Minutes from the WP02 PRR2:

Master oscillator and RF reference distribution

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Talk 1: Master oscillator general overview

Q: *Why 3 channels and not 2 or 4?*
A: Three channels are the minimum required to identify which channel failed in case of phase failure

Q: *How many outputs for the 216 MHz signal*
A: 216 MHz generation module is not yet produced

Q: *The 1.3 GHz is required for the upcoming RF gun test. Does it have enough outputs*?
A: The MO prototype is already installed for the gun test. It is connected to the final cable distribution to bring signals to the required destinations.

Talk 2: 1.3 GHz generation channel

Q: *How is the +40 dBm signal output protected against reflections?*
A: An isolator (not shown on the block diagram) is installed at the main output. Signal monitoring of the 32 individual channels can easily identify which channel is not terminated (in case someone disconnects one of the outputs). Furthermore, the MO output signals are not directly distributed to the end-user but are going through the RF distribution system which, in turn provides additional isolation.

Q: *About the 216 MHz?*
A: In all identified cases, this signal is simply generated locally by the timing module. This is also valid for the master laser oscillator. The MLO only gets a 1.3 GHz direct connection from the MO. The 216 MHz comes from the timing module. Reset of frequency dividers also comes from the timing system. This should be shown in the PRR documentation.

Q: *What is the most critical component in the MO system?*
A: There three 1.3 GHz generation channels but only 1 redundancy controller. 2 or 3 of these units should be planned. A spare redundancy controller should be installed in the rack, so that only its input and output need to be reconnected in case of failure to minimize down time.

Q: C*an such a 1.3 GHz generation box be purchased on the market?*
A: There are none currently available on the market, not with the required phase performance, not within the required time frame and not with the required diagnostics.

Talk 3: Redundancy controller

Q: *What happens if the GPS drift?*
A: The GPS will drift of the master channel will drift, but this is transparent to the accelerator. The other two GPS are phase corrected to track the drift of the master generation channel.

Q: *Where is the output on the three signals combiner circuit board?*
A: The output is in the center of the PCB, sticking out perpendicular to the plane of the PCB.

Q: *What happens when 1 channel get disconnected?*
A: The switching is designed in such a way the source impedance is always 50 ohm on the active channel and open on the other two channels.

Q: *When should an MPS signal be generated?*
A: The diagnostic signals are always available to tell if a 1.3 GHz generation channel fails and switching occurs. However, the MPS is informed only in case the MO switching failed and the MO system could not recover.

Q: Role fo the high Q filter for switching*?*
A: The load Q is around 3000. During channel switching, one can expect a small amplitude drop 2-3dB corresponding to 300 nsec. The LLRF is the system for which this signal amplitude drop is most critical.

Q: *Is the input power to the filter a problem?*
A: The input power of the high Q filter is +40dBm on an SMA connector. The filter designer clarified that this power is not be a problem for the filter. However, it was recommended to test the filter with such input power, in particular to estimate the heat dissipation. It was also requested to find out what is the maximum power level for SMA connector at 1.3 GHz and mention this in the safety part of the PRR dossier.

Q: *about temperature stability of the high Q filter?*
A: The quality factor will not be affected significantly by the heat dissipation. This will be only slow fluctuations not noticeable for the 1.3 GHz generation. It was recommended to check this, and to go beyond the nominal +40 dBm. (For example up to +45 or +46 dBm).

Q: *about redundancy concept?*
A: The redundancy concept was introduced as a late requirement for the MO. There is no redundant master oscillator available on the market, so a lot of effort went into the design of such a concept. If the MO is down, the RF is down, which in turn could bring the cryogenic system down, leading to extended down time. It was mentioned, that although equipped with a redundant MO, FLASH was never switched to its spare unit.

Talk 4: Infrastructure

Q: *Which uninterruptible power supply is used for the MO racks?*
A: Using a local UPS was judged riskier as it requires maintenance. Hence, the standard UPS provided by MKK is used.

Q: *Why use an Ethernet switch in each MO rack, this is overkill?*
A: This was done with the idea to keep redundancy everywhere. However, it also makes more sense to place it in a less sensitive rack. WP02 will look into simplifying this.

Q: *MO top patch panels should be removable without touching the grounding scheme?*
A: This is a requirement. WP28 mentioned that it was not possible to exchange the patch panel. WP02 will look into this.

Q: *about long, large cable installation?*
A: All cables for WP02 have been ordered, KDS entries are on-going. It was recommended that WP02 clarifies with MDI/Wille that the long, heavy cables along the main linac should be installed before the modules. Installation after the module will be much harder. It is too late for L1, but it should be tried for L2, L3. WP02 should also make sure the company has the appropriate training and tooling to assemble the connectors for the very large cable (1-5/8”). WP02 agreed to communicate these two points with the people in charge of cable installation (include Markus Huening and TC in the discussion).

Q: *Safety issues about the power level of RF cables?*
A: The power level for which RF signals are a potential hazard for personnel will be added to the safety document of the PRR. It shall also be mentioned that one should NOT look into the RF cables. WP02 will contact Markus Huening who has experience in this topic.

Talk 5: RF distribution overview

Q: *How easy is it to extend the distribution to 3-4 stations?*
A: The current design allows for three more RF stations (12 cryomodules). The current design can easily be adapted to accommodate for a fourth RF station.

Q: *about concerns of the temperature drift of the 1-5/8” cable?*
A: The 1-5/8” (RFS) cables are used for the long stretch of the interferometer links where the signal loss is an issue. Going with thinner cable would require adding more amplifiers in the signal chain resulting in signal quality degradation, not meeting the specifications. It was mentioned that the order for the cables was already launched. It was asked that WP02 looks anyways for comparison at the temperature stability of the alternative company (Andrews).

Talk 6: Interferometer

Q: *Is a circulator at the output of the amplifier required?*
A: No, the return from the open is at least 20 dB lower

Q: *Suppression factor depends on location of tap point with respect to short?*
A: Yes, but not on its physical location, only electrical location which can be adjusted by phase shifters

Q: Which cable length was used for test in laboratory?
A: Only 10m, but poor quality cable with similar loss. No attempts to regulate the temperature were done, in order to maximize the phase drift.

Q: *What is the expected signal-to-noise ratio degradation due to having cascaded amplifiers in the RF distribution scheme?*
A: The amplifiers have already been selected. A degradation of 1.5-2dB per amplifier is expected. A total phase noise budget was not calculated. WP02 will look into this.

Talk 7: REFMs

Q: *How is the automatic tuning done for the interferometer tap points?*
A: No clear plan defined in the PRR. This is a complex 2D parameter optimization. A commissioning plan shall be established and documented.

Q: *Can the bidirectional couplers, phase shifters and variable attenuators withstand the incoming RF power?*
A: Yes but it needs to be documented

Q: *what about warm commissioning?*
A: A “dummy” REFM was built to provide a local reference to the RF station during its warm commissioning. Two more such devices should be built to allow for the commissioning of up to 3 RF stations simultaneously.

Talk 8: REFM-OPT

Q: *Where is the prototype tested?*
A: it is scheduled to be installed at FLASH at the next maintenance shift. It is currently equipped with the first version of the diagnostic board (TMCB). The XFEL version will be equipped with TMCB2.

Q: *REFM-OPT is a crucial component.*
A: Yes, the plan is to build 2 complete spares for the XFEL.

Talk 9: Schedule

Q: *about the installation of the first MO channel by the end of the year.*
A: The schedule is very tight. The MO prototype is used until the first MO channel is ready. The first MO must be installed for the commissioning of the MLO, scheduled for February 2015.

Q: *about the milestone entitled: "Accelerator distribution commissioned"?*
A: This milestone (taken according to the PIT), should be moved forward in time to match with the current tunnel close date (May 2016). The installation of the RF distribution cannot go faster than the cryomodule installation, but WP02 must take every measure to minimize the installation and commissioning time, based on previous experience for the earlier RF stations. Cool down is schedule to start at the end of the next quarter following tunnel closing.

Q: *about the milestone entitled: "Undulator distribution commissioned"?*
A: This milestone should be cross checked with Winfried Decking.

Closing remarks

WP02 should notify if feedback is missing from work packages, so that no open points are overlooked.