Progress and Issues with VTS Upgrade

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FNAL SRF Meeting
March 23, 2009

VCTF Upgrade Plan

October 2008

ILCTA_IB1 Infrastructure for Vertical RF Cavity Tests

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Version 1.0

December 18, 2006

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Table 3: Estimates of number of cavity test cycles in a year for each upgrade scenario based on expected downtime causes. All numbers are given in days.

Scenario	IB1 Cryo system status	as-is			upgrade		
	#VTS cryostats	1		3	1		3
	#cavities in all available VTS cryostats	1	2	6	1	2	6
Downtime cause							
Cryo down		60	60	90	45	45	45
Pumps unavailable		24	24	36	0	0	10
LHe supply unavailable		12	12	20	0	0	10
VTS unavailable		15	15	25	15	15	25
holidays		10	10	10	10	10	10
Total down days		121	121	181	70	70	100
VTS test cycle		5	6	6	4	5	6
# tests		**48**	**80**	**180[a]**	**73**	**118**	**264**

[a]This scenario carries considerable risk because of the lack of a purification system to remove contamination introduced by three sub atmospheric test stands. The cryo downtime could be considerably higher than estimated.

Part of Fermilab SCRF Infrastructure DOE Review, Februarv 2007

4.3 Recommendations

1. Implement the full flow vacuum pump de-hydration and purification for the vertical Dewar as soon as possible. Consider if the existing slip stream purifier could be relocated into the Dewar return.

Increase possible test cycles from ~50/year to ~250/year

- **Two cavities per cryostat [9-cell elliptical]**
- **Improve cryogenic system and related infrastructure**
- **Add two Vertical Test Stand cryostats (VTS2&3)**

VTS2 Civil Construction Constraints

Maximum Testing Aperture Diameter

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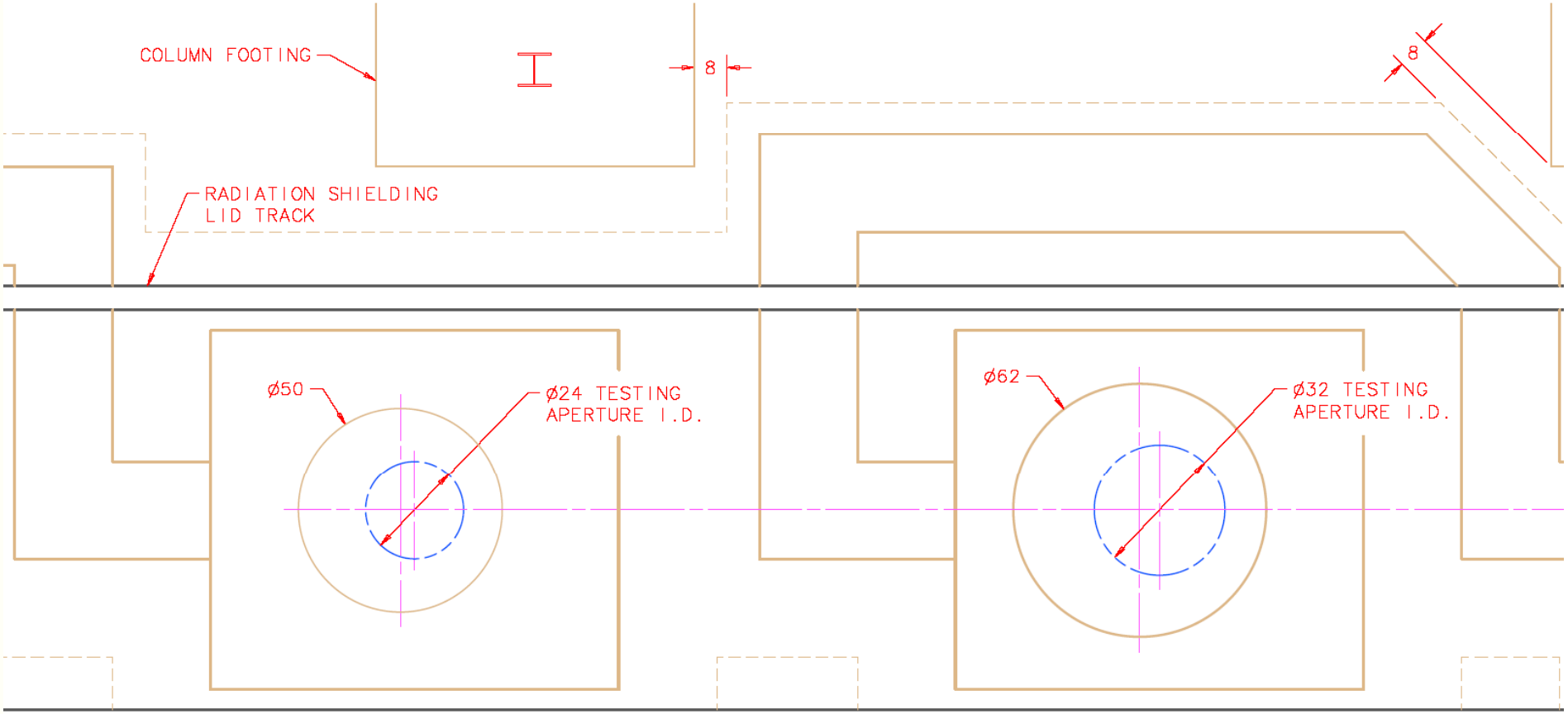
- **VTS1: 24 inches**
- **VTS2: Maximum 32 inches, constrained by rectangular pit dimensions**
  - **Building and shielding lid constraints**



VCTF Upgrade Cavity Requirements

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- Cavities to accommodate
  - ILC/SRF R&D
    - 9-cell and 1-cell elliptical ILC cavities
  - HINS/Project X
    - SSR1
    - SSR2
    - TSR
    - 9-cell elliptical cavities

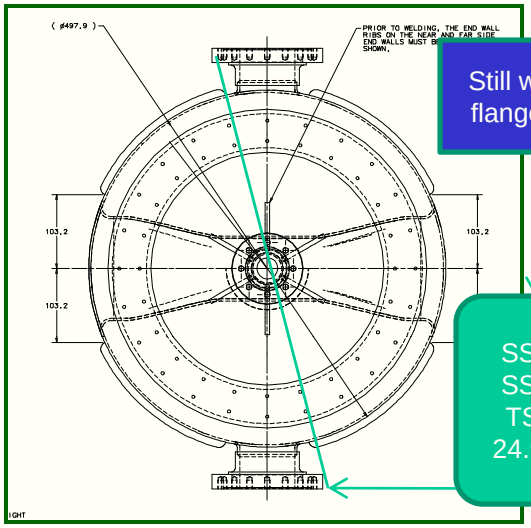
Do not fit in VTS1

- Conclusion
  - VTS1 is sufficient to support FY09, FY10 test plans
  - VTS2 with larger diameter operational by ~Dec. 2010 to support ~~SSR2, TSR, and~~ increased throughput
  - VTS3 needed by ~Sep. 2011

later

SSR1 fit in VTS – beam pipes have to be horizontal (SSR2 and TSR will not fit)

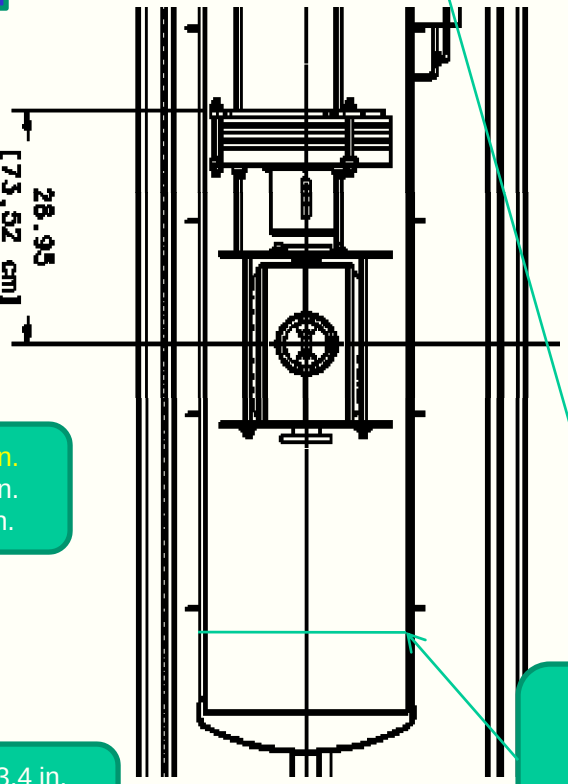
R.L. Wagner August 2008

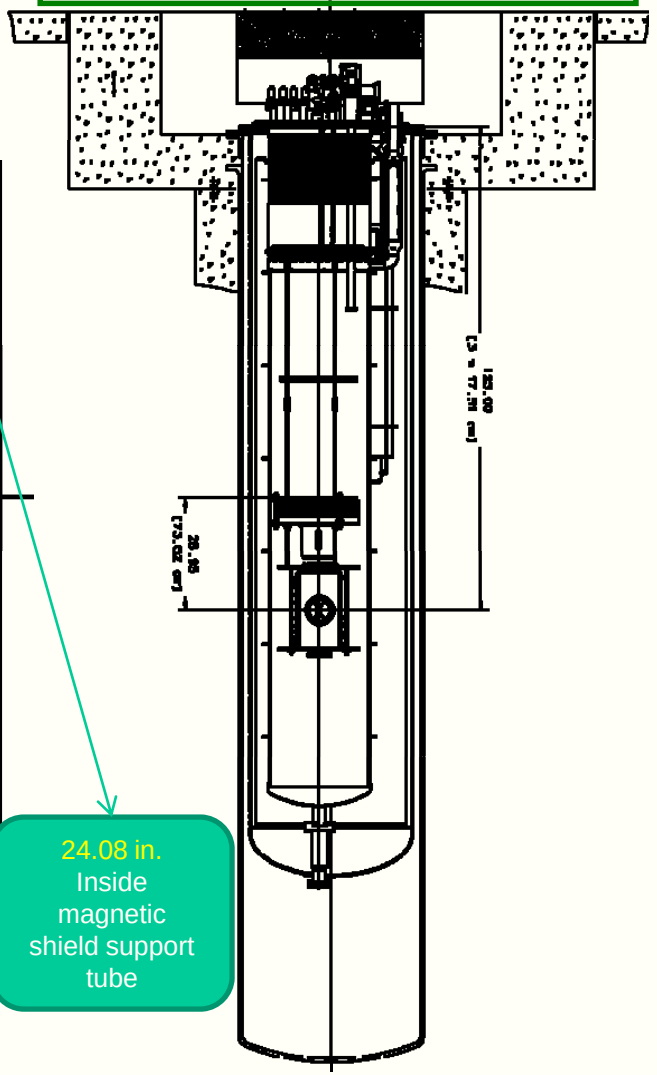


Still without flanges + ..

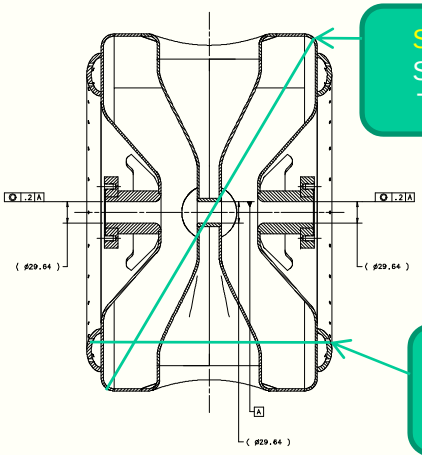
Guess: 30 in. allows for flanges plus right angle RF connections

SSR1
SSR2
TSR:
24.9 in.





SSR1: 22.4 in.
SSR2: 26.7 in.
TSR: 50.8 in.



SSR1: 13.4 in.
SSR2: 17.8 in.
TSR: 47.1 in.

24.08 in.
Inside
magnetic
shield support
tube

VTS2 Design Considerations

- **Shielding for field-emission induced radiation**
  - **VTS1 radiation shielding was designed for ILC 9-cell cavities**
    - **Ee(max)~50 MeV electrons, Ie(max) ~1 μA**
  - **Strongly prefer not to change movable shielding lid**
  - **Was sufficient for SSR1 with 200W amplifier and mounted with beam axis parallel to floor : Ee(max)~0.75 MeV, Ie(max)=0.27 mA**
  - **Study needed for vertically mounted spoke resonators SSR2 and TSR**
  - **Radiation shielding calculation must be updated if the cryostat diameter and/or cavity depth change**
  - **Mechanical support issues must be considered**
- **Magnetic shielding**
  - **Calculation must be updated for different shield geometry**
    - **For 325 MHz cavities, Rs due to remanent magnetic field is less than that of 1.3 GHz cavities by factor ~1/√f =½**
    - **Larger diameter implies longer shield and deeper cavity or other mitigation for end field penetration**
  - **Mechanical support issues must be considered**
- **Pressure Relief**
  - **The VTS1 cryostat pressure relief is adequate to handle a catastrophic loss of vacuum to air for two 9-cell ILC cavities.**
  - **The VTS2 pressure relief calculation must be revised for a larger diameter cryostat and a larger TSR surface cavity.**

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Upper limit based on FNAL educated guess

I.I. estimates in progress

FNAL estimates in progress

VTS2 Collaboration Status

- **Many meetings with Indian Institution (I.I.) colleagues since kickoff meeting Jan.22**
- **Current expectation:**
  1. **Indian Institutions to develop the design of VTS, based on the design specification FNAL provides.**
  2. **After the design is complete FNAL conducts design review.**
  3. **After successful review, FNAL to place an order with US vendor for VTS2 using this design. I.I. to participate in this fabrication, installation and commissioning of VTS2.**
  4. **I.I. to order VTS3 for Fermilab and VTS1 and 2 for Indian Institutions based on the design agreed upon in 2.**
  5. **FNAL provides design specification, drawings etc. for the RF/DAQ system to make a VTS system operational in India. [agreed with JLab] I.I. to learn VTS operation through participation in VTS work at Fermilab. [waiting on visas] FNAL will not build or purchase RF/DAQ system components for I.I. I.I. are free to purchase them from US industries using their manpower but resources from the Fermilab-Indian Institution fund.**

Status of VTS2 design work

- Nth iteration of cryostat spec – FNAL close to releasing doc to I.I.
- I.I. have provided preliminary magnetic shielding calculations and ANSYS model
- Lots of discussion about I.I. provision of detail drawings
- Given uncertainty of VTS 2 test objects, philosophy:
  - Vacuum vessel and helium dewar must be "final"
    - Pressure relief system, mechanical load (top flange)
  - Top plate and internal radiation shielding are somewhat modifiable later
- We are designing for:
  - Two 9-cell cavities or two 1-cell cavities or one SSR1 or one SSR2 (current design) or one TSR (current design)
    - We use existing estimates and assume a large error bar
      - Estimates for SSR2 and TSR from Leo. Ristori
      - May have to have closed cavity vacuum (no pumping line) for TSR
  - …leaving open the possibility to test >2 9-cell cavities