

Tracker Summary
LAT F2F Meeting
February 16, 2005

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Tracker Schedule

- Tower A is RFI, and Tower B is nearly so.
- Tower 1 is in assembly in Pisa this week
 - It should be seeing cosmic rays any time now.
 - It is scheduled to be at Alenia for environmental testing on February 28.
 - A couple of weeks schedule were lost on this tower because of the process of completion of contract negotiations with ASI and because of the need to build ladders without encapsulation for the heavy and bottom trays.
 - Good news: no trays suffered breakage of ladder wire bonds during tray thermal cycles.
- Tower 2 trays are in assembly. Some were delivered to Pisa last week. The prediction from Pisa is that they will all be done by next Tuesday, less than a total of 2 weeks start to finish.
- Sufficient MCMs are in Italy or on the way to complete Tower 3.
- Maybe a half dozen, at most, Tower 4 trays can be built before we run out of MCMs from the old production.

Tracker Schedule

- MCMs from the new production are the critical path for Tower-4
 - The problems with massive pitch-adapter trace cracking were overcome, finally. The root cause was a plating process change that we were not aware of. Electrolytic nickel plating had been changed to non-electrolytic.
 - We are now receiving pitch adapters from two vendors, Parlex and Dyconex.
 - MCM production is in progress, with the first assembled boards undergoing pre-encapsulation electrical testing yesterday and today.
- Our scheduling is based on some assumptions for ramping up Teledyne production:
 - 10 MCMs started the first week
 - 15 the second week
 - 25 the 3rd, 4th, and 5th weeks
 - 35 the 6th and 7th weeks
 - 45 each of the following 6 weeks

Tracker Schedule

Tower A RFI	2/7/05	
Tower B RFI	2/23/05	
Tower 1 RFI	3/24/05	
Tower 2 RFI	4/13/05	
Tower 3 RFI	4/26/05	Cables available up through this tower
Tower 4 RFI	5/16/05	Pushed out 2 weeks by MCM availability
Tower 5 RFI	6/2/05	
Tower 6 RFI	6/16/05	
Tower 7 RFI	6/27/05	Relies on order of new face-sheet prepreg
Tower 8 RFI	7/6/05	
Tower 9 RFI	7/15/05	
Tower 10 RFI	7/26/05	
Tower 11 RFI	8/4/05	Relies on new ASIC order
Tower 12 RFI	8/15/05	
Tower 13 RFI	8/24/05	Italian holidays?
Tower 14 RFI	9/2/05	Relies on new order of tungsten tiles

Schedule Risks

- MCM Production: 4-month hiatus due to technical problems.
 - New MCMs are needed starting with Tower-4.
 - A new ASIC run is needed to complete the flight build, because of poor yield in MCM production to date.
- Face-sheet prepreg: the full order was not purchased early on because of lack of funding from ASI.
 - SLAC decided to make the purchase instead.
 - It is on order from YLA, due March 15 in Plyform.
 - It is needed for Tower 7 trays.
 - This gives a reserve of 2 weeks (would be critical if not for MCMs).
- Flex-circuit cable production continues to be problematic.
 - So far we have not held up tower production (barely).
 - Towers A, 2, and probably 3 each will have at least one cable with a bad coupon test. Our thermal testing indicates that this is not a large risk.
- Some more tungsten tiles and carbon-carbon are needed for the last towers, but there the timing does not appear to be critical.

Schedule Option to Consider

- Skip all environmental testing on the last 4 towers, including the tray thermal cycles, and skip the EMI/EMC testing.
- This moves the Tower-14 RFI up to August 16, only 3 weeks later than the Tower 10 RFI.
- SLAC would probably have to send manpower to Italy to help with the resulting July workload in tower assembly and test.

MCM Production

- Production restarted last week.
- MIP-1 inspections indicate quality at least comparable to last year's production for the pitch-adapter bonding.
 - With better controls in place now on the nickel plating we hope for a significant reduction in trace cracking w.r.t. last year's production.
 - The LAT MIP-1 inspection, however, is much more thorough now and will help prevent problems from propagating further into production.
 - In addition to QA, we are also trying to keep up a much larger presence of physicists at Teledyne to monitor the production than we had last year.
 - No tape with silicone adhesive is being used now!
- Charlie Young (SLAC staff physicist) is doing an excellent job of pushing forward the Teledyne production and the parts procurements. His goal is to get Teledyne to start 10 MCMs per day as soon as possible.
- The first MIP-2 testing and inspections started yesterday, with 2 of 3 MCMs passing. This work is continuing today.

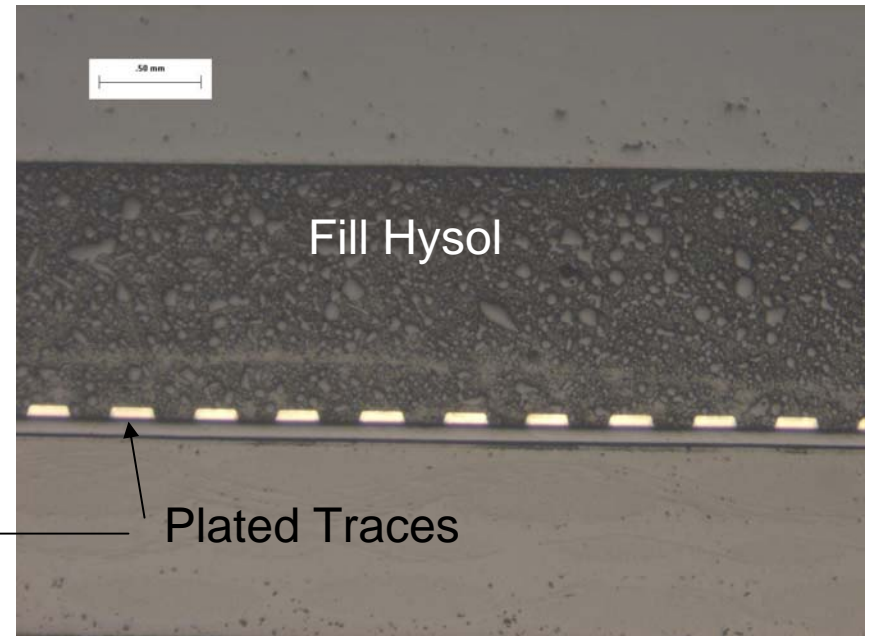
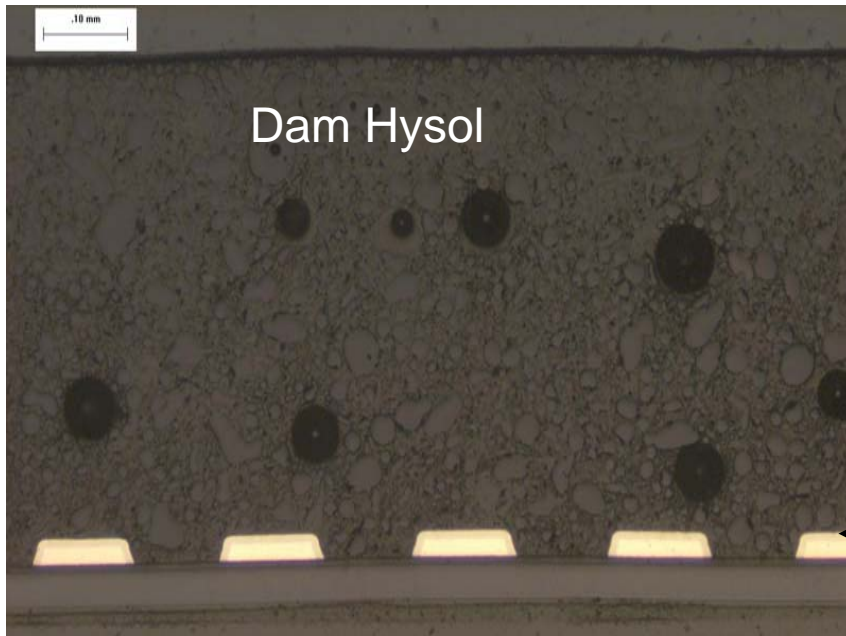
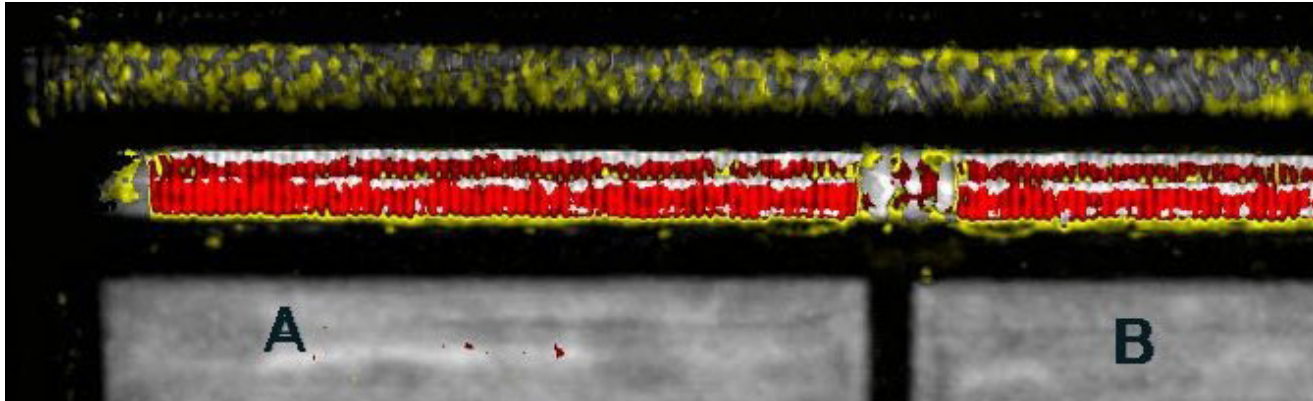
MCM Production

- The first MCMs could be completed by the end of this week
 - The MIP-3 inspection and test will include 100% testing of the wire bonds to the pitch adapter.
- Thermal cycles and burn-in can start next week.
 - This week we are moving the UCSC thermal chamber to SLAC to increase the burn-in capacity to 1.5 towers per week.
- The electrical testing before and after thermal cycles will be our first direct verification as to whether the elimination of silicone contamination solved the encapsulation delamination problem.

Encapsulation Delamination

- The Tiger Team concluded that the most probably root cause of the failures in the last 2/3 of last year's production was silicone contamination resulting from masking tape placed over the pitch adapter to protect it during soldering.
- In January we wire bonded and encapsulated some non-flight (non-functional) MCMs and tested them by acoustic microscopy (CSAM).
 - The CSAM images indicated that large-scale delamination is still present, both before and after thermal cycles.
 - However, we learned just yesterday that sections made of those boards cannot see any delamination, even at 1000x.
 - Some more of these tests are in progress to confirm this.
 - This week 2 MCMs that were imaged earlier and then thermal cycled will be imaged again.
 - Up to now we have measurements before and after thermal cycles, but not on the same parts.
 - Diane Kolos will section one of them to look directly for delamination.
 - Teledyne CSAM imaged one MCM. I have not yet seen those results.

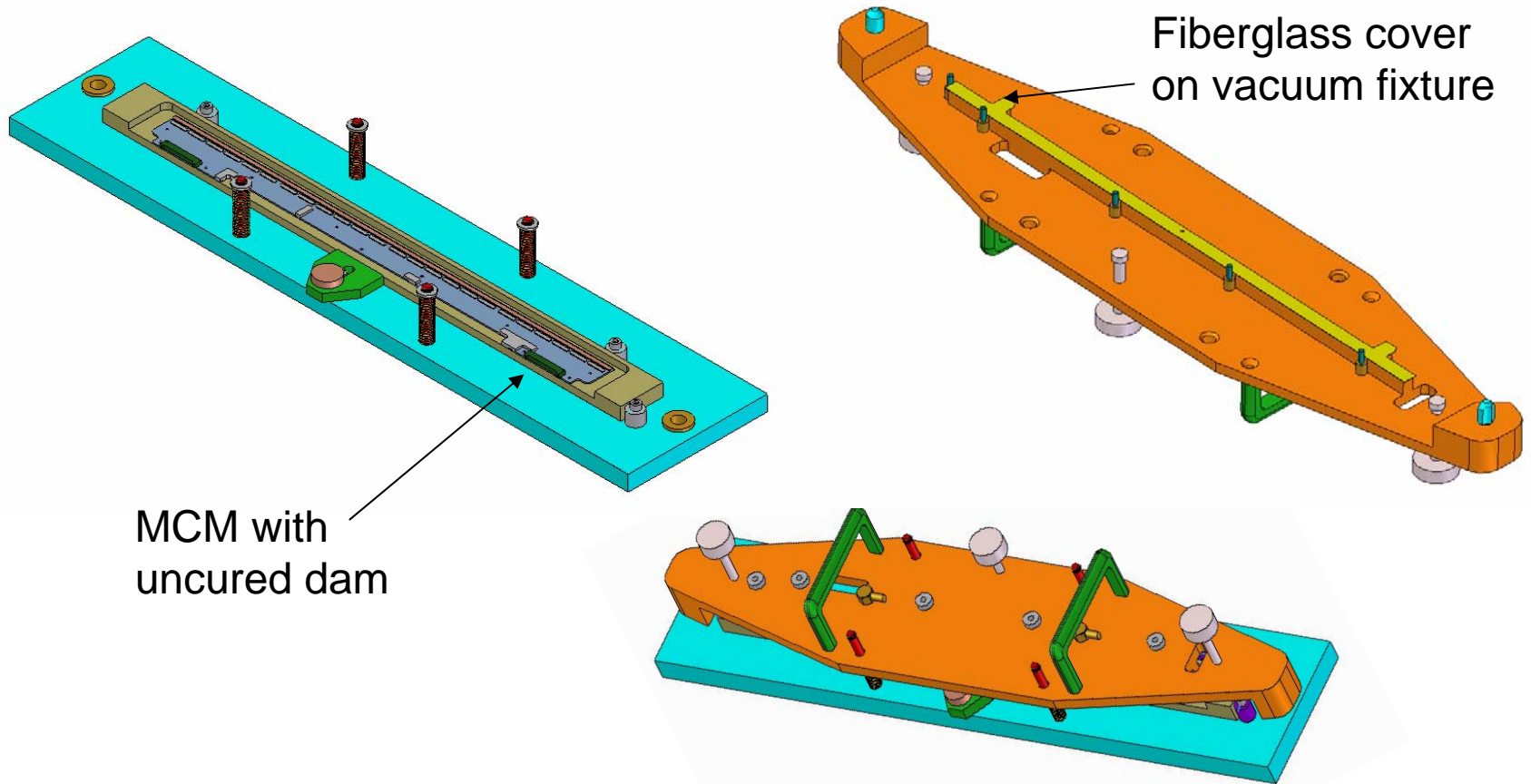
CSAM and Section on S/N 2057



Encapsulation Delamination

- So what is the red in the CSAM image?
- The Goddard experts convinced me that it really does correspond to a strong reflection in the pitch-adapter region.
- Henning Leidecker believes that we are seeing a very thin delamination just from the surface of the gold, in which case it is probably not of any concern.
 - It's a bit hard for me to understand why Diane could not see it at 1000x, in that case.
 - The 30MHz sound wave has a wavelength of 47 microns in epoxy, about twice the thickness of one of the traces.
 - I was told that the method can see delaminations of a fraction of a micron.
- The acid test will be the electrical testing of all wire bonds after thermal cycles.

Just In Case...



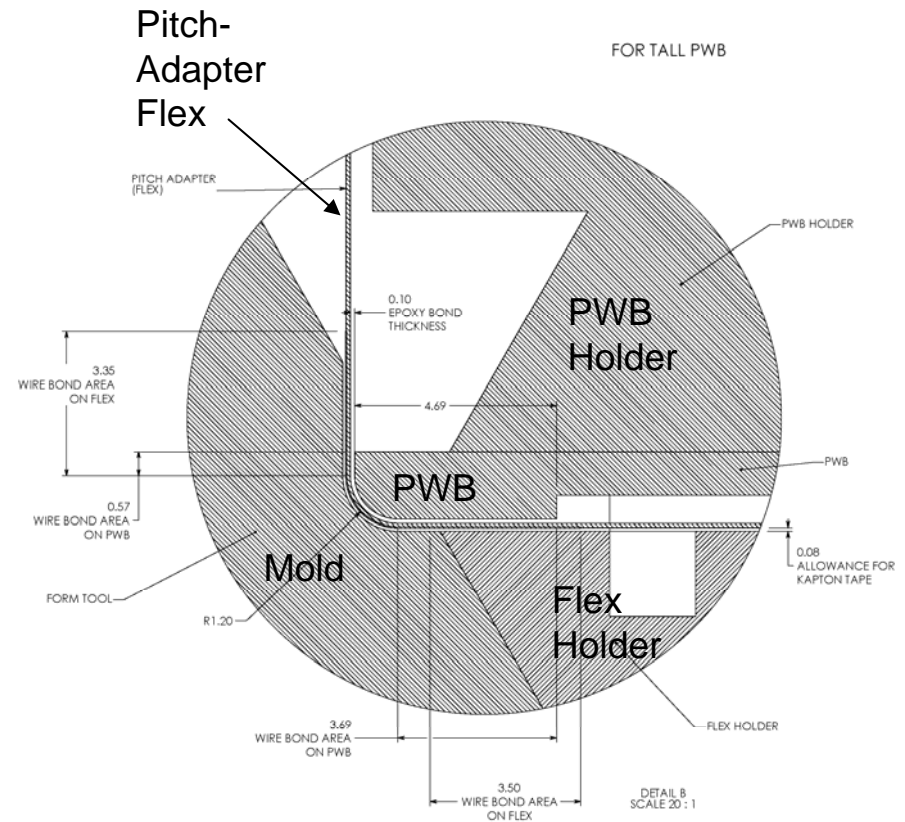
Design of a fixture for mounting a cover on top of the Hysol dam is in progress. This would be used in place of the encapsulation fill and would certainly eliminate the problem of encapsulation delamination breaking wire bonds.

Back-Up Plan

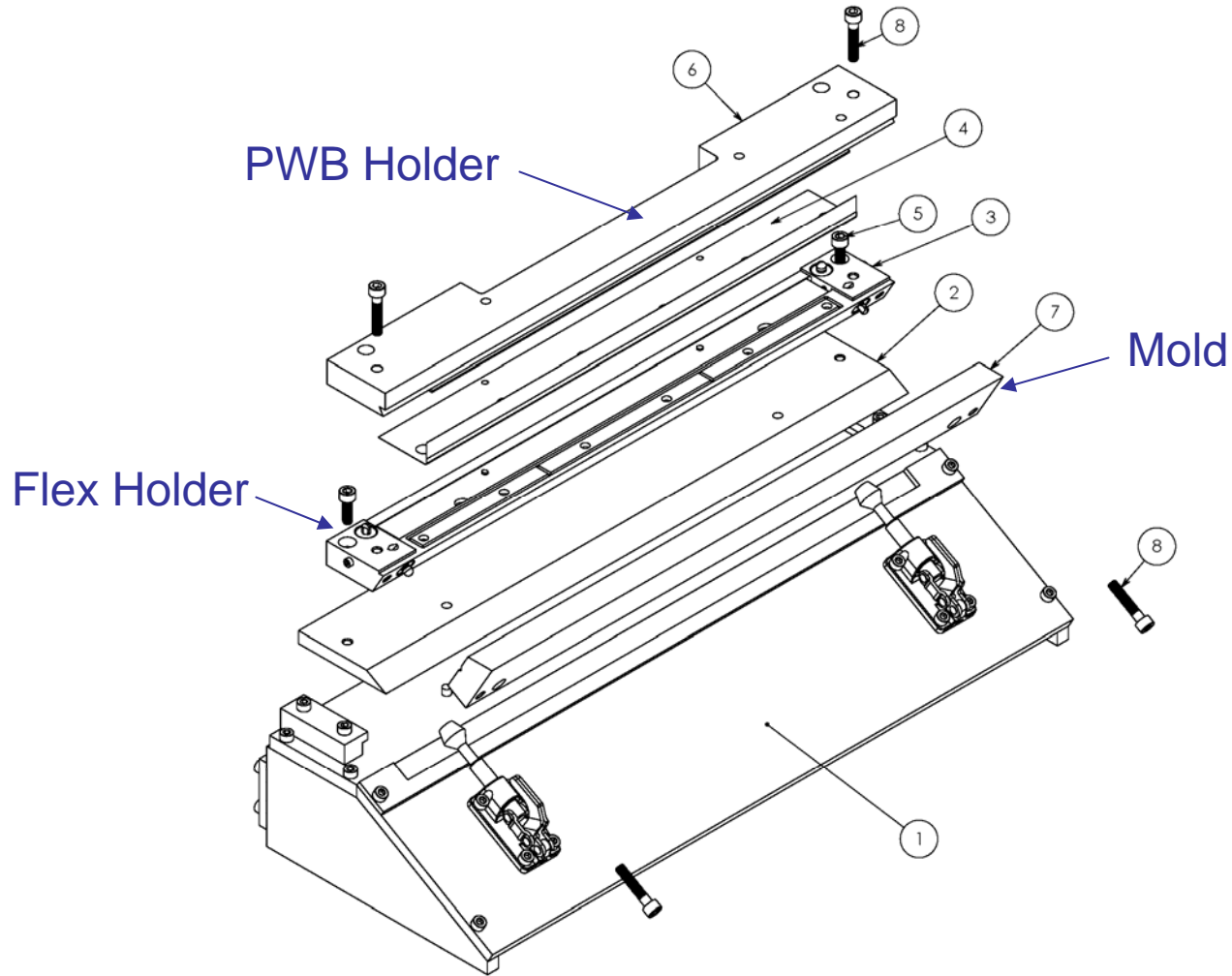
- 25 covers are on order from DDI, due end of next week.
- The fixture design will be completed this week.
- Machine the fixture in the Central Lab shop next week (the shop is nearly idle right now).
- Assemble the fixture and dry test it at SLAC.
- Take the fixture to Teledyne around March 2 and assemble 10 non-functional parts.
- Test the parts at SLAC. We need to develop a test plan before then, including thermal cycles, bending, and destructive pulls.
- Decide whether to introduce this into the production.
 - The assumption is that we will only do this if the problems with wire bond breaking are seen again in the new production.
 - This would require lots of documentation changes, contract changes, materials, etc. *Not easy, so hopefully it won't be necessary.*

Pitch Adapter Bonding

- The Teledyne process is not satisfactory:
 - Uncontrolled tension.
 - Uneven surface for wire bonding in Italy.
 - Large incidence of voids that have to be reworked.
 - Poor control on alignment.
- A better method is to form the bend in a mold. This was tried by G&A with good results.
- We now have a design for a production fixture, and the first article will be built and ready for test by the end of next week.



New Fixture Design



PA Bonding Plan

- Continue with the old process until the new fixture is ready for production.
- Test the first-article fixture at SLAC with several glue thicknesses.
 - Peter is getting some stencils made.
 - Do visual and CMM inspections to evaluate the results.
- Try out the fixture at Teledyne March 3.
- Continue making at least 10 parts over the following week, and put them through the full production flow. LAT QA and the Tracker team will evaluate the bonding quality.
- Send the first fixture back out to be anodized.
- Prepare the documentation changes needed at Teledyne.
- 4 fixtures delivered around March 15.
- Begin full-scale production with the new fixtures the week of March 21.

Cables

- Steve Kahn has taken over supervision of this effort, which also ties up a lot of manpower within the QA, Electronics, and Tracker groups.
- Coupon testing results are better with the improved process, with only 5% to 20% failures (depending on whom you talk to).
- Continued poor quality performance from Parlex:
 - Of 4 cables delivered last week, all 4 were rejected by QA and Dave Nelson.
 - This continues to deplete our supply of expensive connectors!
 - Weekly corrective action meetings continue (including today).
 - Parlex is also rejecting a lot of cables in house (pre-assembly) because of contamination between layers by foreign material.
- Continued poor schedule performance from Parlex.
- We will be forced to install 2 cables with bad coupons into Tower 2
- Tower 3 likely will have at least one cable with bad coupons.
- Steve hopes to get the production of good cables caught up in time to equip Tower 4.
- Management elected to cancel efforts to qualify a second vendor, but at Parlex there seems to be no end of new problems. They are a significant schedule risk.