HLRF 072706

- Agenda
  - Vancouver Summary
  - Plenary proposals for ACD for cost reduction R&D
  - Single Tunnel Impact
  - Future work
    - ACD proposals
    - Costs
    - R&D Report

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- Vancouver Summary
  - HLRF Costs deemed completed in session with Cost Engineers
  - Did we use Risk Table correctly?
  - Found missing reference in Distribution spread sheet, 15% low number
    - Large costs from Asia partly due to taking only 15% discount for full quantities
  - Damping Ring estimates not shown by DR group; communications problem
    - Cost secrecy hinders communications
  - In Plenary HLRF summary suggested formalizing ACD for klystron & distribution
  - Garbincius requests response on impact of single tunnel – Preliminary done, August 15th for more studied response

ACD Breakout Discussion

- S. Fukuda on 36 beam MBK klystron
  - 50KV design would not be cheaper than 10MW tube, but has advantages for modulator
  - 50kV easier than 120kV
  - Modification of Marx from 120 to 50 kV would have advantages but would not save parts (power is constant, lower V, higher I)
  - Marx already takes credit for these savings
  - Sheet Beam (SBK) claims potential 2X cost reduction, smaller size and weight (no solenoid)
- Distribution
  - New design seeks to eliminate cavity circulators, go to simpler phase shifter than 3-stub tuner
  - Needs extensive modeling, fault analysis, prototyping
- Urged R&D funds for SBK, Distribution on basis of 2X potential cost savings

1-Tunnel Impact

- Attached breakout discussion preliminary results sent to Garbincius
- More complete response requested by August 15th.

HLRF Single Tunnel Options

HLRF Breakouts
Vancouver GDE Meeting
Friday July 21 2006
R. Larsen for HLRF Team

3 Scenarios +1

- 1. All BCD in single tunnel, no alcoves
- 2. BCD Mod, LLRF in single tunnel alcoves every 5 km.
- 3. Marx in tunnel
- 4. All ACD Big 3 in single tunnel

1. All BCD in 1- Tunnel No Alcoves

- Assumptions
  - Radiation damage from dark current is not a risk or can be controlled by shielding.
  - Tunnel can be sized to accommodate all components with acceptable clearances and working spaces
- Klystrons, power supplies, charger, modulator and LLRF
  - Design with HA so most units will last for mission time of 9 months.
  - Can be accomplished providing High Availability architectures used throughout
  - Significant cost penalty to make Bouncer Mod into HA.
  - Minimal impact using Marx (if works as planned)

1-Tunnel Pros and Cons

- Pros
  - Eliminates service tunnel and penetrations, long runs of WG & cables (large saving)
  - Shortens LLRF & cryo-module cable plant (small saving)

1-Tunnel Pros & Cons 2

- Cons
  - Introduces additional heat, vibration components into tunnel – will require isolation. (Compromise performance)
  - Decreases availability so amelioration in form of stronger HA design needed (Design cost increase)
  - Larger main tunnel required; will offset (possibly large) fraction of service tunnel savings
  - Installation more constrained, will take longer
  - Limited access during operations requires “fire-drill” forced downtime maintenance mode instead of orderly replacement at any time.

1-Tunnel Summary

- Can be done but will incur offsetting costs:
  - Larger main tunnel
  - More HA design and some increased unit cost
  - Additional heat, vibration in main tunnel requiring engineering solutions
  - More stress on personnel due to high tunnel temperatures
  - Standby maintenance mode of operation instead of routine orderly replacement

2. BCD Modulators in 1-Tunnel Alcoves

- Pros
  - Modulators accessible in case of failure; repair without stopping machine
- Cons
  - Additional alcove costs
  - Long modulator cable runs introduce major expense, availability penalty
  - Cable plant generates heat losses, poses tunnel fire safety hazards

BCD in 1-Tunnel Alcoves Summary

- Technical and cost compromises c.f. 1-Tunnel
- Better for servicing if modulator reliability a concern, but increased cost due to alcoves, HV cable plant

3. Marx in 1-Tunnel no Alcoves

- HA design makes possible run for mission time of 9 months with minimum intervention.
- Reduced space, weight, cost advantages
- Card-modular design minimizes MTTR

4. All ACD Big 3 in Single Tunnel

- Marx ACD
  - Reduce size, weight, cost; eliminate oil, pulse transformer; reduce costs ~2X
- Sheet Beam Klystron ACD
  - Reduce size, weight, space, high voltage; eliminate solenoid & power, require less space in tunnel
  - Potential cost reduction ~2X
- Distribution ACD
  - Design complete 12 m cryo-system without circulators, 3-stub tuners
  - Potential cost reduction ~2X
- Overall HLRF cost reduction => incremental cost of 2nd tunnel (Snowmass)

General Comments 1 Tunnel

- Radiation/Activation
  - Components such as klystrons and modulators may become activated over time in which case repair or remanufacture can become very costly or impractical
- Cooling Water Temperature- Klystrons
  - Stacking klystron cooling circuits poses single point failure for multiple klystrons as well as difficulties for operation, maintenance
  - Should keep single loops that can be isolated, possibly at reduced flow and higher delta T
- Rack Cooling
  - Rack electronics should be kept on separate loop with maximum inlet temp of 25C for controlled 40C air temperature in closed water cooled rack
  - Minimal cost gain, many technical disadvantages to air-cooled racks