Report on OMC CDR for opto-mechanical design only

wht-naomi-99
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Meeting date: 7 Nov 1997 at ROE

Present: Eli Atad, Colin Dickson, Ron Humphreys, Tom Gregory, Andy Weise, Andy Longmore, Richard Bennett, Tully Peacocke, Martyn Wells, Richard Myers.
Apologies: Peter Hastings, Donald Pettie (both ill).

1 Overview

This report contains minutes from the NAOMI OMC Opto-Mechanical Design CDR meeting, a list of resulting Action items and a general responses to the CDR by the Project Scientist, Engineer and Manager (in the reverse of the above order!).

2 General Response

?? The review document was clear and generally met the requirements of the review, which had been set out by the Project Engineer and Project Manager beforehand.
?? Progress on ICDs was still behind schedule, but a start had now been made.
?? A summary of known Risk Areas would have been helpful, although it is expected that these were identified during the meeting anyway.
?? The meeting had identified some areas where improvements in the design could be made, but these were expected to be relatively minor changes to component mountings. These areas are described in the minutes and action items.
?? The Review identified only one area which would prevent the internal goal of confirming that long term items could be ordered – more information on the FSM is required to ensure a sensible combination of mirror weight, moment and tip-tilt mechanism is chosen.
?? For completeness an up-dated Requirements Traceability matrix would have been helpful.
?? Similar to the handling of the PDR, the local Project Team is asked to prepare a response to this report summarising how the Action Items have been or will be met (except of course for external actions, which should be followed up by the local manager or project manager as appropriate). The goal for this is to have the OMC design in a well-defined state before the WFS CDR and NCU CDR documentation needs to be completed (if possible) or at the latest, before the WFS CDR itself (currently scheduled for 18th December).
?? The response should contain an up-dated OMC Traceability Matrix. The Project Manager will supply a list of areas where additional statements are needed with regards to meeting Work Package Requirements.

3 Action Items List

The actions items are copied directly from the minutes, in order of appearance. Any items which are not immediately clear should be checked in the meeting context.

ACTION TULLY: check epoxy mounting for resistance to acid and for stress induction on curing. It was noted that RGO have expertise in this area.
ACTION TULLY: restore safeguards (bezel)
ACTION TULLY: put in different locking (through sides of baseplate) and ensure design guards against over-tightening.
ACTION: TULLY consider spring plunger forces required to force components against eccentrics (not the DM)
ACTION TULLY: consider incorporating an extra ring or other mechanism to allow introduction of pure rotation capability during alignment.
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ACTION TULLY: find out from TTC about the location of the pivot point in OAP adjustment.
ACTION TULLY: get existing information on GHRIL bench vibration from Bruce Gentles.
ACTION MEL: Organise a small-group discussion to determine course of action / make choice between tender options (whichever is most appropriate) once sufficient information on mirror light-weighting and risk of staged payment approach has been obtained.
ACTION: TULLY: add z sections clamped to plate to provide stability against earth tremor (is this same action as that to prevent components 'walking' under repeated thermal cycling??)
ACTION: TULLY same action on adding pure rotation capability for OAP2 as for FSM OAP (1)
ACTION TULLY: to add mechanical aid to rotation of OMC mounting plate.
ACTION: RMM talk to DJRobinson/CNDunlop about possibly having forces against the eccentrics for the DM mount.
ACTION Tully: test translation stage stack as soon as possible and try and find early solution to vibration problems if required.
ACTION TULLY: check the stability and repeatability of the translation stages especially wrt angle of output beam from a mounted component, as soon as possible.
ACTION TULLY: check on the 1240 model bearing type and find upgrade if necessary.
ACTION MW: get sample coatings from OS/SORL
ACTION: MW and TG to arrange for samples to be obtained and tested in the GHRIL environment (including tests of any proposed cleaning process).
ACTION TULLY: Improve access to dichroic / field lens mount adjustment (turn it upside down from current arrangement?).
ACTION TULLY: check that the relative expansion of the glasses in the field lens doublet is not significant.
ACTION: ROE to check effect of light-weighting OAP1 – can we get inside existing TTC spec? Also we could consider unlight-weighted SiC.
ACTION TULLY: get additional quotes for field lens, as the current quotes seemed excessively high.
ACTION MartynW: look at simple final metric for optics being right (preferably put in something off-axis)
ACTION: TULLY to add requirement for second target on optical rail, so that they can be mutually aligned with mirror absent then viewed together with mirror in place. Also consider having a second alignment telescope so that two telescopes could be mutually aligned to each other at either end of the system.
ACTION: MW to write-up current ideas for alignment and diagnostics
ACTION: MW to confirm that if telescope focus is to take out the 0.36 and 0.24mm defocus due to thermal effects, any residual aberrations are negligible.
ACTION TomG: re-check end-to-end height of bench above Nasmyth output beam and provide first iteration draft of ICD to define OMC-GHRIL interface.
ACTION MW: Add note on beam quality (even to the effect that it is not readily defined because the optical prescription does not provide for manufacturing errors, but that ROE and RGO will continue to look together at the end-to end performance as more information becomes available).
ACTION MW: Define tolerance on principal ray due to alignment approach.
ACTION: JMDS to organise meeting involving DGP and/or CC (and check with APGR also?) to confirm staff levels identified are (a) likely to be sufficient and (b) will be available within current plans.

4 Meeting Minutes

4.1 Introduction

Mel outlined key goals for the meeting:

?? confirmation of the detailed design of the OMC specifically
?? establish sufficient confidence level in the existing design that approval of long lead-time items can be given
?? obtain feedback and confirmation on required resources

4.2 GHRIL Handling

Tom Gregory gave an update on ING GHRIL plans:
Use ING infrastructure upgrades to do:

?? Electronics cooling: electronics room stabilised 10-15 C.

- Extract hot air through roof near electronics rack in corner; cool air returns to GHRIL
- Heat Exchanger on roof exchanges to glycol/water circuit shared with UES
- All heat down through yoke/twister and out to external cooling plant
- Use mirror-cooling chiller (mirror cooling no longer planned)

?? Optical Hatch

- 1.1metre hatch

?? Light/air baffle around derotator
?? Positive pressure
?? Overhead cable trays
?? Standard Fire Safety equipment

4.3 Mechanical

Tully Peacocke described mechanical design details, starting with changes since PDR.

?? Fold mirror added since PDR; resulting changes in performance are small and are described in CDR document.
?? DM repackaged by Durham (DJRobinson)
?? The calibration mask is now fixed at Nasmyth focus (not on a stage)
?? The WFS space envelope has been enlarged as a result of modifications to the OMC field lens/dichroic design. This allowed more space around the pick-off, which the WFS design was able to utilise.

4.3.1 TTC FSM:

Has Al structure and tip-tilt plate. Add zerodur mirror. But need athermal mounting, which must also be RIGID because of TT action. Mirror bonded into Invar ring with vacuum welded flexure. Over 35 C temp (+25 to –10) change INVAR shrinks and puts force on flexure. FEA shows this is at a level where it can be ignored. Fundamental frequencies are sufficiently high that there should not be vibration problems. Little scope for introduction of damping because mounting must be athermal: maybe small ring. Glue must resist recoating stripping agent (dilute nitric acid). Should test this first.
Mount has three screw feet, each with locknuts. Rotation is by eccentrics on chassis itself.
There is plenty of thickness in the base block which could be machined out to insert damping.
Tom: note that epoxy might contract when curing and stress the OAP.
ACTION TULLY: check epoxy mounting for resistance to acid and for stress induction on curing. It was noted that RGO have expertise in this area.
Eli: established OAP mounting testing must be done by the project.
AndyW: should have safeguards against glue failure
ACTION TULLY: restore safeguards (bezel)
AndyW: locknuts can alter eccentric positions on tightening
AndyW: domed feet could cause depressions in bench; do we need inserts in chassis plate?
ACTION TULLY: put in different locking (through sides of baseplate) and ensure design guards against over-tightening.
Tully: In general: Al structure on Fe plate: thermal expansion difference 80 microns. Over many thermal cycles the components might drift or ‘walk’.
Ron: should we have force against eccentrics?
ACTION: TULLY consider spring plunger forces required to force components against eccentrics (not the DM)
Tom: can we get a pure rotation of the OAP during optical alignment. Answer: No!
ACTION TULLY: consider incorporating an extra ring or other mechanism to allow introduction of pure rotation capability during alignment.
Ron: where is the pivot point during translation of mirror in motion?
ACTION TULLY: find out from TTC about the location of the pivot point in OAP adjustment.
Ron: is FSM mirror light-weighted?
Tully: no; it weighs 0.7kg; possible concern to TTC. Eli thought it could be light-weighted without risk.
ACTION TULLY: get existing information on GHRIL bench vibration from Bruce Gentles.
ACTION MEL: Organise a small-group discussion to determine course of action / make choice between tender options (whichever is most appropriate) once sufficient information on mirror light-weighting and risk of staged payment approach has been obtained.

4.3.2 Parabola-2 and flat

These are made of Zerodur and Pyrex (respectively). Invar bonded to ring; same recoating issue as FSM. The flat and second OAP are the same size so the same mount has been adopted for the sake of efficiency.
Al housing block
Protective bezel on the front and back cover – can be removed without disturbing mirror
Same modified locking system as FSM
Vibration: Known CCC-driven frequencies of 1, 50, 100Hz should be well attenuated
AndyW: how do you cope with a manufacturing error in mirror diameter of +/- 1mm? Do you need to wait until the mirror is delivered before manufacturing chassis plate?
Tully: will adjust thickness of invar pads to deal with this, so plate can be manufactured before delivery.
Tom: how do we cope with earth tremor: are components fully captive to plate?
Tully: (after discussion): can add z sections clamped to plate with sprung pressure
ACTION: TULLY: add z sections clamped to plate to provide stability against earth tremor (is this same action as that to prevent components 'walking' under repeated thermal cycling??)
ACTION: TULLY same action on adding pure rotation capability for OAP2 as for FSM OAP (1)
ACTION TULLY: to add mechanical aid to rotation of OMC mounting plate.

4.3.3 DM

Translation stages are Tully's responsibility, mounting design is Durham's responsibility.
Concern expressed that there will be vibration problem because DM is on top of a fairly long structure. It was agreed that the only pragmatic way to find this out is to do tests as early as possible on the translation stages.
AndyW had checked the model number for the proposed translation slide and it was not the type of bearing described in the CDR documentation.
ACTION Tully: test translation stage stack as soon as possible and try and find early solution to vibration problems if required.
RonH: should we have force against eccentrics for the DM also?
ACTION: RMM talk to DJRobinson/CNDunlop about possibly having forces against the eccentrics for the DM mount.
AndyW: could the angular tolerance on the translation stage stability cause any problems with image motion? Answer: could cause ~250um (=1".3) motion at the pick-off. However, the effect should be repeatable.
ACTION TULLY: check the stability and repeatability of the translation stages especially wrt angle of output beam from a mounted component, as soon as possible.
ACTION TULLY: check on the 1240 model bearing type and find upgrade if necessary.

4.4 Optical Coatings

Martyn reported there was no change since PDR to the expected performance of the coatings. Manufacturers had confirmed that they could meet the specifications.
Tom Gregory reported that the reflectance of some samples which had been in GHRIL for several months was now down to 93%. Apart from this, there were still no well-controlled tests of witness piece performances or of any cleaning tests.
ACTION: MW and TG to arrange for samples to be obtained and tested in the GHRIL environment (including tests of any proposed cleaning process).
ACTION MW: get sample coatings from OS/SORL

4.5 Dichroic and Field Lens

AndyW: Access to the adjustments on the mount looks difficult. Can it be made easier?
ACTION TULLY: Improve access to dichroic / field lens mount adjustment (turn it upside down from current arrangement?).
Eli: is there significant relative expansion of glasses in field lens doublet?
ACTION TULLY: check that the relative expansion of the glasses in the field lens doublet is not significant.

4.6 Nasmyth Focus Calibration Plate

Will not have accurate adjustment on mounts, as it will now be used to define the beam, not aligned to it. Will have kinematic mounting for accurate replacement.
Sue Worswick had suggested that the co-ordinates of the holes, which need to be known to a few microns, could be measured on SuperCOSMOS.

4.7 Tenders

General impression was that companies were struggling to meet FSM tip-tilt frequency / amplitude specifications.
Optical components would be supplied separately (no-one had agreed to mount the mirrors as part of the FSM package, although this was not ruled out in all cases).
OAPs potential sources: SORL; FSM: Zeiss (new); dichroic: Zeiss were only company who agreed to quote. Delivery times ranged from 3 to 6 months.
Eli: could there be some premium on TTC option as it already exists (IN FACT the use of 'proven technology' is a WP requirement)?
ACTION: ROE to check effect of light-weighting OAP1 – can we get inside existing TTC spec? Also we could consider unlight-weighted SiC.
ACTION TULLY: get additional quotes for field lens, as the current quotes seemed excessively high.

4.8 Optical Alignment

MW described in detail the optical alignment procedures.
Lengthy discussion. Particular concerns were expressed that if tests were all for on-axis alignment it might be possible to get the OAPs apparently aligned but still have poor off-axis performance. MW felt that the procedure of aligning the two OAPs independently should avoid this. It was agreed nevertheless that more checks should be made of the off-axis image quality.
It was also agreed that during routine operation ING would need some simple measures which confirmed that the system was maintaining alignment (or otherwise). These need only identify whether or not a problem existed; specific diagnostics would then be used to determine what was misaligned, based on the detailed alignment procedures.
TomG suggested that the initial alignment be performed without the dichroic and field lens as the goal is to provide the best possible images to the science instrument.
ACTION MartynW: look at simple final metric for optics being right (preferably put in something off-axis)
As a result of discussions, some ideas on the best alignment procedure were modified.
Methods of best using the retro-reflecting mirror and the target on the optical rail were discussed.
ACTION: TULLY to add requirement for second target on optical rail, so that they can be mutually aligned with mirror absent then viewed together with mirror in place. Also consider having a second alignment telescope so that two telescopes could be mutually aligned to each other at either end of the system.
ACTION: MW to write-up current ideas for alignment and diagnostics
ACTION: MW to confirm that if telescope focus is to take out the 0.36 and 0.24mm defocus due to thermal effects, any residual aberrations are negligible.
ACTION TomG: re-check end-to-end height of bench above Nasmyth output beam and provide first iteration draft of ICD to define OMC-GHRIL interface.

4.9 Calibration Unit

Tully described revisions to the NCU made since the PDR. Changes were to meet the space envelope.

?? Fold mirror was removed
?? Integrating sphere was now on top of the unit, mounted kinematically so that is could be removed.
?? Integrating sphere could be replaced by the alignment laser, which could provide f/11 beam or a pencil beam.
?? The drive-in mirror now moves horizontally, which placed less demand on position repeatability.

4.10 ICD

The ICD has been started but is not yet complete. A draft has been sent to RAH. It was noted that control of ICDs should be managed through Ron to ensure that everyone worked to the same (agreed) versions.
ACTION MW: Add note on beam quality (even to the effect that it is not readily defined because the optical prescription does not provide for manufacturing errors, but that ROE and RGO will continue to look together at the end-to end performance as more information becomes available).
ACTION MW: Define tolerance on principal ray due to alignment approach.
Discussion of GHRIL table measurements by Tom

4.11 Project Plan and Resources

The Project Plan Gantt Chart showed delivery to Durham for system integration was scheduled for the beginning of 1999. This assumed that a significant amount of system testing would be done once it could be integrated with the wavefront sensor. In the light of recent developments on the descoping of the Test Focal Station, the actual integration period in Durham may be lengthened in exchange for a shorter period of off-GHRIL pre-commissioning testing at the WHT. A staff year was allowed for ROE contributions to this testing, any re-work and the telescope commissioning phase.
Further discussion of resource availability was held over until Donald Pettie and/or Colin Cunningham were available, but the plan described was consistent with resources agreed at a recent local Project Managers Meeting. Some additional effort had been freed up to attempt to recover time lost on the electronics area caused by the resignation of Stephen Stuart.
ACTION: JMDS to organise meeting involving DGP and/or CC (and check with APGR also?) to confirm staff levels identified are (a) likely to be sufficient and (b) will be available within current plans.