# Availability Task Force Notes

Marc Ross, September 15, 2009

These are my notes from the Availability meeting held at Slac Monday September 14, 2009 with Tom Himel and Ewan Paterson. Akira Yamamoto and Eckhard Elsen attended via teleconference.

The goal of the meeting was:

1) Define a few top level conclusions to be presented and proposed to the Task Force. These would subsequently become part of the Task Force report to the GDE at ALCPG09.

2) Review the list of assumptions, (and related backup preparation for the report), Tom included in his email (September 3). Of course, as Tom says in his mail, that list was incomplete, intended just to give a flavor. We focused on some of that list in our discussion.

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Top Level Conclusions (since the meeting Tom and Ewan developed a better conclusions slide – posted on the indico site for the September 15 / September 16 webex teleconference meeting):

(First two from September 8 / September 9 meeting.)

a. "Availsim results with different energy overheads indicate the single tunnel RF systems should be dropped in favor of Klystron Cluster or DRFS".

b. "The availability difference between Klystron Cluster and DRFS at low energy overhead shown by the simulation is not significant and is expected to be offset by differences in performance".

c. The single tunnel main linac configuration, with the two proposed HLRF schemes as studied by the Task Force, is viable, from the point of view of availability, and has an availability performance equivalent to that of the 2007 RDR baseline twin tunnel scheme.

We also discussed the activity of the task force and I propose we try to summarize what we did and how that has helped us progress beyond the RDR. In many cases, our process is reflected in the assumptions below. Beyond the RDR availability work, we have taken the following three steps:

1. We assume a Operations and Maintenance Model similar to that deployed at light sources
2. Based on two new technical developments (Klystron cluster and Distributed RF), we have a different approach to klystron management
3. We assume component performance (MTBF) to be close to that achieved in industry and in light sources.

'To do' topics for upcoming studies:

1. Show the impact of halving the recovery time,
2. Separate energy overhead and beamline component reliability
3. Show the impact of limited staffing levels
4. Two 'global systems', cryogenics and high voltage power distribution, are the single largest contributors to down time – this should be re-evaluated.

Assumptions:

1. The Operations and Maintenance Model is based on a 5 month run and 1 month long down, including recovery time. The Model includes a 'Maintenance Day' once every two weeks.
    a. During the downtime 10% of cryo systems are warmed and have all their bad components repaired.
    b. In order to have the same total up-time, the 'long downs' are limited to two one-month intervals. This clearly will have a constraining impact on upgrade strategies etc. Total uptime in a year = nine months * 75% uptime =~ 5000 hours (an easy number to remember).
    c. This assumption represents a different approach from that used since the 'US Technology Options Study' (March 2004), (http://www.slac.stanford.edu/xorg/accelops/byChapter/Chap4.pdf) and subsequent studies. In the Study (4.3.2): *"There are no regularly scheduled maintenance shutdowns, except yearly. Interventions occur only when the accelerator is broken, which is what happens at most operating accelerators. In real life, maintenance might be planned when the energy overhead was getting low without waiting to actually run out of energy. However, since the simulation does not add any penalty for unplanned or off-hours downtimes, this becomes a subtlety which does not really impact the results."*
    d. The assumption is important for the DRFS HLRF scheme because all (or a very large fraction) of the maintenance is done within the schedule maintenance periods. This is a salient difference between the DRFS and KCS schemes.

e. We discussed the difference between two one-month long downs and a single two month down. The simulation shows little difference – most of the work is arranged to fit into either the Maintenance Days or the one-month long downs. But we may expect top-level operational costs to be different when we include (for example) seasonal variations of electrical power costs.
f. This assumption shows a contrasting approach to that of the quote above, "… which is what happens at most operating accelerators…", and is indicative of the Task Force work in general in that it is a move toward light sources and 'factories' and away from the systems examined in the initial simulation development stage.

2. The Operations and Maintenance Model assumes here is no limit to the number of maintenance staff.
   a. We expect this may impact DRFS maintenance, but there may be other unrelated impacts. The way the simulation is coded, the number of available staff is an input. In order to find the sensitive threshold we decided to pick a particular baseline scheme (see below) and run the simulations until the sensitvity appears.
   b. It may be reasonable to assume a limit – is this between 50 and 100? It is clearly below 1000.
   c. From: http://ilcagenda.linearcollider.org/getFile.py/access?contribId=1&resId=1&materialId=slides&confId=3719 , slide 20, (Shigeki's July 8 presentation), it appears that 2 persons per shaft is adequate for RF-related maintenance.
   d. We expect this topic to be further explained in the DRFS section to be provided by Tetsuo.
3. Recovery time is handled no differently in this series of simulations than it was in earlier ones.
   a. Simulated recovery time is calculated on a per-system basis (source, DR, etc) and is allowed to vary according to an exponential distribution after each interruption. (A detail Tom considered: how is 'good' recovery performance credited?)
   b. We think it is important to try to understand recovery time in operating accelerators and to develop a consistent model for the simulation. This will be a topic for upcoming Task Force meetings.
   c. Typical recovery time is poor because systems are operated with the beam as a primary diagnostic. This is a reflection of shortcomings in the control system and the maintenance work QA process.
4. Simulation results depend on assumed component performance. For this series of simulations, good component performance has been assumed.
   a. Performance data from light sources has been assumed in some cases.

    b. Overall, we lack data that can be directly applied. New material from KEK was obtained last month, but it will take some time to interpret and include it properly.
    c. The report will include a table with rows for key simulated components and columns showing data sources and the values assumed for the simulation. To aid visual understanding, these will be color coded showing the degree of assumed improvement.
    d. We expect to most salient aspect of the chart to be that it shows the need for additional input data, i.e. many cells are empty.

5. It was observed that the biggest single sources of downtime are the top level cryogenic system and the primary AC distribution system. These were assigned fixed levels during initial availability studies (2003).
    a. These two systems downtime is set to a fixed 1.5 percent.
    b. The table showing the causes of downtime, for example, the table in the RDR, does not include this important top-level information.
6. For purposes of near term studies, we picked a reference case which is intended to be practical.
    a. 3% overhead with klystron cluster is the reference case.
    b. Further runs with the DRFS will use a similar overhead percentage.

For planning purposes, we expect to go over Tom's talk at our September 23 meeting (nominal time). It is important to include as much as possible of the DRFS work now ongoing at KEK. We will ask Tetsuo for an update and for a commitment to provide what he can a few days before the September 23 meeting.