Availability Task Force: Subgroup #2

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Subgroup #2

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- Identify the drivers which dominate overall availability of each model (KCS, DRFS, RDR)
- Consider practical (what) and strategic approaches (who and how) on realizing the needed availability

- Examine different operations / maintenance models
- Develop a set of studies to be done using Availsim

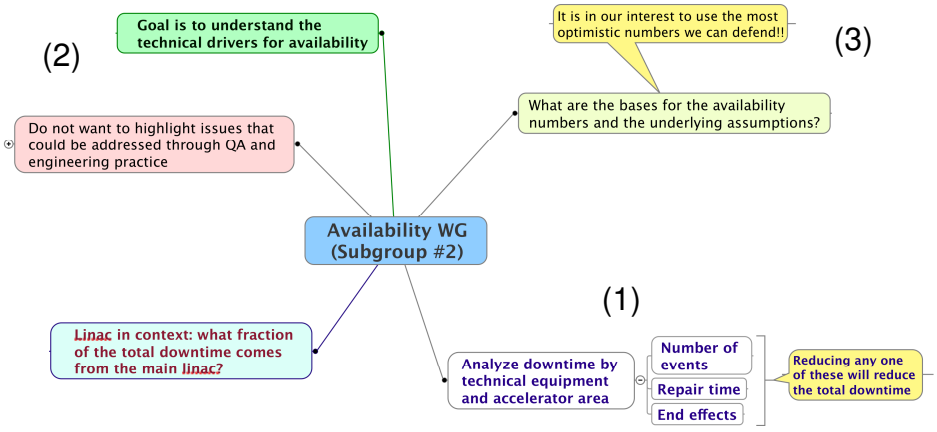
- Ultimately, answer the question:

  "What does it take in order for the two linac configurations to be credible from an Availability stand-point?"

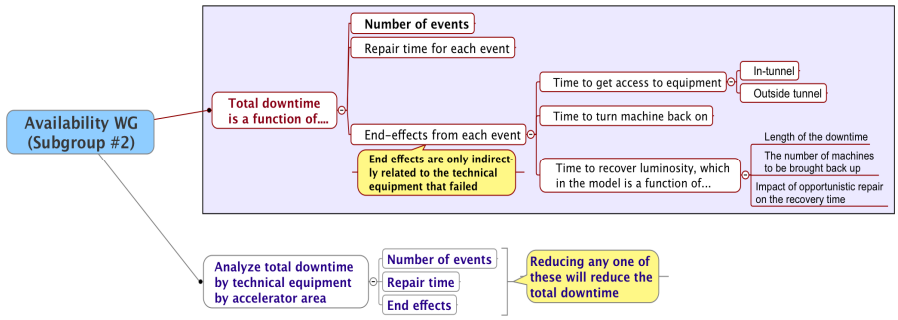
First things first...

- Set up two Availsim models
  - **Two linac models – one for each HLRF configuration**
  - **Everything else should be identical in both models**
  - **Single tunnel is defined for both SB2009 options**
    - Direct comparisons of 1 vs 2 tunnels are not needed
- For each HLRF configuration, we need
  - **Parts models for RF building block [do we have them?]**
  - **Estimates of repair times**
  - **Estimates of mean time between failures...**

Initially focus on three topic areas



Downtime analysis



- Analyze downtime events by Area System and Technical System
- Are there dominant effects from...?
  - **End effects from repairs, eg tunnel access times, time to recover luminosity**
  - **Repair times for particular components**
  - **Numbers of failures of particular components**
- Will provide valuable guidance for future simulations

De-emphasize 'Engineering QA' issues

Device	Needed improvement factor	Downtime to these devices (%)	Nominal MTBF (hours)
Power supplies	20	0.2	50,000
Power supply controllers	10	0.6	100,000
Flow switches	10	0.5	250,000
Water instrumentation near pump	10	0.2	30,000
Magnets - water cooled	6	0.4	3,000,000
Kicker pulser	5	0.3	100,000
Coupler interlock sensors	5	0.2	1000,000
Collimators and beam stoppers	5	0.3	100,000
All electronics modules	3	1.0	100,000
AC breakers < 500 kW		0.8	360,000
Vacuum valve controllers		1.1	190,000
Regional MPS system		1.1	5,000
Power supply - corrector		0.9	400,000
Vacuum valves		0.8	1,000,000
Water pumps		0.4	120,000
Modulator		0.4	50,000
Klystron - linac		0.8	40,000
Coupler interlock electronics		0.4	1,000,000
Vacuum pumps		0.9	10,000,000
Controls backbone		0.8	300,000

- To assess viability, we want to assess the technology drivers to availability
- Some components might be considered as 'QA drivers' to availability. These should be de-emphasized in the model
- What's on that list...?

Consider three categories of equipment...

- 'Standard' components
  - **Vacuum pumps, flow switches, circuit breakers, ...**
  - **COTS parts**
- Technical systems with large operating base
  - **Magnets, power supplies, controls,...**
  - **Good statistics for reliability estimates**
- Technical systems with little / no operating base
  - **Newly developed parts, challenging specs**
  - **Insufficient data for estimating MTBF**

'Best available' MTBF data....

- Availsim is using MTBF numbers largely based on SLC operating experience
- Better reliability has been achieved at other labs on some of the relevant subsystems
  - **Take the best numbers we can find, update Availsim**
  - **Who can get that information?**
- It is in our best interest to use the most optimistic numbers that we can defend!

APS Reliability Summary for FY08

FY 2008 Actual	Unavailability Percent	Unavailability Hours	Number of Faults	Mean Time to Beam Loss	Faults Per Day
RF	1.04%	47.53	14	319.9	0.08
Diagnostics	0.35%	16.17	7	639.8	0.04
PS	0.68%	31.42	18	248.8	0.10
Controls	0.02%	1.03	2	2239.4	0.01
Network	0.00%	0.00	0		0.00
Interlocks	0.01%	0.50	2	2239.4	0.01
Accelerator	0.00%	0.00	0		0.00
Beamline	0.04%	1.62	1	4478.8	0.01
Radiation	0.02%	1.12	1	4478.8	0.01
MOM	0.03%	1.53	2	2239.4	0.01
S&A	0.00%	0.00	0		0.00
Operations	0.15%	6.83	2	2239.4	0.01
Physics	0.00%	0.00	0		0.00
ID-FE	0.00%	0.00	0		0.00
ID-FE/MD	0.00%	0.00	0		0.00
ID-FE/XFE	0.00%	0.00	0		0.00
Utilities	0.03%	1.60	1	4478.8	0.01
Electrical - APS	0.00%	0.00	0		0.00
Electrical - ANL	0.00%	0.00	0		0.00
Cooling - ANL	0.03%	1.60	1	4478.8	0.01
Other	0.02%	0.80	0		0.00
Unidentified	0.02%	0.85	1	4478.8	0.01
Total	2.36%	108.27	49	91.4	0.26

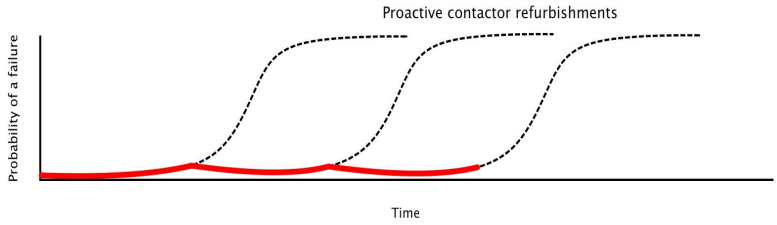
User Downtime Hours	109.4
Scheduled Hours	4588
Delivered Hours	4478.4
User Availability	97.6%

Reasonable MTBFs for unproven technologies?

- Difficult!
- Could be extrapolated based on failures over a number of test hours ...but only to a limited extent
  - **Eg 10,000hrs without a failure might be enough to claim an MTBF of 30,000+hrs (but not 300,000hrs)**
- Can be estimated using data from similar equipment
- Calculate using one of several methods (maybe)
- Use Availsim to help assess what's needed
- *How is the HLRF Group addressing this issue?*

Preemptive maintenance

- Applies to: hoses, cables, capacitors, mechanical pumps, circuit breakers, cooling fans, etc, etc
- The clock is effectively reset on the expected time to failure.
- Also applies to fixing systemic problems based on prior failures
- PM for all units may take one shutdown or many shutdowns
- In Availsim, this will be modeled by assigning long MTBFs



Maintenance models

- Basic parameters
  - **Operate nine months per year (integrated luminosity)**
  - **Three months for shutdowns, maintenance, accelerator studies,...**
  - **RDR assumed one 3-month shutdown per year**
- Impact of allowing opportunistic maintenance...?
- How to apportion the 3 months of ‘downtime’

Wrap-up (to do list)

- Set up and run Availsim models for the two SB2009 configurations
- Analyze downtime data to understand relative contributions from end-effects, repair times, ...
- Collect 'best available' reliability data from other labs and incorporate into Availsim
- Set up Availsim to allow study of different operations / maintenance models
- Generate a studies list!