are designed for fork lift handling, easy opening, and reuse
- Hg flasks shipped in overpack containers (10 gal. drum)
- Truck shipment of equipment to MIT for integrated systems testing, then return to ORNL
- Surface ship to CERN in a 20ft sealand container
- Return to ORNL for reuse



Procurement Plan



- Long lead item pump equipment
 - Write procurement spec for pump cylinders prior to Title II design review
 - 16 weeks delivery time for cylinders
 - start bid & award process in July 2005
 - purchase pump cylinders with FY06 \$\$ after Oct. 1, 2005
 - BNL handles \$\$ and procurement
 - \$50-60K is estimated
- Target loop
 - Write procurement spec for target loop prior to Title II design review
 - start bid & award process in Oct 2005 using ORNL Procurement Group
 - \$40-50K needs to be available from Collaboration

• Hg

- obtain quantity needed from ORNL
- Current market cost is \$850/liter



OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY



Off Normal Events and Recovery



- Worst Case: Entire Hg inventory leaks into secondary containment (SC)
 - contained in bottom of containment box
 - after cool down move equipment out of beam line
 - after additional cool down period pump from SC emergency port to refill flasks
 - Add "new" SC (plastic bag)
 - Return equipment to ORNL

OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY Likely Case: Hg vapors detected in SC

- After 1 day cool down monitor exterior of SC for leakage, visually inspect for leak, connect portable monitor to test port (false + ??)
- If no apparent leak continue with testing





Updated Schedule

CERN experiment shown in March 2007

	Start	Finish	1		200	04							-	2005							1					2	2006						-		_	20	07			
Hg larget System Design-hTOF11	D a te	Date	Jul	Aug	Sept	Oct	Nov	Dec Ja	in F	eb N	lar Ap	r May	Ju	n Ju	I A	ug Se	pt	Oct	Nov	Dec	Jan	Fel	b Ma	ar Ap	r May	Jur	n Ju	I A	ug Se	pt O	ct I	lov [Dec	Jan	Feb	Mar	Apr	Ma	y Ju	n
Solenoid/Cryostat Milestones			(Rev. 8	, Apri	il 25,	2005)						1									1																		
Fabricate	5/31/04	5/15/05															-	-			-	-														-	-			-
Deliver/Install at MIT	5/16/05	6/26/05										Ň					-	-	-		-	-			-			-		-	-	-					-			-
Magnet System Test at MIT	6/27/05	8/28/05	-														-	-	-		-	-			-				ntegra	ed S	vste	ms					-			-
Setup Target Equipment at MIT	7/10/06	7/30/06											-	-		_						-	-			-	\diamond	0	Testina	at M	1 IT	-					-			-
Integrated System Test at MIT	7/31/06	9/24/06	-								-		-	-	-	-	-			by	ĊERM	N Eng	ginee	rs	-	-				7	1	- 1	+							-
Install/Test Power Supply at CERN (by	1/30/06	3/27/06			– Note	es:														and	d Tech	hnicia	ans			-		Ŧ		-	-						-			-
others)					1. T	his So	chedu	le is B	a se d	on T	esting													2257																
Install Cryo System Equipment & Dewar (by	1/30/06	3/27/06			2 R	ed di	in mai amon	ds Indi	cate	Fstin	ated	Fravel																												
others)								u u u	-				-	_	_																					L		_	_	_
Ship larget System Back to ORNL	10/2/06	10/29/06																												· 🏊										
Ship Target System To CERN	11/6/06	12/31/06	-									1									-											_		,						
Install and Test Equipment in TT2A Tunnel	1/1/07	1/28/07										1																					-1					-	-	-
																																	†							
Commission Test Equipment at CERN (verify	1/29/07	2/25/07																																		,				
system operational capability in TT2A)	0/00/07	0/44/07											-	_	_	_	_					-	_			_					_								_	_
Beam On Experiment	2/26/07	3/11/07											-	_	_	_	-				-	-	_				_			_	_				-	<u> </u>			_	_
cooldown, dismantle, ship target/Ho to ORNU)	3/12/07	//31/07	1										1				- 1				1	1														_	—	<u> </u>		_
contraction and the state of th			-		$ \rightarrow $						_		-	_	_		+				-	-	_	_						-			\rightarrow			<u> </u>	-	+		-
Hg Target System			1									1	1					-	-		1	1	-								-		-+	\rightarrow		-	-	+	+	-
1. System Design			1				rinoot				CEDA	.1	0	E D NI	MIT			-	-		1	1			GS TO	BE		11 10			-		-+	\rightarrow		-	-	+	+	
1a. Engineering Coordination	7/5/04	7/1/07	-			P	nncett	on			CERI	•		= R N _	WIII								IVI		03 10	DE		00										_		
	11/15/04		<u> </u>				•				-	7	1	-	-	. 🕈	1																	-						-
1b. Establish Interfaces & Obtain	8/2/04	11/14/04		<u> </u>			~				F	rincet	on			AccA	pp05	5																						
Requirements	0 10 10 4	0/04/04			(D.N.)								_	_	_	_	_				-	_	_			_					_					<u> </u>				_
1c. Neutronics Calcs (BNL)	8/2/04	8/31/04				-)								_	_																					L		_	_	_
1d. Develop Interface Dwgs	8/2/04	9/30/04		\sim		>																											I							
1e. Design Ha Flow Loop System													+	Title II	Desi	ign Durma		itle II	Desi	gn R	eview		_		_			-		-			-+				-			_
							Title		an					Review	e to m	Pump	- 10 N	lozzle	Dec	ian	à																			
Title I Design	11/15/04	1/30/05	-					erbesi	gn _ ≕roʻ			1	- •	subsy	7	' I	P	7	e Des	sign	1	1												-						
	7/18/05						× –		٦Ť		Title	II Desi	an	X			Y																							
Title II Design	2/21/05	7/10/05						Title	L L	<u>~</u>			<u> </u>		<u>_</u>		_																I							
14 Develop Breevrem and Specification for	8/1/05	9/25/05						Desi	au F				-		_	_					-	-	_				_			_	_								_	_
Pump Equipment	2/7/05	1/6/05						Revie	w 文	'			<u> </u>	-		- 17	1	E.u.e.d.		D													I							
1 g. Procurement (Bid & Award) for Pump	7/11/05	9/25/05											-					r unas Proou	s ror	Pum	1P _	-	-			-		-	_		-						-			-
Equipment														-		11		Availa	able in	n FY	06																			
1h. Fabricate Pump Equipment - Deliver to	10/3/05	1/31/06														-///					1	4																		
ORNL (16 weeks)										(BNL)			_		/ //						_									_					L			_	_
11. Design Optical Diagnostics (BNL)	2/7/05	2/6/05											-	_	_	<u> </u>																	I							
1i Design Target Windows (BNL)	9/27/04	8/28/05																					_			-		-		-			-+				-			-
1k Nozzle/Ha Deflector Tests (Princeton)	4/4/05	7/31/05	-		- 1				(B	NI.)	_		1				-				-	-	_			_			_	-	-	-							_	-
11 Develop Procurement Spec for Target	8/15/05	9/16/05	-							-/		(P rine	ceton)	-	_	+				-	-	_	_		-		+		-			-+	\rightarrow		<u> </u>		+	+	
Loop	2,10,00		1										1	1	7		7				1	1														1	1			
1 m . Procurement (Bid & Award) for Target	10/3/05	1/1/06										1	1				t,				4							+				-	-+					+		
Loop																	ľ				۲																			
1n. Fabrication	1/2/06	3/30/06																			Ý -			- V																
1o. Control System Development	1/2/06	3/12/06																			Ý	1																		
1p. Assembly and Systems Test @ ORNL	4/3/06	7/2/06																						∇			-	T												
1 q. Prepare/Ship Target Assembly to MIT	7/3/06	7/9/06																									8													
1 r. Install Target Equipment at MIT	7/10/06	7/30/06																									4													
	7/17/06	E /2 1 /0 5										-	-	_	_	_	_					-	_	_	_	_	-мі	T_	_	_	_		\rightarrow			<u> </u>		+	_	
2. Develop Decommissioning and Disposition Plan	2/1/05	3/31/05	1						4				\$				- 1				1	1														1	1			
3. Develop Shipping & Installation Plan for	3/21/05	5/31/05	-					-							-	-	+				-	-				-	-	+		-	-		-+	\rightarrow		<u> </u>	-	+	+	-
MIT and CERN			1								<u> </u>		Ŷ				- 1				1	1														1	1			
4. Develop System Test Plan & Operations	3/21/05	5/31/05									•	-	¢																					-	CER	N				
Plan			-																		-																<u> </u>			
5. Provide Support for the High-Power Tests	1/1/07	4/15/07	1										1				- 1				1	1												-	- 🤞	۰ ا	۰.			
	2/26/07		1										1				- 1				1	1											4	–	_	_				
	4/2/07		1																		1															1	1			
			1									1									1	1											-	-				1	-	
			Jul	Aug	Sept	Oct	Nov	Dec Ja	in F	eb N	1ar Ap	r May	Ju	n Ju	I AI	ug Se	pt	Oct	Nov	Dec	Jan	Fel	b Ma	ar Ap	r May	Jur	ו Ju	A	ug Se	pt O	ct I	Vov [Dec	Jan	Feb	Mar	Apr	Ma	y Ju	n

OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY



Schematic Diagram





OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY



Operations



(Approx.)	Soleno	oid							
Time	Cryogenics	Power	Target Pump	Proton Beam	Optical				
(sec.)		Supply	System	4	Diagnostic				
minus 30	Magnet full of	Standby	Refill syringe	Call for beam	Off				
	LN ₂ @ 80°K		pump w/ Hg		1 8 8 1 1				
minus 10	Purge LN ₂ with	Standby	Standby	Wait for beam	Standby				
	gaseous He								
0 to 8	Magnet full of	Ramp to full	Pressurize	Wait for beam	Standby				
	He gas	current	Hydraul. Cylinder						
8 to 8.5	Magnet full of	Ramp to full	Maintain	Wait for beam	Standby				
	He gas	current	Cylinder Pressure						
8.5 to 9.5	Magnet full of	At full	Activate syringe	24 GeV, 1	Operate laser				
	He gas	current	for 20 m/s jet	MW	and high				
					speed camera				
9.5 to 10.0	Magnet full of	Begin de-	Shut down	Standby	Off				
	He gas	energizing	syringe pump						
10.0 to 13.5	Magnet full of	De-energize	Standby	Standby	Off				
	He gas	to zero		1					
13.5 to	Fill magnet	Cool down	Standby	Standby	Off				
1800.0*	with LN ₂ @	to ~80°K							
	80°K								

* Assumes a 30-minute dwell period.

OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY



Operations (cont.)





OAK RIDGE NATIONAL LABORATORY U. S. DEPARTMENT OF ENERGY

