SNS 100000000-PL0001-R04

SNS Parameters List

October 2000

SPALLATION NEUTRON SOURCE

A U.S. Department of Energy Multilaboratory Project

Argonne National Laboratory • Brookhaven National Laboratory • Thomas Jefferson National Accelerator Facility • Lawrence Berkeley National Laboratory • Los Alamos National Laboratory • Oak Ridge National Laboratory

SNS

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SNS PARAMETER LIST

October 2000

Prepared for the
U.S. Department of Energy
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UT-BATTELLE, LLC
managing
Spallation Neutron Source activities at

Argonne National Laboratory	Brookhaven National Laboratory
Thomas Jefferson National Accelerator Facility	Lawrence Berkeley National Laboratory
Los Alamos National Laboratory	Oak Ridge National Laboratory

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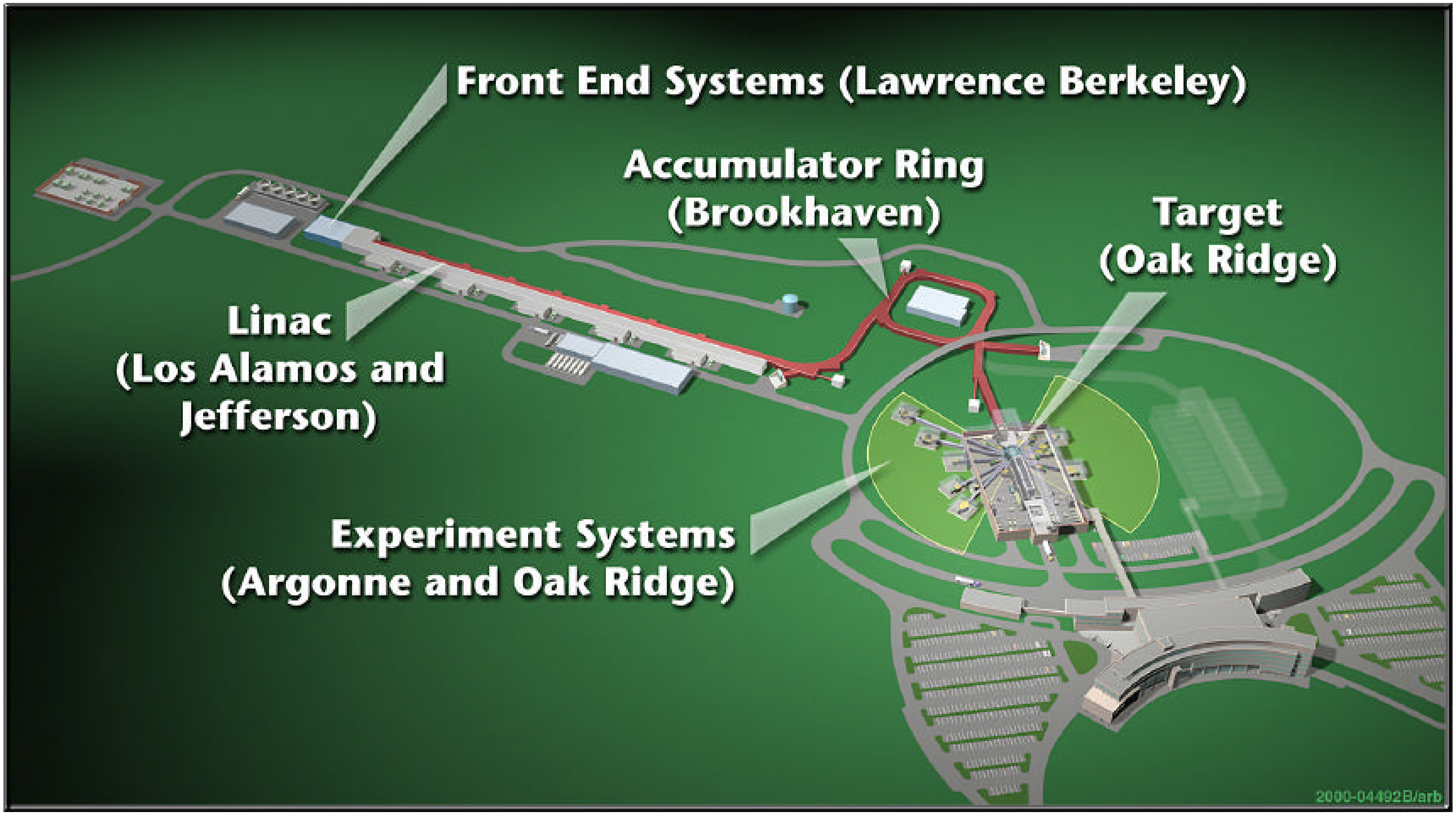

SNS Site Master Plan

Summary Parameters for the Spallation Neutron Source

Proton beam power on target	2.0 MW
Average proton beam current on target	2.0 mA
Pulse repetition rate	60 Hz
Peak linac H^- current	52 mA
RFQ output energy	2.5 MeV
Chopper beam-on duty factor	68 %
FE-Linac length, with 5 empty cryomodule slots	335 m
DTL output energy	87 MeV
Number of RFQ-DTL 402.5-MHz 2.5-MW klystrons	7
CCL output energy	185 MeV
Number of CCL 805-MHz 5.0-MW klystrons	4
SRF linac output energy	~1.0 GeV
Number of SRF cavities	92
Number of SRF 805-MHz 0.55-MW klystrons	92
Linac beam duty factor	6.0 %
HEBT length	170 m
Accumulator ring circumference	248 m
Ring orbit rotation time	945 ns
Number of injected turns	1060
Ring fill time	1.0 ms
Ring beam extraction gap	250 ns
RTBT length	150 m
Protons per pulse on target	2.08E+14
Proton pulse width on target	695 ns
Target material	Hg
Number of ambient/cold moderators	1/3
Number of neutron beam shutters	18
Initial number of instruments	10

SNS EMITTANCE AND APERTURE VALUES

Transverse in π mm mrad and longitudinal in π MeV degree

	ε_{norm}	ε_{unnorm}
RFQ (0.065 to 2.5 MeV)		
Input transverse rms from LEBT	0.20	
Output transverse rms	0.21	
Output longitudinal rms at 402.5 MHz	0.104	0.104
MEBT (2.5 MeV)		
Output transverse rms with errors	0.27	
Output longitudinal rms at 402.5 MHz	0.121	0.121
LINAC (2.5 MeV to 1.0 GeV)		
DTL bore radius	12.5 mm	
CCL bore radius	15.0 mm	
SRFL bore radius	43.0 - 48.8 mm	
Output transverse rms without jitter	0.41*	
Output transverse centroid jitter	± 0.2 mm*	
Output transverse rms with jitter	0.50*	
Output longitudinal rms at 805.0 MHz	0.60*	0.60*
Output rms energy spread		0.33 MeV
HEBT (1.0 GeV)		
Output transverse rms at foil with jitter	0.50*	0.28*
Halo adjustable betatron collimators for 18 rms		5.0
Rms energy spread at achromat center		0.72 MeV
Energy scrape with momentum collimator		± 3.0 MeV
Energy jitter from linac before corrector RF cavity		± 2.2 MeV*
Energy jitter after corrector RF cavity		± 0.2 MeV
Rms energy spread before spreader RF cavity		0.85 MeV
Painted energy spread after spreader RF cavity		± 4.0 MeV
RING (1.0 GeV)		
Anti-correlated/correlated painted full transverse (under study)		160/240
Transverse ring acceptance for Δp/p = ±1%		480
Transverse ring acceptance for Δp/p = ±2%		160
Expected momentum acceptance		± 1.0 %
Full beam momentum acceptance		± 2.0 %
Halo adjustable betatron collimators		225-240
Injection DC and AC bump magnets		480
Extraction channel		400
Longitudinal RF bucket area		17 eV-s
Longitudinal beam bunch area		10 eV-s
RTBT (1.0 GeV)		
Full transverse acceptance	480	
H x V beam size on target	200x70 mm	

*Understudy

WBS			Req.	Parameter	Base Value	Unit	Comment
1.	0.			**SPALLATION NEUTRON SOURCE**			
1.	0.		x	Proton beam power	2	MW	
1.	0.		x	Proton beam energy	1	GeV	
1.	0.		x	Average beam current on target	2	mA	
1.	0.		x	Protons per second on target	1.2E+16	protons/s	
1.	0.		x	Maximum pulse rate	60	Hz	
1.	0.		x	Protons per pulse on target	2.1E+14	protons	
1.	0.		x	Charge per pulse	33	uC	
1.	0.		x	Energy per pulse	33	kJ	
1.	0.		x	Peak H- front-end current	52	mA	
1.	0.		x	Linac beam duty factor	6.0	%	
1.	0.		x	Accumulator ring circumference	248.0	m	
1.	0.		x	Ring filling time	1.0	ms	Includes 50 us ramp up
1.	0.		x	Number of injected turns	1060	turns	
1.	0.		x	Orbit rotation and chopping frequency	1.058	MHz	
1.	0.		x	Orbit rotation time	945	ns	
1.	0.		x	Ring injection pulse length chopper	645	ns	
1.	0.		x	Ring injection kicker gap chopper	300	ns	
1.	0.		x	Ring filling fraction	68	%	
1.	0.		x	Ring extraction pulse length	695	ns	
1.	0.		x	Ring extraction kicker gap	250	ns	
1.	0.		x	Maximum uncontrolled beam loss	1	W/m	
1.	3.			**FRONT END**			
1.	3.		x	Ion	H minus		
1.	3.		x	RFQ output energy	2.5	MeV	
1.	3.		x	Peak output current	52	mA	
1.	3.		x	Front end length from IS back flange to DTL	7.494	m	
1.	3.		x	Beam-floor distance	50.0	in	
1.	3.	1.		**ION SOURCE AND LEBT**			
1.	3.	1.	x	H minus IS type	RF volume		Multicusp Cs-enhanced
1.	3.	1.		Peak H- ion source current	65	mA	Assuming 80% front end Trans.
1.	3.	1.		Electron suppression	mag deflection		
1.	3.	1.		Extraction gap electric field	40	kV/cm	
1.	3.	1.		LEBT focusing configuration	2 einzel lenses		
1.	3.	1.		LEBT H&V position offset steering	mechanical		LEBT on sliding mount
1.	3.	1.		LEBT H&V angle offset steering	electrical		Bias 2nd einzel lens quadrants
1.	3.	1.		LEBT deflection chopper peak voltage +/-	2.5	kV	145 mrad
1.	3.	1.	x	RFQ input energy	65	keV	
1.	3.	1.		Length of LEBT	12	cm	
1.	3.	1.	x	Estimated output rms norm H&V emittance	0.20	pi-mm-mrad	
1.	3.	1.	x	IS lifetime	3	weeks	Maintenance cycle
1.	3.	1.	x	IS replacement time	2	hour	
1.	3.	2.		**RFQ ACCELERATOR**			
1.	3.	2.	x	Output energy	2.5	MeV	
1.	3.	2.	x	Maximum peak output current	52	mA	
1.	3.	2.	x	RF frequency	402.5	MHz	
1.	3.	2.		Structure type	4 vane		4 modules
1.	3.	2.		Vane total length	3.723	m	
1.	3.	2.		Stable phase	-30	deg	
1.	3.	2.		Transverse mode stabilization	pi mode rods		
1.	3.	2.		Nominal aperture radius ro	3.51	mm	
1.	3.	2.		Vane transverse radius	3.51	mm	
1.	3.	2.		Rms surface field during macropulse	1.85	Kilpatrick	
1.	3.	2.		Rms macropulse structure power	630	kW	Assumes 67% of Cu Q
1.	4.	1.	x	Number of 2.5 MW peak power klystrons	1		
1.	3.	2.		Simulated output rms norm H emittance w/ no errors	0.21	pi-mm-mrad	10,000 particles
1.	3.	2.		Simulated output H Twiss beta	0.16	m	
1.	3.	2.		Simulated output H Twiss alpha	-1.61		
1.	3.	2.		Simulated output rms norm V emittance w/ no errors	0.21	pi-mm-mrad	10,000 particles
1.	3.	2.		Simulated output V Twiss beta	0.19	m	

1.	3.	2.		Simulated output V Twiss alpha	1.90		
1.	3.	2.		Simulated output rms L emittance at 402.5 MHz	0.104	pi-MeV-deg	10,000 particles
1.	3.	2.		Simulated output rms energy spread	9.2	keV	
1.	3.	2.		Simulated output phase spread	11.4	deg	
1.	3.	3.		**MEBT**			
1.	3.	3.		Length	3.62	m	
1.	3.	3.	x	Output peak operating current	52	mA	
1.	3.	3.		Number of quadrupoles	14		
1.	3.	3.		Quads 1-4 and 11-14 clear bore dia	3	cm	
1.	3.	3.		Quads 5 - 10 clear bore dia	4.0	cm	
1.	3.	3.		Effective quad lengths	6.1/6.6	cm	Narrow/wide bore
1.	3.	3.		Maximum quad gradient	35	T/m	
1.	3.	3.		Number of two-plane beam steerers	6		Quad poletip windings
1.	3.	3.		Number of rebuncher cavities	4		
1.	3.	3.		Rebuncher cavity type	TM010 pillbox		Single gap
1.	3.	3.	x	Rebuncher cavity frequency	402.5	MHz	
1.	3.	3.		Rebuncher peak voltage integral	75,45,51,106	kV	
1.	3.	3.	x	Simulated output rms norm H emittance with errors	0.27	pi-mm-mrad	
1.	3.	3.	x	Simulated output H Twiss beta	0.51	m	Under study to match DTL input
1.	3.	3.	x	Simulated output H Twiss alpha	-0.59		Under study to match DTL input
1.	3.	3.	x	Simulated output rms norm V emittance with errors	0.27	pi-mm-mrad	
1.	3.	3.	x	Simulated output V Twiss beta	0.18	m	Under study to match DTL input
1.	3.	3.	x	Simulated output V Twiss alpha	-0.41		Under study to match DTL input
1.	3.	3.		Simulated output rms L emittance with errors	0.126	pi-MeV-deg	At 402.5 MHz
1.	3.	3.	x	Simulated output rms energy spread	13.9	keV	
1.	3.	3.	x	Simulated output rms phase spread	8.7	deg	
1.	3.	3.		Quad gradient rms tolerance	1	%	
1.	3.	3.		Rebuncher cavity field rms tolerance	2	%	
1.	3.	3.		Rebuncher cavity phase rms tolerance	1	deg	
1.	3.	3.		Quad position rms tolerance on sub-raft	0.025	mm	
1.	3.	3.		Sub-raft position rms tolerance on major support	0.04	mm	
1.	3.	3.	x	Simulated additional emittance growth w/ uncorr errors	10	%	For all three planes
1.	4.	5.		**TRAVELING WAVE CHOPPERS**			
1.	4.	5.	x	Number of choppers	2		Chopper and antichopper
1.	4.	5.	x	chopper length	0.35	m	
1.	4.	5.	x	Full rise/fall time	10	ns	
1.	4.	5.	x	Beam-on duty factor	68	%	
1.	4.	5.	x	Gap	1.8	cm	
1.	4.	5.	x	Total deflection voltage	+/- 2350	V	18 mrad deflection
1.	4.	5.	x	Post chopper off/on beam-current ratio	1.0E-4		Goal 1.0E-5
1.	3.	3.		**DIAGNOSTICS**			
1.	3.	3.		Number of beam current toroids	2		
1.	3.	3.		Number of profile monitors	5		
1.	3.	3.		Number of beam scrapers	1		
1.	3.	3.		Number of two-plane stripline BPMs	6		Inside quads, include phase meas..
1.	3.	3.		Number of emittance scanners	1		
1.	4.			**LINAC**			
1.	4.		x	Simulated output energy	949	MeV	
1.	4.		x	Average beam current	2.08	mA	Beam power = 2.08 MW
1.	4.		x	Average macropulse current	36	mA	
1.	4.		x	Peak macropulse current	52	mA	
1.	4.			Protons per micro bunch	8.70E+08		
1.	4.			RF duty factor	7.2	%	HV Gate Duty Factor
1.	4.			Peak total RF power	50.4	MW	
1.	4.			Average total RF power	2.9	MW	
1.	4.			Average beam power	2.1	MW	
1.	4.		x	Specified ac wall power for RF	25	MW	
1.	4.		x	Simulated output H&V rms norm emittance w/ errors and wo/ jitter	0.41	pi-mm-mrad	Under study
1.	4.		x	Simulated output transverse centroid jitter +/-	0.20	mm	Under study
1.	4.		x	Simulated output H&V rms norm emittance w/ errors and w/ jitter	0.50	pi-mm-mrad	Under study

1.	4.		x	Simulated output H Twiss beta	10.1	m	Under study
1.	4.		x	Simulated output H Twiss alpha	-1.85		Under study
1.	4.		x	Simulated output V Twiss beta	5.3	m	Under study
1.	4.		x	Simulated output V Twiss alpha	1		Under study
1.	4.		x	Simulated output L rms emittance w/ errors	0.6	pi-MeV-deg	Under study
1.	4.		x	Simulated output rms energy spread	0.33	MeV	Under study
1.	4.		x	Simulated output total phase width	12.6	deg	Under study
1.	4.		x	Maximum output energy jitter +/-	2.2	MeV	99.99%
1.	4.		x	Total linac length	279.933	m	Excludes 47.346m for 6 more high-beta cryomodules
1.	4.		x	Linac tunnel width x height	14X10	ft	No crane
1.	4.		x	Linac tunnel length	321.781	m	Excludes 9.233 m of DTL in FE bldg and includes 3.735 m of contingency
1.	4.		x	Beam-floor distance	50.0	in	
1.	4.			Quad transverse displacement rms tolerance	0.07	mm	Limit +/- 0.13 mm
1.	4.			Quad tilt rms tolerance	6	mrad	Limit +/- 10 mrad
1.	4.			Quad roll rms tolerance	3	mrad	Limit +/- 5 mrad
1.	4.			Quad gradient rms tolerance	0.14	%	Limit +/- 0.25 %
1.	4.			Distance rms tolerance between end gaps of segs	0.15	mm	Limit +/- 0.25 mm
1.	4.			Tolerance rms between adjacent gaps in a segment	0.03	mm	Limit +/- 0.05 mm
1.	4.			Segment end transverse displacement rms tolerance	0.3	mm	Limit +/- 0.5 mm
1.	4.	2.		**DTL ACCELERATOR**			
1.	4.	2.	x	RF frequency	402.5	MHz	
1.	4.	2.	x	Output energy	86.8	MeV	
1.	4.	2.		Number of tanks	6		
1.	4.	2.		Max Kilpatrick field	1.3		
1.	4.	2.		Bore radius	1.25	cm	
1.	4.	2.		Focusing structure	FFODDO		
1.	4.	2.		Focusing period	6	beta-lambda	
1.	4.	2.		Quadrupole type	permanent mag		
1.	4.	2.		Quad integral GL	1.295	T	
1.	4.	2.		Quad location	inside DTs		
1.	4.	2.	x	Total length	36.573	m	Tank 1 entry plane to tank 6 exit plane
1.	4.	2.	x	Average operating vacuum pressure	1.8E-07	Torr	
1	4	2		Tank 1 length	4.1519	m	Between inside end walls
1	4	2		Tank 1 inside diameter	TBD	cm	Superfish diameter = 43.0 cm
1	4	2		Tank 1 drift-tube diameter	9	cm	
1	4	2		Tank 1 stem diameter	1.905	cm	DT 49, 52, 55, 58 have 2.54 cm
1	4	2		Tank 1 number of cells	60		
1	4	2		Tank 1 number of drift tubes	59		
1	4	2		Tank 1 number of post couplers	19		
1	4	2		Tank 1 energy gain	5.023	MeV	
1	4	2		Tank 1 synchronous phase	-36	deg	Average, ramp is -45 to -27
1	4	2		Tank 1 stored energy	4.78	J	
1	4	2		Tank 1 cavity power	0.337	MW	
1	4	2		Tank 1 average E_0T	1.495	MV/m	
1	4	2		Tank 1 shunt impedance ZT^2	27.56	MW/m	
1	4	2		Tank 1 unloaded Q	35,887		
1	4	2		Tank 1 cavity-to-waveguide coupling	1.508		
1	4	2		Tank 1 external Q	23,803		
1	4	2		Tank 1 loaded Q	14,311		@34 mA average current
1	4	2		Tank 1 beam power	0.171	MW	@34 mA average current
1	4	2		Tank 1 detuning angle	-8.4	deg	@34 mA average current
1	4	2		Tank 2 length	6.0622	m	Between inside end walls
1	4	2		Tank 2 inside diameter	TBD	cm	Superfish diameter = 43.0 cm
1	4	2		Tank 2 drift-tube diameter	9	cm	
1	4	2		Tank 2 stem diameter	1.905	cm	DT 36, 39, 42, 45 have 2.54 cm
1	4	2		Tank 2 number of cells	48		
1	4	2		Tank 2 number of drift tubes	47		
1	4	2		Tank 2 number of post couplers	23		
1	4	2		Tank 2 energy gain	15.315	MeV	
1	4	2		Tank 2 synchronous phase	-25	deg	
1	4	2		Tank 2 stored energy	16.51	J	
1	4	2		Tank 2 cavity power	1.046	MW	
1	4	2		Tank 2 average E_0T	2.787	MV/m	

1	4	2	Tank 2 shunt impedance ZT^2	45.03 MW/m	
1	4	2	Tank 2 unloaded Q	39,919	
1	4	2	Tank 2 cavity-to-waveguide coupling	1.498	
1	4	2	Tank 2 external Q	26,646	
1	4	2	Tank 2 loaded Q	15,980	@ 34 mA average current
1	4	2	Tank 2 beam power	0.521 MW	@34 mA average current
1	4	2	Tank 2 detuning angle	-5.3 deg	@34 mA average current
1	4	2	Tank 3 length	6.3233 m	Between inside end walls
1	4	2	Tank 3 inside diameter	TBD cm	Superfish diameter = 45.0 cm
1	4	2	Tank 3 drift-tube diameter	11 cm	
1	4	2	Tank 3 stem diameter	3.175 cm	
1	4	2	Tank 3 number of cells	34	
1	4	2	Tank 3 number of drift tubes	33	
1	4	2	Tank 3 number of post couplers	16	
1	4	2	Tank 3 energy gain	16.951 MeV	
1	4	2	Tank 3 synchronous phase	-25 deg	
1	4	2	Tank 3 stored energy	21.69 J	
1	4	2	Tank 3 cavity power	1.302 MW	
1	4	2	Tank 3 average E_0T	2.958 MV/m	
1	4	2	Tank 3 shunt impedance ZT^2	42.48 MW/m	
1	4	2	Tank 3 unloaded Q	42,212	
1	4	2	Tank 3 cavity-to-waveguide coupling	1.442	
1	4	2	Tank 2 external Q	29,204	
1	4	2	Tank 3 loaded Q	17,247	@ 34 mA average current
1	4	2	Tank 3 beam power	0.576 MW	@34 mA average current
1	4	2	Tank 3 detuning angle	-4.8 deg	@34 mA average current
1	4	2	Tank 4 length	6.4131 m	Between inside end walls
1	4	2	Tank 4 inside diameter	TBD cm	Superfish diameter = 45.0 cm
1	4	2	Tank 4 drift-tube diameter	11 cm	
1	4	2	Tank 4 stem diameter	3.175 cm	
1	4	2	Tank 4 number of cells	28	
1	4	2	Tank 4 number of drift tubes	27	
1	4	2	Tank 4 number of post couplers	27	
1	4	2	Tank 4 energy gain	16.79 MeV	
1	4	2	Tank 4 synchronous phase	-25 deg	
1	4	2	Tank 4 stored energy	21.15 J	
1	4	2	Tank 4 cavity power	1.259 MW	
1	4	2	Tank 4 average E_0T	2.889 MV/m	
1	4	2	Tank 4 shunt impedance ZT^2	42.49 MW/m	
1	4	2	Tank 4 unloaded Q	42,472	
1	4	2	Tank 4 cavity-to-waveguide coupling	1.453	
1	4	2	Tank 4 external Q	29,222	
1	4	2	Tank 4 loaded Q	17,311	@ 34 mA average current
1	4	2	Tank 4 beam power	0.571 MW	@34 mA average current
1	4	2	Tank 4 detuning angle	-4.8 deg	@34 mA average current
1	4	2	Tank 5 length	6.2958 m	Between inside end walls
1	4	2	Tank 5 inside diameter	TBD cm	Superfish diameter = 45.0 cm
1	4	2	Tank 5 drift-tube diameter	11 cm	
1	4	2	Tank 5 stem diameter	3.175 cm	
1	4	2	Tank 5 number of cells	24	
1	4	2	Tank 5 number of drift tubes	23	
1	4	2	Tank 5 number of post couplers	23	
1	4	2	Tank 5 energy gain	15.916 MeV	
1	4	2	Tank 5 synchronous phase	-25 deg	
1	4	2	Tank 5 stored energy	21.36 J	
1	4	2	Tank 5 cavity power	1.27 MW	
1	4	2	Tank 5 average E_0T	2.789 MV/m	
1	4	2	Tank 5 shunt impedance ZT^2	38.56 MW/m	
1	4	2	Tank 5 unloaded Q	42,526	
1	4	2	Tank 5 cavity-to-waveguide coupling	1.45	
1	4	2	Tank 5 external Q	29,338	
1	4	2	Tank 5 loaded Q	17,361	@ 34 mA average current
1	4	2	Tank 5 beam power	0.571 MW	@34 mA average current
1	4	2	Tank 5 detuning angle	-4.9 deg	@34 mA average current
1	4	2	Tank 6 length	6.3379 M	Between inside end walls
1	4	2	Tank 6 inside diameter	TBD cm	Superfish diameter = 45.0 cm
1	4	2	Tank 6 drift-tube diameter	11 cm	
1	4	2	Tank 6 stem diameter	3.175 cm	

1	4	2		Tank 6 number of cells	22		
1	4	2		Tank 6 number of drift tubes	21		
1	4	2		Tank 6 number of post couplers	21		
1	4	2		Tank 6 energy gain	14.333	MeV	
1	4	2		Tank 6 synchronous phase	-35	deg	Average, ramp is –25 to -45
1	4	2		Tank 6 stored energy	21.48	J	
1	4	2		Tank 6 cavity power	1.281	MW	
1	4	2		Tank 6 average E_0T	2.761	MV/m	
1	4	2		Tank 6 shunt impedance ZT^2	37.71	MW/m	
1	4	2		Tank 6 unloaded Q	42,412		
1	4	2		Tank 6 cavity-to-waveguide coupling	1.38		
1	4	2		Tank 6 external Q	30,728		
1	4	2		Tank 6 loaded Q	17,818		@ 34 mA average current
1	4	2		Tank 6 beam power	0.487	MW	@34 mA average current
1	4	2		Tank 6 detuning angle	-6.4	deg	@34 mA average current
1.	4.	5.		**DTL DIAGNOSTICS**			
1.	4.	5.		Number of beam position and phase monitors	12		
1.	4.	5.		Number of beam loss monitors	12		
1.	4.	5.		Number of current monitors	6		
1.	4.	5.		Number of wire scanners	6		
1.	4.	5.		Number of Faraday cups	5		
1.	4.	5.		Number of harps	2		
1.	4.	4.		**CCL ACCELERATOR**			
1.	4.	4.	x	RF frequency	805	MHz	
1.	4.	4.	x	Output energy	185.7	MeV	
1.	4.	4.		Number of accelerating cells per segment	8		
1.	4.	4.		Number of segments per module	12		
1.	4.	4.		Number of RF modules	4		
1.	4.	4.		DTL to CCL physics distance	24.319	cm	
1.	4.	4.		DTL to CCL mechanical space	19.229	cm	
1.	4.	4.		Minimum intersegment mechanical space	32.659	cm	
1.	4.	4.		Max Kilpatrick field	1.3		
1.	4.	4.		Bore radius	1.5	cm	
1.	4.	4.		Focusing structure	FODO		
1.	4.	4.		Focusing period	13	beta-lambda	
1.	4.	4.		Number of quadrupoles	49		
1.	4.	4.		Quad type	EM		
1.	4.	4.		Quad integral GL at entry	2.445	T	
1.	4.	4.		Quad integral GL at exit	0.767	T	
1.	4.	4.		Quad location	between segs.		Outside vacuum
1.	4.	4.		Number of steering dipoles	16		Under study
1.	4.	4.		Number of BPMs	8		Under study
1.	4.	4.		CCL accelerator length not including space to CCL	55.119	m	
1.	4.	4.		CCL system length including space to CCL	55.3618	m	
1.	4.	4.	x	Average operating vacuum pressure	0.9E-7	Torr	
1	4	4		Module 1 length	11.8392	m	Nominal physics length
1	4	4		Module 1 cell-to-cell coupling	5.33	%	
1	4	4		Module 1 energy gain	20.334	MeV	
1	4	4		Module 1 synchronous phase	-30	deg	
1	4	4		Module 1 stored energy	6.858	J	
1	4	4		Module 1 cavity power	2.127	MW	
1	4	4		Module 1 average E_0T	1.983	MV/m	Average over module length
1	4	4		Module 1 shunt impedance ZT^2	21.89	MΩm	Average over module length
1	4	4		Module 1 unloaded Q	16,310		
1	4	4		Module 1 cavity-to-waveguide coupling	1.325		Total for two irises
1	4	4		Module 1 external Q	12,309		
1	4	4		Module 1 loaded Q	7,015		@ 34 mA average current
1	4	4		Module 1 beam power	0.691	MW	@ 34 mA average current
1	4	4		Module 1 detuning angle	-4.6	deg	@ 34 mA average current
1	4	4		Module 2 length	12.9455	m	Nominal physics length
1	4	4		Module 2 cell-to-cell coupling	5.06	%	
1	4	4		Module 2 energy gain	23.979	MeV	
1	4	4		Module 2 synchronous phase	-30	deg	
1	4	4		Module 2 stored energy	8.489	J	
1	4	4		Module 2 cavity power	2.465	MW	
1	4	4		Module 2 average E_0T	2.139	MV/m	Average over module length

1	4	4		Module 2 shunt impedance ZT^2	24.02	MΩm	Average over module length
1	4	4		Module 2 unloaded Q	17,418		
1	4	4		Module 2 cavity-to-waveguide coupling	1.331		Total for two irises
1	4	4		Module 2 external Q	13,089		
1	4	4		Module 2 loaded Q	7,473		@ 34 mA average current
1	4	4		Module 2 beam power	0.815	MW	@ 34 mA average current
1	4	4		Module 2 detuning angle	-4.7	deg	@ 34 mA average current
1	4	4		Module 3 length	14.0013	m	Nominal physics length
1	4	4		Module 3 cell-to-cell coupling	4.8	%	
1	4	4		Module 3 energy gain	26.074	MeV	
1	4	4		Module 3 synchronous phase	-29.5	deg	Average, ramp is –30 to -29
1	4	4		Module 3 stored energy	9.086	J	
1	4	4		Module 3 cavity power	2.493	MW	
1	4	4		Module 3 average E_0T	2.14	MV/m	Average over module length
1	4	4		Module 3 shunt impedance ZT^2	25.71	MΩm	Average over module length
1	4	4		Module 3 unloaded Q	18,432		
1	4	4		Module 3 cavity-to-waveguide coupling	1.356		Total for two irises
1	4	4		Module 3 external Q	13,597		
1	4	4		Module 3 loaded Q	7,825		@ 34 mA average current
1	4	4		Module 3 beam power	0.887	MW	@ 34 mA average current
1	4	4		Module 3 detuning angle	-4.9	deg	@ 34 mA average current
1	4	4		Module 4 length	14.9951	m	Nominal physics length
1	4	4		Module 4 cell-to-cell coupling	4.56	%	
1	4	4		Module 4 energy gain	28.412	MeV	
1	4	4		Module 4 synchronous phase	-28	deg	Average, ramp is –29 to -27
1	4	4		Module 4 stored energy	9.66	J	
1	4	4		Module 4 cavity power	2.53	MW	
1	4	4		Module 4 average E_0T	2.146	MV/m	Average over module length
1	4	4		Module 4 shunt impedance ZT^2	27.29	MΩm	Average over module length
1	4	4		Module 4 unloaded Q	19,311		
1	4	4		Module 4 cavity-to-waveguide coupling	1.382		Total for two irises
1	4	4		Module 4 external Q	13,975		
1	4	4		Module 4 loaded Q	8,108		@ 34 mA average current
1	4	4		Module 4 beam power	0.966	MW	@ 34 mA average current
1	4	4		Module 4 detuning angle	-4.9	deg	@ 34 mA average current
1.	4.	5.		**CCL DIAGNOSTICS**			
1.	4.	5.		Number of beam position and phase monitors	16		
1.	4.	5.		Number of beam loss monitors	24		
1.	4.	5.		Number of current monitors	2		
1.	4.	5.		Number of wire scanners	8		
1.	4.			**SUPERCONDUCTING RF LINAC**			
1.	4.		x	RF frequency	805	MHz	
1.	4.			Peak surface field	27.5	MeV/ m	
1.	4.		x	Medium beta cavity geometrical beta	0.61		
1.	4.		x	High beta cavity geometrical beta	0.81		
1.	4.		x	Number of med beta cryomodules	11		
1.	4.		x	Number of high beta cryomodules	15		
1.	4.		x	Cryomodule length med beta	4.239	m	Includes gate valves
1.	4.		x	Cryomodule length high beta	6.291	m	Includes gate valves
1.	4.		x	Warm space between cryomodule valves	1.6	m	Between gate valves
1.	4.		x	Period length med beta	5.839	m	
1.	4.		x	Period length high beta	7.891	m	
1.	4.		x	Total SRF linac length	180.994	m	26 cryomodules + 25 warm spaces
1.	4.		x	Length of 186 MeV differential pumping section	2.35	m	Contains quad doublet, understudy
1.	4.		x	Last warm space for quad	1.6	m	
1.	4.		x	Length of 969 MeV differential pumping section	3	m	Contains quad doublet, understudy
1.	4.		x	Length for six additional high beta cryomodules	47.346	m	
1.	4.		x	Total length for SRF linac	235.29	m	
1.	4.			Simulated transition energy between sections	379	MeV	
1.	4.			Transverse focusing lattice	warm doublets		
1.	4.			Warm beam pipe vacuum	1.00E-09	Torr	
1.	4.		x	Beam height	50.0	inches	

1.	4.	**SRF LINAC CAVITIES**			
1.	4.	Cavity type	elliptical		
1.	4.	Cavity operating mode	pi		
1.	4.	Cavity material	Niobium		
1.	4.	Cavity material thickness	4	mm	3.8 mm after processing
1.	4.	Cavity operating temperature	2.1	degree K	
1.	4.	Number of cells per cavity	6		
1.	4.	Number of med beta cavities	33		
1.	4.	Number of high beta cavities	60		
1.	4.	Cell length med beta	0.1136	m	
1.	4.	Medium beta cavity geometrical beta	0.61		
1.	4.	Cell length med beta	0.1136	m	
1.	4.	Iris radius med beta inner cell	0.043	m	
1.	4.	Iris radius med beta HOM coupler end cell	0.043	m	
1.	4.	Iris radius med beta power coupler end cell	0.065	m	
1.	4.	Equator radius med beta inner cell	0.16376	m	
1.	4.	Equator radius med beta HOM coupler end cell	0.16376	m	
1.	4.	Equator radius med beta power coupler end cell	0.16698	m	
1.	4.	Dome radius med beta inner cell	0.035	m	
1.	4.	Dome radius med beta HOM coupler end cell	0.0336	m	
1.	4.	Dome radius med beta power coupler end cell (inner)	0.03456	m	
1.	4.	Dome radius med beta power coupler end cell (outer)	0.03435	m	
1.	4.	a/b med beta inner cell	0.59		
1.	4.	a/b med beta HOM coupler end cell	0.67		
1.	4.	a/b med beta power coupler end cell (inner)	0.59		
1.	4.	a/b med beta power coupler end cell (outer)	0.67		
1.	4.	A/B med beta inner cell	1		
1.	4.	A/B med beta HOM coupler end cell	1		
1.	4.	A/B med beta power coupler end cell (inner)	1		
1.	4.	A/B med beta power coupler end cell (outer)	1		
1.	4.	Angle med beta inner cell	7	deg	
1.	4.	Angle med beta HOM coupler end cell	8.36	deg	
1.	4.	Angle med beta power coupler end cell (inner)	7	deg	
1.	4.	Angle med beta power coupler end cell (outer)	10	deg	
1.	4.	High Beta cavity geometrical beta	0.81		
1.	4.	Cell length high beta	0.151	m	
1.	4.	Iris radius high beta inner cell	0.0488	m	
1.	4.	Iris radius high beta HOM coupler end cell	0.0488	m	
1.	4.	Iris radius high beta power coupler end cell	0.07	m	
1.	4.	Equator radius high beta inner cell	0.16416	m	
1.	4.	Equator radius high beta HOM coupler end cell	0.16416	m	
1.	4.	Equator radius high beta power coupler end cell	0.16588	m	
1.	4.	Dome radius high beta inner cell	0.05237	m	
1.	4.	minor asix/2 high beta HOM coupler end cell, A	0.05170	m	
1.	4.	major asix/2 high beta HOM coupler end cell, B	0.05687	m	
1.	4.	Dome radius high beta power coupler end cell (inner)	0.05213	m	
1.	4.	Dome radius high beta power coupler end cell (outer)	0.05508	m	
1.	4.	a/b high beta inner cell	0.556		
1.	4.	a/b high beta HOM coupler end cell	0.556		
1.	4.	a/b high beta power coupler end cell (inner)	0.556		
1.	4.	a/b high beta power coupler end cell (outer)	0.588		
1.	4.	A/B high beta inner cell	1		
1.	4.	A/B high beta HOM coupler end cell	0.91		
1.	4.	A/B high beta power coupler end cell (inner)	1		
1.	4.	A/B high beta power coupler end cell (outer)	1		
1.	4.	Angle high beta inner cell	7	deg	
1.	4.	Angle high beta HOM coupler end cell	7.97	deg	
1.	4.	Angle high beta power coupler end cell (inner)	7	deg	
1.	4.	Angle high beta power coupler end cell (outer)	7	deg	
1.	4.	Mid beta coupling constant	1.61	%	
1.	4.	High beta coupling constant	1.61	%	
1.	4.	Qo med beta	>5e9		
1.	4.	Qo high beta	>5e9		
1.	4.	R/Qo med beta	350	Ohms/m	
1.	4.	R/Qo high beta	500	Ohms/m	
1.	4.	Medium B Cavity external Q	7.30E+05		
1.	4.	High Beta Cavity external Q	7.00E+05		
1.	4.	Q variation +/-	20	%	

1.	4.		Typical band width	1600	Hz	
1.	4.		Cavity stiffeners	yes		
1.	4.		Lorentz force detuning coefficient-medium beta	2.9	Hz/(MV/m)^2	
1.	4.		Lorentz force detuning coefficient-high beta	1.2	Hz/(MV/m)^2	
1.	4.		Lorentz force coefficient variation +/-	50	%	
1.	4.		Microphonic amplitude limit +/-	100	Hz	Six sigma
1.	4.		Cavity active length med beta	0.6816	m	
1.	4.		Cavity active length high beta	0.906	m	
1.	4.		Total cavity end space for couplers	0.385	m	
1.	4.		Total cavity length med beta	1.0666	m	
1.	4.		Total cavity length high beta	1.291	m	
1.	4.		Maximum Epeak	27.5	MV/m	
1.	4.		Epeak/Eacc interior cells med beta	2.63		
1.	4.		Epeak/Eacc interior cells high beta	2.14		
1.	4.		Bpeak/Epeak interior cells med beta	2.07	mT//MV/m	
1.	4.		Bpeak/Epeak interior cells high beta	2.14	mT//MV/m	
1.	4.		Eacc interior cells med beta	10.5	MV/m	
1.	4.		Eacc interior cells high beta	12.8	MV/m	
1.	4.		Eo interior cells med beta	13.5	MV/m	
1.	4.		Eo interior cells high beta	16.6	MV/m	
1.	4.		Bpeak interior cells med beta	57	mT	
1.	4.		Bpeak interior cells high beta	59	mT	
1.	4.		**SRF LINAC CRYOMODULES**			
1.	4.		Cavities per cryomodule med beta	3		
1.	4.		Cavities per cryomodule high beta	4		
1.	4.		Cryomodule length med beta	4.239	m	
1.	4.		Cryomodule length high beta	6.291	m	
1.	4.		Cryomodule diameter	0.914	m	
1.	4.		Shield static heat load med beta cryomodule	170	W	
1.	4.		Shield static heat load high beta cryomodule	200	W	
1.	4.		2.1 K static heat load med beta cryomodule	25	W	
1.	4.		2.1 K static heat load high beta cryomodule	28	W	
1.	4.		Cavity dynamic heat load per med beta cryomodule	16	W	
1.	4.		Cavity dynamic heat load per high beta cryomodule	18	W	
1.	4.		Magnetic fields at cryomodules from rebar	0.0001	T	
1.	4.		Cavity displacement tolerance relative to cryomodule	+/-1	mm	Maximum
1.	4.		Cavity tilt tolerance relative to cryomodule	+/-1	mrad	Maximum
1.	4.		Cryomodule alignment tolerance	+/-1	mm	Maximum
1.	4.		**SRF LINAC POWER COUPLERS**			
1.	4.		Power couplers per cavity	1		
1.	4.		Number of power couplers	93		
1.	4.		Maximum power of coupler	550	kW	
1.	4.		Power coupler design	KEK-B		
1.	4.		Power coupler vacuum	5.00E-09	Torr	
1.	4.		**SRF LINAC HOM COUPLERS**			
1.	4.		HOM couplers per cavity	2		
1.	4.		Number of HOM couplers	2 x 92		
1.	4.		HOM coupler design	TTF		
1.	4.		**SRF LINAC TUNERS**			
1.	4.		Number of tuners	93		
1.	4.		Tuner tuning rate	3000	Hz/min	
1.	4.		Tuner tuning range	+/-100	kHz	
1.	4.	12.	**SRF LINAC CYROPLANT**			
1.	4.	12.	Primary circuit temperature	2.1	K	
1.	4.	12.	Primary circuit pressure	0.041	bar	
1.	4.	12.	Primary circuit static load per review 9.12.00	900	W	
1.	4.	12.	Primary circuit dynamic load	500	W	
1.	4.	12.	Primary circuit capacity per review 9.12.00	2,800	W	
1.	4.	12.	Primary circuit margin	100	%	50 % @ 1.3GeV
1.	4.	12.	Secondary circuit temperature	5	K	
1.	4.	12.	Secondary circuit pressure	3	bar	
1.	4.	12.	Secondary circuit static load	5	g/s	
1.	4.	12.	Secondary circuit dynamic load	2.5	g/s	

1.	4.	12.		Secondary circuit capacity	15	g/s	
1.	4.	12.		Secondary circuit margin	100	%	
1.	4.	12.		Shield circuit temperature	35-55	K	
1.	4.	12.		Shield circuit pressure	4.0-3.0	bar	
1.	4.	12.		Shield circuit static load	5530	W	
1.	4.	12.		Shield circuit dynamic load	0	W	
1.	4.	12.		Shield circuit capacity	8300	W	
1.	4.	12.		Shield circuit margin	50	W	
1.	4.	9.		**SRF LINAC FOCUSING QUADRUPOLES**			
1.	4.	9.		Lattice	warm doublets		
1.	4.	9.		Number of quadrupole singlets	52		Additional quads to HEBT understudy
1.	4.	9.		Aperture diameter	8	cm	
1.	4.	9.		Maximum outer diameter	0.55	m	
1.	4.	9.		Iron core length	0.35	m	
1.	4.	9.		Effective length	0.41	m	
1.	4.	9.		Max pole tip field	0.3	T	
1.	4.	9.		Max gradient	7.2	T/m	
1.	4.	9.		Max integrated gradient	2.98	T	
1.	4.	5.		**SRF LINAC DIAGNOSTICS**			
1.	4.	5.		Number of beam position and phase monitors	32		
1.	4.	5.		Number of beam loss monitors	64		
1.	4.	5.		Number of current monitors	3		
1.	4.	5.		Number of wire scanners	32		
1.	4.	1.		**RF POWER SYSTEMS**			
1.	4.	1.		Modulator type	IGBT		
1.	4.	1.		402.5 MHz klystron peak RF power	2.5	MW	Includes 25 % control margin
1.	4.	1.		Number of RFQ 402.5 MHz klystrons	1		
1.	4.	1.		Number of 402.5 MHz klystrons per DTL tank	1		
1.	4.	1.		Number of DTL 402.5 MHz klystrons	6		
1.	4.	1.		Total number of 402.5 MHz klystrons	7		
1.	4.	1.		Number of 402.5 MHz klystrons per transmitter	1		
1.	4.	1.		Number of 402.5 MHz klystrons per modulator	2		
1.	4.	1.		Number of 402.5 MHz circulators	7		
1.	4.	1.		402.5 MHz klystron efficiency	58	%	
1.	4.	1.		402.5 MHz klystron average RF power	0.175	MW	
1.	4.	1.		402.5 MHz RF field tilt rms tolerance in tank	0.06	%	
1.	4.	1.		805 MHz CCL klystron peak power	5	MW	Includes 25 % control margin
1.	4.	1.		Number of 805 MHz klystrons per CCL module	1		
1.	4.	1.		Number of CCL 805 MHz klystrons	4		
1.	4.	1.		Number of 5 MW HEBT 805 MHz klystrons	2		
1.	4.	1.		Number of 805 MHz klystrons per transmitter	1		
1.	4.	1.		Number of 805 MHz klystrons per modulator	2		
1.	4.	1.		Number of 805 MHz circulators	6		
1.	4.	1.		805 MHz 5 MW klystron efficiency	55	%	
1.	4.	1.		SRF klystron peak power	0.55	MW	Includes 33 % control margin
1.	4.	1.		Number of SRF cavities per klystron	1		
1.	4.	1.		Number of SRFL 805 MHz klystrons	92		
1.	4.	1.		Number of SRF klystrons per transmitter	6 or 5		
1.	4.	1.		Number of SRF klystrons per HV power conditioner	12 or 11		
1.	4.	1.		Number of SRF klystron circulators	92		
1.	4.	1.		805 MHz klystron average RF power	0.35	MW	
1.	4.	1.		805 MHz 550 KW klystron efficiency	63	%	
1.	4.	1.		RF module phase dynamic rms tolerance	0.5	deg	Limit +/- 0.75 deg
1.	4.	1.		RF module amplitude dynamic rms tolerance	0.5	%	Limit +/- 0.75 deg
1.	4.	1.		RF module phase static rms tolerance	1	deg	Limit +/- 1.0 deg
1.	4.	1.		RF module amplitude static rms tolerance	0.6	%	Limit +/- 1.0 %
1.	4.	1.		RF segment amplitude static rms tolerance	0.6	%	Limit +/- 1.0 %
1.	4.	1.		RF field response time	100	us	depends on DTL CCL Nb linac
1.	4.	1.	x	Klystron gallery width x height	30x20	ft	
1.	5.	1.		**HEBT BEAM LINE**			
1.	5.	1.	x	Total HEBT length	169.49	m	Diff pumping to inj septum center
1.	5.	1.	x	Length of additional linac dump beam line	42	m	

1.	5.	1.	x	Length of linac to achromat matching section LAMS	40	m	
1.	5.	1.	x	Number of LAMS FODO cells	5.0		8.0 m per FODO cell
1.	5.	1.	x	Length of achromat	59	m	
1.	5.	1.	x	Number of achromat FODO cells	4		14.0 m per FODO cell
1.	5.	1.	x	Achromat total bend angle	90	deg	
1.	5.	1.	x	Achromat maximum dispersion	6.8	m	
1.	5.	1.	x	Length of achromat to ring matching section ARMS	70	m	
1.	5.	1.	x	Number of ARMS FODO cells	7.5		8.0 m per FODO cell
1.	5.	1.		Number of Ludewig betatron collimators	2		
1.	5.	1.		Number of betatron foil collimators	2		
1.	5.	1.		Location of momentum collimator	achromat center		
1.	5.	1.	x	Rms energy spread at achromat center	0.72	MeV	
1.	5.	1.	x	Energy scrape with momentum collimator	+/- 3.0	MeV	
1.	5.	1.	x	Energy total jitter before energy corrector	+/- 2.2	MeV	Under study
1.	5.	1.	x	Energy total jitter after energy corrector	+/- 0.2	MeV	
1.	5.	1.	x	Rms energy spread before energy spreader	0.85	MeV	
1.	5.	1.	x	Total time ave energy spread at foil	+/- 4.0	MeV	
1.	5.	1.	x	Number of energy sweeps per macropulse	100		
1.	5.	1.	x	Simulated output H&V rms norm emittance w/ errors and wo/ jitter	0.41	pi-mm-mrad	Under study
1.	5.	1.	x	Simulated output transverse centroid jitter +/-	0.20	mm	Under study
1.	5.	1.	x	Simulated output H&V rms norm emittance w/ errors and w/ jitter	0.50	pi-mm-mrad	Under study
1.	5.	1.		Foil H Twiss beta	8.75	m	
1.	5.	1.		Foil H Twiss alpha	0.058		
1.	5.	1.		Foil V Twiss beta	13.25	m	
1.	5.	1.		Foil V Twiss alpha	0.039		
1.	5.	1.	x	Tunnel width x height	17x18	ft	Crane hook at 10 ft 3 in
1.	5.	1.	x	Beam-floor distance	50.0	in	
1.	5.	1.	x	Operating vacuum pressure	5E-8 to 1E-8	Torr	From SRFL to Ring
1.	5.	1.		**HEBT MAGNETS**			
1.	5.	1.		Number of 11.25 deg C type dipoles	8		
1.	5.	1.		11.25 deg dipole field	0.21	T	
1.	5.	1.		11.25 deg dipole gap	8	cm	
1.	5.	1.		11.25 deg dipole length	5.3	m	
1.	5.	1.		Number of 7.5 deg dipoles	1		
1.	5.	1.		7.5 deg dipole field	0.21	T	
1.	5.	1.		7.5 deg dipole gap	8	cm	
1.	5.	1.		7.5 deg dipole length	3.55	m	
1.	5.	1.		Number of 12 cm bore quadrupoles	31		25 (HEBT) + 6 (linac dump)
1.	5.	1.		12 cm bore quad gradient	5.5	T/m	
1.	5.	1.		12 cm bore quad length	0.5	m	
1.	5.	1.		Number of 21 cm bore quadrupoles	9		Same as ring quads
1.	5.	1.		21 cm bore quad gradient	3	T/m	
1.	5.	1.		21 cm bore quad length	0..5	m	
1.	5.	1.		Number of 26.4 cm bore injection dump quadruples	1		
1.	5.	1.		Injection dump quad gradient	3.6	T/m	
1.	5.	1.		Injection dump quad length	0.4	m	
1.	5.	1.		Number of 12x12 cm dipole correctors	12		
1.	5.	1.		12x12 cm corr length	0.2	m	
1.	5.	1.		12x12 cm corr field	0.03	T	
1.	5.	1.		Number of 24x24 cm correctors	5		
1.	5.	1.		24x24 cm corr length	0.3	m	
1.	5.	1.		24x24 cm corr field	0.02	T	
1.	5.	1.		Dipole magnetic field errors +/-	0.01	%	Integrated at full acceptance
1.	5.	1.		Quadrupole magnetic field errors +/-	0.1	%	Integrated at full acceptance
1.	5.	1.		Dipole corrector magnetic field errors +/-	1.0	%	Integrated at full acceptance
1.	5.	1.		Magnet translation rms alignment tolerance	0.1	mm	
1.	5.	1.		Magnet pitch and yaw rms alignment tolerance	1	mrad	
1.	5.	1.		Magnet rotation rms alignment tolerance	2	mrad	
1.	5.	1.		Number of dipole ps	3		700 A and 40,40,150 V
1.	5.	1.		Number of quadrupole ps	26		200-800 A and 15-60 V
1.	5.	1.		Number of corrector bipolar PS	36		20 A and 30 V
1.	4.	5.		**HEBT RF CAVITIES**			
1.	4.	5.	x	Number energy corrector cavities	1		
1.	4.	5.	x	Energy corrector cavity location	92	m	From the linac

1.	4.	5.	x	Energy corrector frequency	805	MHz	Same as CCL
1.	4.	5.	x	Energy corrector aperture dia	4.8	cm	
1.	4.	5.	x	Energy corrector peak voltage EoTL	4	MV	
1.	4.	5.	x	Energy corrector length	1.14	m	7 accelerating cells
1.	4.	5.	x	Energy corrector RF requirement	0.4	MW	
1.	4.	5.	x	Number energy spreader cavities	1		
1.	4.	5.	x	Energy spreader cavity location	140	m	From the linac
1.	4.	5.	x	Energy spreader frequency	805.0 +/- 0.1	MHz	Same as CCL
1.	4.	5.	x	Energy spreader aperture dia	4.8	cm	
1.	4.	5.	x	Energy spreader peak voltage EoTL	4	MV	
1.	4.	5.	x	Energy spreader length	1.14	m	7 accelerating cells
1.	4.	5.	x	Energy spreader RF requirement	0.4	MW	
1.	5.	7.		**HEBT DIAGNOSTICS**			
1.	5.	7.		Number of beam position and phase monitors	22		
1.	5.	7.		Number of beam loss monitors	40		
1.	5.	7.		Number of current monitors	5		
1.	5.	7.		Number of wire scanners	11		
1.	5.	7.		Number of harps	2		
1.	5.	7.		Number of beam in gap monitors	1		
1.	5.	7.		Number of phase width monitors	1		
1.	5.			**ACCUMULATOR RING**			
1.	5.		x	Proton magnetic rigidity	5.6575	Tm	
1.	5.		x	Max uncontrolled ring beam loss	0.01	%	1 nA/m
1.	5.		x	Unnormalized 99% emittance	160	pi-mm-mrad	347 pi-mm-mrad normalized
1.	5.			Ring betatron acceptance	480	pi-mm-mrad	
1.	5.			Collimator acceptance	225-240	pi-mm-mrad	Under study
1.	5.			Expected momentum acceptance	+/- 1.0		
1.	5.			Full beam momentum acceptance	+/- 2.0	%	
1.	5.			Zero betatron amplitude momentum acceptance	+/- 3.8	%	
1.	5.			Bunching factor	0.44		Dual harmonic RF
1.	5.			Space charge uniform-beam Laslett tune shift	0.14		No wall impedance
1.	5.		x	Ring circumference	248	m	
1.	5.		x	Average radius	39.47	m	
1.	5.		x	Lattice superperiods	4		
1.	5.			Max dispersion in straight sections	<10	cm	
1.	5.			Arc lattice	4 FODO cells		
1.	5.			Arc FODO cell length	8	m	
1.	5.			Drift in arc FODO cells	2x1	m	
1.	5.			Straight section lattice	2 doublets		
1.	5.			Short drift in long straights	2X6.85	m	
1.	5.			Long drift in long straights	12.5	m	
1.	5.			Phase advance per arc FODO cell	90	deg	
1.	5.			Nominal betatron H tune	6.32		Design tunes 5.8-6.3
1.	5.			Nominal betatron V tune	5.80		Design tunes 4.8-5.8
1.	5.			Transition gamma	5.25		
1.	5.			Frequency slip factor	-0.198		
1.	5.			Natural H chromaticity	-7.7		
1.	5.			Natural V chromaticity	-6.4		
1.	5.			Maximum dispersion function	3.7	m	Nominal tunes
1.	5.			Maximum H/V Twiss beta	27/13	m	Nominal tunes
1.	5.			Electron bounce frequency from proton charge	100-175	MHz	
1.	5.		x	Ring tunnel width x height	17x18	ft	Crane hook at 10 ft 3 in
1.	5.		x	Offset for injection painting V dynamic bump	4.6	cm	
1.	5.		x	Ring V beamline offset wrt HEBT beamline	-4.6	cm	
1.	5.		x	Ring beam-floor distance	48.2	in	
1.	5.		x	Offset for injection painting H dynamic bump	4.0	cm	
1.	5.		x	Offset for injection H static bump	10.0	cm	
1.	5.		x	Ring H beamline offset wrt HEBT beamline	14.0	cm	
1.	5.	2.		**RING INJECTION SYSTEM**			
1.	5.	2.		Foil size HxV	4x8	mm	3 open sides
1.	5.	2.		Foil thickness	300	ug/cm2	
1.	5.	2.		Linac beam missing foil	2	%	
1.	5.	2.		Neutral Ho beam from foil	2	%	H- beam is negligible
1.	5.	2.		Stripped electron beam power	2	kW	

1.	5.	2.	Stripped electron radius	1.2	cm	B=0.25 T
1.	5.	2.	Stripped electron beam dump	copper		Water cooled Cu block
1.	5.	2.	Transverse painting scheme	correlated		Understudy
1.	5.	2.	Average foil hits per proton	6		Understudy
1.	5.	2.	Number of H and V in-ring kicker magnets	4 and 4		
1.	5.	2.	Kicker magnet time constant	300	us	
1.	5.	2.	Kicker HxV aperture	20.6 X 23.5	cm	Picture frame outside vacuum
1.	5.	2.	Long kicker max horizontal kick angle	9.5	mrad	
1.	5.	2.	Short kicker max horizontal kick angle	1.0	mrad	
1.	5.	2.	Long kicker max vertical kick angle	6.7	mrad	
1.	5.	2.	Short kicker max vertical kick angle	0.4	mrad	
1.	5.	2.	Long kicker max horizontal magnetic field	0.79	T	
1.	5.	2.	Short kicker max horizontal magnetic field	0.16	T	
1.	5.	2.	Long kicker max vertical magnetic field	0.56	T	
1.	5.	2.	Short kicker max vertical magnetic field	0.06	T	
1.	5.	2.	Long kicker core length	0.48	m	
1.	5.	2.	Short kicker core length	0.16	m	
1.	5.	2.	Long kicker effective length	0.68	m	
1.	5.	2.	Short kicker effective length	0.35	m	
1.	5.	2.	Number of injection kicker ps	8		110A-100V to 1400A-800V
1.	5.	2.	Programmable injection kicker ps	yes		
1.	5.	2.	Number of dc in-ring horizontal bump magnets	4		IDH1-IDH4
1.	5.	2.	IDH1 bending angle	42	mrad	
1.	5.	2.	IDH1 HxV aperture	18.0 x 23.6	cm	Septum
1.	5.	2.	IDH1 effective magnetic length	0.863	m	
1.	5.	2.	IDH1 core length	0.572	m	
1.	5.	2.	IDH1 magnetic field	0.33	T	PS for 0.275 T
1.	5.	2.	IDh2 bending angle	46.2	mrad	
1.	5.	2.	IDH2 HxV aperture	17.0 x 23.6	cm	C magnet
1.	5.	2.	IDH2 magnetic effective length	0.872	m	
1.	5.	2.	IDH2 core length	0.572	m	
1.	5.	2.	IDH2 magnetic field	0.30	T	PS for 0.30 T
1.	5.	2.	IDH3 bending angle	42	mrad	
1.	5.	2.	IDH3 HxV aperture	22.0 x 23.6	cm	C magnet
1.	5.	2.	IDH3 magnetic effective length	0.99	m	
1.	5.	2.	IDH3 core length	0.69	m	
1.	5.	2.	IDH3 magnetic field	0.24	T	PS for 0.24 T
1.	5.	2.	IDH4 bending angle	46.2	mrad	
1.	5.	2.	IDH4 HxV aperture	38.0 x 23.6	cm	C magnet
1.	5.	2.	IDH4 magnetic effective length	0.89	m	
1.	5.	2.	IDH4 core length	0.514	m	
1.	5.	2.	IDH4 magnetic field	0.36	T	PS for 0.294 T
1.	5.	2.	Injection septum bend angle	110.8	mrad	
1.	5.	2.	Injection septum HxV aperture	6.2 x 7.4	cm	
1.	5.	2.	Injection septum magnetic length	3.00	m	
1.	5.	2.	Injection septum core length	2.93	m	
1.	5.	2.	Injection septum magnetic field	0.25	T	PS for 0.208 T
1.	5.	2.	Injection septum thickness	1.0	cm	
1.	5.	2.	Injection dump septum bend angle	100	mrad	
1.	5.	2.	Injection dump septum VxH aperture	16.5 x 6.2	cm	
1.	5.	2.	Injection dump septum magnetic length	1.80	m	
1.	5.	2.	Injection dump septum core length	1.54	m	
1.	5.	2.	Injection dump septum magnetic field	0.37	T	PS for 0.31 T
1.	5.	2.	Injection dump septum thickness	1.0	cm	
1.	5.	2.	Injection dipole magnetic field errors +/-	0.1	%	Integrated at full acceptance
1.	5.	2.	Injection kicker field errors +/-	1.0	%	Integrated at full acceptance
1.	5.	2.	Number of injection dc ps (4 dip, 2 sept, 1 quad)	7		820-4000 A and ~20 V
1.	5.	2.	Number of corr ps	2		20 A and 30 V
1.	5.	3.	**RING MAGNET SYSTEM**			
1.	5.	3.	Core material	1006 steel		Solid core
1.	5.	3.	Number of H frame sector dipoles	32		33 w/ reference dipole
1.	5.	3.	Dipole magnetic field	0.7935	T	
1.	5.	3.	Dipole bend angle	11.25	deg	Bending radius = 7.996 m
1.	5.	3.	Dipole gap	17	cm	HGFW = 23 cm
1.	5.	3.	Dipole pole width	45	cm	
1.	5.	3.	Dipole magnetic path length	1.4	m	
1.	5.	3.	Dipole radius of curvature	7.6394	m	

1.	5.	3.		Dipole sigitta	3.85	cm	
1.	5.	3.		Dipole magnetic field tolerance	+/ -0.0001		
1.	5.	3.		Number of arc regular quadrupoles	28		
1.	5.	3.		Bore of arc regular quads	21.0	cm	
1.	5.	3.		Magnetic length of arc regular quads	0.50	m	
1.	5.	3.		Magnetic gradient of arc regular quads	4.7-5.6	T/m	
1.	5.	3.		Maximum poletip field of arc regular quads	0.49-0.59	T	
1.	5.	3.		Number of arc large quadrupoles	8		
1.	5.	3.		Bore of arc large quads	26.4	cm	
1.	5.	3.		Magnetic length of arc large quads	0.50	m	
1.	5.	3.		Magnetic gradient of arc large quads	4.7-5.6	T/m	
1.	5.	3.		Maximum poletip field of arc large quads	0.61-0.73	T	
1.	5.	3.		Number of straight section long quadrupoles	8		
1.	5.	3.		Bore of straight section long quads	30.0	cm	
1.	5.	3.		Magnetic length of straight section long quads	0.70	m	
1.	5.	3.		Magnetic gradient of straight section long quads	4.3-5.2	T/m	
1.	5.	3.		Maximum poletip field of straight section long quads	0.65-0.78	T	
1.	5.	3.		Number of straight section short quadrupoles	8		
1.	5.	3.		Bore of straight section short quads	30.0	cm	
1.	5.	3.		Magnetic length of straight section short quads	0.55	m	
1.	5.	3.		Magnetic gradient of straight section short quads	4.3-5.2	T/m	
1.	5.	3.		Maximum poletip field of straight section short quads	0.65-0.78	T	
1.	5.	3.		Number of 24x24 cm dipole and multipole correctors	28		
1.	5.	3.		24x24 cm corrector length	0.3	m	
1.	5.	3.		24x24 cm corrector field	0.02	T	
1.	5.	3.		Number of 26x26 cm correctors	8		
1.	5.	3.		26x26 cm corrector length	0.3	m	
1.	5.	3.		26x26 cm corrector field	0.02	T	
1.	5.	3.		Number of 31x31 cm correctors	8		
1.	5.	3.		31x31 cm corrector length	0.3	m	
1.	5.	3.		31x31 cm corrector field	0.02	T	
1.	5.	3.		Ring dipole magnetic field errors +/-	0.01	%	Integrated at full acceptance
1.	5.	3.		Ring quadrupole magnetic field errors +/-	0.01	%	Integrated at full acceptance
1.	5.	3.		Chromaticity sextupoles +/1	1.0	%	Integrated at full acceptance
1.	5.	3.		Dipole, quad, skew quad, sext, skew sext, oct, skew oct magnetic field errors +/-	1.0	%	Integrated at full acceptance
1.	5.	3.		Poletip machining tolerance	+/- 0.05	mm	
1.	5.	3.		Poletip mating tolerance	+/- 0.05	mm	
1.	5.	3.		Quad displacement rms alignment tolerance	0.1	mm	
1.	5.	3.		Dipole roll rms alignment tolerance	0.2	mrad	
1.	5.	3.		Magnet translation rms alignment tolerance	0.1	mm	
1.	5.	3.		Magnet pitch rms alignment tolerance	0.2	mrad	
1.	5.	3.		Magnet yaw rms alignment tolerance	0.5	mrad	
1.	5.	3.		Magnet rotation rms alignment tolerance	0.2	mrad	
1.	5.	3.		Magnet twist rms tolerance	0.5	mrad	
1.	5.	4.		**RING POWER SUPPLIES**			
1.	5.	4.		Dipole primary ps	4600	A	400 V
1.	5.	4.		Quadrupole primary ps QV1	900	A	300 V
1.	5.	4.		Quadrupole primary ps QH2	900	A	500 V
1.	5.	4.		Quadrupole primary ps QH3	900	A	350 V
1.	5.	4.		Quadrupole primary ps QV11	1000	A	300 V
1.	5.	4.		Quadrupole primary ps QH10	1000	A	350 V
1.	5.	4.		Number of dipole and sext corr bipolar PS	56		20 A and 30 V
1.	5.	4.		Number of skew quad and oct corr ps	18		20 A and 60 V
1.	5.	4.		Number of quad corr ps	7		50 A and 30 V
1.	5.	5.		**RING VACUUM SYSTEM**			
1.	5.	5.	x	Average operating vacuum pressure	1.0E-08	Torr	
1.	5.	5.		Chamber material	Stainless steel		TiN coating
1.	5.	6.		**RING RF SYSTEM**			
1.	5.	6.		RF system type	1st and 2nd harm		
1.	5.	6.	x	Total Injected energy spread	+/- 4	MeV	
1.	5.	6.	x	Total extracted energy spread	+/- 10	MeV	
1.	5.	6.		Bucket area	17	eV-sec	
1.	5.	6.		Bunch area with 250ns gap	10	eV-sec	Wo/ space charge or parasitics
1.	5.	6.		Cavity length	1.7	m	

1.	5.	6.		Accelerating gaps per cavity	2		
1.	5.	6.		1st harmonic frequency	1.188	MHz	
1.	5.	6.		Number 1st harmonic cavities	3		
1.	5.	6.		Voltage per first harmonic gap	6.7	kV	
1.	5.	6.		Total 1st harmonic voltage per turn	40	kV	
1.	5.	6.	x	2nd harmonic frequency	2.376	MHz	
1.	5.	6.		Number of 2nd harmonic cavities	1		
1.	5.	6.		Voltage per 2nd harmonic gap	10	kV	
1.	5.	6.		Total 2nd harmonic voltage per turn	20	kV	
1.	5.	6.	x	Beam current 1st harmonic amplitude	52	A	
1.	5.	6.		Beam current 2nd amplitude	4	A	
1.	5.	6.		Peak bunched beam current	96	A	
1.	5.	6.		Space charge L impedance iZ/n	150	Ohms	
1.	5.	6.		Broad band L wall resistance	50	Ohms	
1.	5.	6.		Ferrite material	Phillips 4M2		
1.	5.	6.		Beam loading compensation	feed forward		
1.	5.	6.		Phase loop bandwidth	5-30	kHz	
1.	5.	6.		Gain loop bandwidth	5-30	kHz	
1.	5.	6.		RF tube	Thompson 558		
1.	5.	6.		Anode charging PS voltage	15	kV	DC
1.	5.	6.		Anode charging PS current	3.33	A	Average
1.	5.	6.		Anode charging PS regulation	0.5	%	
1.	5.	6.		Anode charging PS ripple	0.3	%	Peak to peak
1.	5.	6.		Screen PS voltage	2	kV	DC
1.	5.	6.		Screen PS current	2	A	Average
1.	5.	6.		Screen PS regulation	0.2	%	
1.	5.	6.		Screen PS ripple	0.3	%	Peak to peak
1.	5.	7.		**RING DIAGNOSTICS**			
1.	5.	7.		Number of beam position monitors	44		Striplines at each quad
1.	5.	7.		Number of beam loss monitors	119		Fast and slow monitors
1.	5.	7.		Number of beam current monitors	2		
1.	5.	7.		Number of wire scanners	1		
1.	5.	7.		Number of foil video monitors	1		
1.	5.	7.		Number of beam in gap monitors	1		Kicker and detector
1.	5.	7.		Number of ionization profile monitors	1		Residual gas ionization monitor
1.	5.	7.		Number of tune measurement systems	1		Kicker excited and FFT analyzed
1.	5.	8.		**RING COLLIMATION**			
1.	5.	8.		Number of scrapers	1		
1.	5.	8.		Number of Ludewig type collimators	3		7 total Ludewig type collimators
1.	5.	8.		Halo attenuation factor in Ludewig collimator	10,000:1		
1.	5.	8.		Halo attenuation factor in ring	20:1		For 480 pi mm mrad acceptance
1.	5.	8.		Power absorption capacity per collimator	20	kW	
1.	5.	8.		Total mass per collimator	35	metric tons	
1.	5.	9.		**RING EXTRACTION**			
1.	5.	9.	x	Extraction type	single turn		Fast kicker and Lambertson
1.	5.	9.	x	Beam extraction time gap	250	ns	
1.	5.	9.	x	Kicker rise time	200	ns	0 to 97%
1.	5.	9.		Kicker flattop time	700	ns	
1.	5.	9.		Number of fast ferrite kicker sections	14		
1.	5.	9.		Kicker vertical downward deflection angles	1.16 -1.65	mrad	Full aperture kickers
1.	5.	9.		Kicker integral field	6400 - 9200	Gauss cm	
1.	5.	9.		Kicker horizontal gaps	14.3 - 19.5	cm	
1.	5.	9.		Kicker vertical gaps	13.1 - 25.0	cm	
1.	5.	9.		Kicker core length per section	40	cm	Core spacing 8 cm
1.	5.	9.		Kicker total length	2 x 3.28	m	
1.	5.	9.		Vertical displacement at Lambertson entrance	16.8	cm	
1.	5.	9.		Beam extracts to target with 13 of 14 kickers inoperable	yes		
1.	5.	9.		Number of PFNs	14		
1.	5.	9.		Number of PFN ps	14		
1.	5.	9.		Lambertson horizontal bend angle	16.8	deg	
1.	5.	9.		Lambertson septum thickness	1	cm	
1.	5.	9.		Lambertson field free region HxV gap	30x14	cm	
1.	5.	9.		Lambertson core length	2.1	m	
1.	5.	9.		Lambertson magnetic field	0.8	T	
1.	5.	9.		Extraction Lambertson magnetic field errors +/-	0.1	%	Integrated at full acceptance

1.	5.	9.		Extraction Lambertson max residual field +/-	8	Gauss	Other table has 1 Gauss
1.	5.	9.		Extraction kicker field errors +/-	1.0	%	Integrated at full acceptance
1.	5.	9.		Lambertson PS	2000	A	20V dc
1.	5.	10.		**RTBT BEAM LINE**			
1.	5.	10.	x	Beam spot on target H x V	200 x 70	mm	
1.	5.	10.	x	Number of Ludewig betatron collimators	2		
1.	5.	10.	x	Target H Twiss beta	83	m	
1.	5.	10.	x	Target H Twiss alpha	0		
1.	5.	10.	x	Target V Twiss beta	10.2	m	
1.	5.	10.	x	Target V Twiss alpha	0		
1.	5.	10.	x	Beam line length	150.75	m	Lambertson center to target
1.	5.	10.	x	Number of 11.6 m FODO cells	15		
1.	5.	10.	x	Ring extraction dump beam line length	28	m	
1.	5.	10.	x	Tunnel width x height	17x18	ft	Crane hook at 10 ft 3 in
1.	5.	10.	x	Beam-floor distance	39.2 to 41.0	in	Start at 39.2 and end at 41.0
1.	5.	10.	x	RTBT elevation wrt ring	-0.2286	m	
1.	5.	10.	x	Operating vacuum pressure	1E-8 to 1E-7	Torr	From ring to target
1.	5.	10.		**RTBT MAGNETS**			
1.	5.	10.		Number of vertical dipoles	1		
1.	5.	10.		Vertical dipole gap	17	cm	
1.	5.	10.		Vertical dipole length	0.5	m	
1.	5.	10.		Vertical dipole field	0.25	T	
1.	5.	10.		Number of 17.0 deg H switcher dipoles	1		
1.	5.	10.		Switching dipole gap	17	cm	
1.	5.	10.		Switching dipole length	2.44	m	
1.	5.	10.		Switching dipole magnetic field	0.66	T	
1.	5.	10.		Number of 21 cm bore quads including 2 for dump	23		
1.	5.	10.		21 cm quad gradient	4.5	T/m	
1.	5.	10.		21 cm quad length	0.50	m	
1.	5.	10.		Number of 31 cm bore quads including 2 for dump	4		
1.	5.	10.		31 cm quad gradient	7.00	T/m	
1.	5.	10.		31 cm quad length	0.50	m	
1.	5.	10.		Number of 36 cm bore spreading quadrupoles	5		
1.	5.	10.		Spreading quad gradient	3	T/m	
1.	5.	10.		Spreading quad length	1.00	m	
1.	5.	10.		Number of 24 x 24 cm dipole correctors	16		
1.	5.	10.		24 x 24 cm corr length	0.3	m	
1.	5.	10.		24 x 24 cm corr field	0.02	T	
1.	5.	10.		Number of 36x36 cm spreading correctors	4		
1.	5.	10.		36x36 cm corr length	0.3	m	
1.	5.	10.		36x36 cm corr field	0.02	T	
1.	5.	10.		RTBT dipole magnetic field errors +/-	0.01	%	Integrated at full acceptance
1.	5.	10.		RTBT quadrupole magnetic field errors +/-	0.1	%	Integrated at full acceptance
1.	5.	10.		RTBT dipole corrector magnetic field errors +/-	1.0	%	Integrated at full acceptance
1.	5.	10.		Magnet translation rms alignment tolerance	0.1	mm	
1.	5.	10.		Magnet pitch and yaw rms alignment tolerance	1	mrad	
1.	5.	10.		Magnet rotation rms alignment tolerance	1	mrad	Extraction and RTBT
1.	5.	10.		Number of dipole PS	2		2000A-50V and 900A-80V
1.	5.	10.		Number of quadrupole PS	21		700A-50V to 800A-120V
1.	5.	10.		Number of corrector bipolar PS	32		20 A and 30 V
1.	5.	7.		**RTBT DIAGNOSTICS**			
1.	5.	7.		Number of beam position monitors	17		
1.	5.	7.		Number of beam loss monitors	57		
1.	5.	7.		Number of current toroids	5		
1.	5.	7.		Number of wire scanners	5		
1.	5.	7.		Number of harps	2		
1.	6.			**TARGET SYSTEMS**			
1.	6.		x	Number of target stations	1		
1.	6.		x	Number of neutron beam shutters	18		
1.	6.		x	Number of neutron beam lines	24		
1.	6.		x	Proton beam floor distance	78	inches	

1.	6.	4.		**TARGET VESSEL**			
1.	6.	4.		Material	316 SS		
1.	6.	4.		Atmosphere	He		At < 0.1 MPa
1.	6.	4.	x	Proton beam window material	Inconel 718		
1.	6.	4.	x	Proton beam window thickness	4.0	mm	
1.	6.	4.	x	Proton beam window coolant	light water		
1.	6.	4.	x	Proton beam window coolant thickness	1.5	mm	
1.	6.	1.		**TARGET ASSEMBLIES**			
1.	6.	1.	x	Front cross section of target VxH	104x 404	mm	
1.	6.	1.	x	Beam spot on target VxH	70x200	mm	
1.	6.	1.	x	Tolerance on beam centroid H&V	+/- 2	mm	
1.	6.	1.	x	Normal peak current density	0.25	A/m^2	
1.	6.	1.	x	Normal time ave power within beam spot	90	%	
1.	6.	1.	x	Time ave current density over beam spot	0.143	A/m^2	
1.	6.	1.	x	Normal single pulse peak density	2.57E+16	protons/m^2	
1.	6.	1.	x	Off normal single pulse density	3.2E+16	protons/m^2	For 2 pulses max
1.	6.	1.	x	Unscheduled beam off > 5s	50	per day	
1.	6.	1.	x	Unscheduled beam off >300 s	10	per day	
1.	6.	1.		Target material	Hg		Hg inventory < 2.0 cubic m
1.	6.	1.		Hg nominal operating temperature	60 - 90	deg C	
1.	6.	1.		Hg target nominal operating pressure	0.3	MPa	
1.	6.	1.		Hg power loading	1.2	MW	
1.	6.	1.		Shell material	316 SS LN		
1.	6.	1.		Shell temperature	<200	deg C	
1.	6.	1.		Shroud material	316 SS LN		
1.	6.	1.		Shroud cooling	light water		
1.	6.	1.		Target plug material	Fe-alloy water SS		
1.	6.	2.		**AMBIENT MODERATORS**			
1.	6.	2.	x	Number of moderators	1		
1.	6.	2.	x	Moderator material	light water		
1.	6.	2.	x	Position	below target		Upstream
1.	6.	2.		**CRYOGENIC MODERATORS**			
1.	6.	2.	x	Number	3		
1.	6.	2.	x	Moderator material	supercritical H		
1.	6.	2.	x	Position	2 above target and 1 downstream below		
1.	6.	2.	x	Viewed face	120 x 100	mm	
1.	6.	2.	x	Pre moderator	light water		
1.	6.	2.	x	Non grooved surfaces	yes		
1.	6.	2.	x	Poison upstream top only	Al clad Gd		
1.	6.	2.	x	Decoupler upstream top only	Cd		
1.	6.	3.		**REFLECTOR ASSEMBLIES**			
1.	6.	3.		Reflector material	Be / Pb		
1.	6.	3.		Configuration	nested cylinders		
1.	6.	3.		Coolant	heavy water		
1.	6.	3.		Outer diameter of Be	0.64	m	With heavy water
1.	6.	5.		**TARGET SYSTEM SHIELDING**			
1.	6.	5.	x	Number of single channel shutters	12		
1.	6.	5.	x	Number of multi channel shutters	6		
1.	6.	5.	x	Shutter configuration	ISIS type		Light water cooled
1.	6.	5.	x	Neutron HxV channel within single shutter	200 x 220	mm	
1.	6.	9.		**BEAM DUMPS**			
1.	6.	9.	x	Number of beam dumps	3		
1.	6.	9.	x	Minimum target diameter	300	mm	
1.	6.	9.	x	Tolerance on beam center	+/- 50	mm	
1.	6.	9.		Materials	Fe-alloy Cu SS		
1.	6.	9.		Cooling	light water		
1.	6.	9.		Atmosphere	He		At 0.1 MPa
1.	6.	9.		Reentrant	yes		
1.	6.	9.	x	Maximum single pulse energy	42	kJ	

1.	6.	9.		**LINAC DUMP**		
1.	6.	9.	x	Maximum power	33	kW
1.	6.	9.	x	Operational hours per year	500	hr
1.	6.	9.	x	Pulse length	0.1 to 1.0	ms
1.	6.	9.	x	Maximum horizontal beam size	60	mm
1.	6.	9.	x	Maximum vertical beam size	60	mm
1.	6.	9.		**RING INJECTION DUMP**		
1.	6.	9.	x	Maximum power	200	kW
1.	6.	9.	x	Operational hours per year	5000	hr
1.	6.	9.	x	Nominal pulse length	0.1 to 1.0	ms
1.	6.	9.	x	Maximum horizontal beam size	200	mm
1.	6.	9.	x	Maximum vertical beam size	100	mm
1.	6.	9.		**RING EXTRACTION DUMP**		
1.	6.	9.	x	Maximum power	33	kW
1.	6.	9.	x	Operational hours per year	500	hr
1.	6.	9.	x	Nominal pulse length	600	ns
1.	6.	9.	x	Maximum horizontal beam size	200	mm
1.	6.	9.	x	Maximum vertical beam size	200	mm
1.	7.			**NEUTRON INSTRUMENTATION (Reference Suite)**		
1.	7.	4.		**INSTRUMENT #1 High Resolution Backscattering Spectrometer**		
1.	7.	4.		Beam Line	2	
1.	7.	4.		Moderator location	top-upbeam	
1.	7.	4.		Moderator material	liquid H2	
1.	7.	4.		Moderator coupling	decoupled	
1.	7.	4.		Moderator-sample distance	84	m
1.	7.	5.		**INSTRUMENT #2 Magnetism Reflectometer**		
1.	7.	5.		Beam Line	4a	
1.	7.	5.		Moderator location	top downbeam	
1.	7.	5.		Moderator material	liquid H2	
1.	7.	5.		Moderator coupling	coupled	
1.	7.	5.		Moderator-sample distance	17	m
1.	7.	5.		Sample-detector distance	2	m
1.	7.	6.		**INSTRUMENT #3 Liquids Reflectometer**		
1.	7.	6.		Beam Line	4b	
1.	7.	6.		Moderator location	top downbeam	
1.	7.	6.		Moderator material	liquid H2	
1.	7.	6.		Moderator coupling	coupled	
1.	7.	6.		Moderator-sample distance	13	m
1.	7.	6.		Sample-detector distance	1.5	m
1.	7.	7.		**INSTRUMENT #4 - Chopper Spectrometer**	TBD	
1.	7.	8.		**INSTRUMENT #5 - SANS**	TBD	
1.	7.	9.		**INSTRUMENT #6 - Engineering Diffractometer**	TBD	
1.	7.	10.		**INSTRUMENT #7**	TBD	
1.	7.	11.		**INSTRUMENT #8**	TBD	
1.	7.	12.		**INSTRUMENT #9**	TBD	
1.	7.	13.		**INSTRUMENT #10**	TBD	
1.	7.			**NEUTRON INSTRUMENTATION**		
1.	7.	4.				High-resolution backscattering spect.
1.	7.	4.		**Beam Line**		
1.	7.	4.		**Moderator location**		
1.	7.	4.		**Moderator material**		
1.	7.	4.		**Moderator coupling**		
1.	7.	4.		**Moderator-sample distance**	m	
1.	7.	5.				Magnetism reflectometer
1.	7.	5.		**Beam Line**		
1.	7.	5.		**Moderator location**		

1.	7.	5.	**Moderator material**		
1.	7.	5.	**Moderator coupling**		
1.	7.	5.	**Moderator-sample distance**	m	
1.	7.	5.	**Sample-detector distance**	m	
1.	7.	6.			Liquids reflectometer
1.	7.	6.	**Beam Line**		
1.	7.	6.	**Moderator location**		
1.	7.	6.	**Moderator material**		
1.	7.	6.	**Moderator coupling**		
1.	7.	6.	**Moderator-sample distance**	m	
1.	7.	6.	**Sample-detector distance**	m	