\* Section 1.2. 1st para. End of last sentence. Should define "LO WFS NGS" since this is its first usage [updated document]

\* Sect. 1.3. Might include KAON 642 (mentioned in sect. 1.2) as a reference. [updated document]

\* Sect. 2.

+ 2nd para. 2nd sent. For a little more clarity I would suggest this be rewritten as follows: "The LGS WFS sends this data to the NGAO real-time-control (RTC) subsystem. The RTC uses the fixed asterism data to drive the low-order deformable mirror (LODM) and the high-order deformable mirror (HODM). Each patrolling LGS WFS data is used to drive the 32x32 actuator MEMS DM in the corresponding LOWFS channel. The tip-tilt information from each LGSWFS is used to drive the corresponding fast TT mirror in the LGS WFS itself." Note that none of this information is used to drive the "fast TT stage on which the LODM is mounted”. [updated document]

+ 3rd para. 1st sent. "supervisory control" should be replaced with "AO control" to be consistent with section 3.5.2 of the preliminary design manual. Also in Fig. 2. [updated document]

+ 3rd para. Last sent. "a status signal" Is it clear that there will only be one status signal? Might write this more generally as "status signals". [updated document]

+ Fig. 2. Is there any control coming from the RTC to the LGS WFS? I don't think so. I believe that all control is provided by the AO control computer. [updated document]

+ Fig. 2. Font needs to be bigger. Please use "TT" instead of "Tt" in the PnS box. Actually probably should change "PnS" to "Patrolling" to be consistent. I believe that this is the first use of PnS in the document. [Font size was increased for all figure captions]

+ 5th para. 1st sent. I believe this is the first use of "OSM". Should define. [updated document]

+ 6th para. 2nd sent. Suggest insertion of a comma after "Patrolling LGS" [updated document]

+ 7th para. Need spaces after "Figure 4" and "Figure 5" [updated document]

+ Fig. 3. Font is way too small. [Font size was increased for all figure captions]

+ Fig. 3. I know that this is just a schematic but drawing the 10" "Fixed LGS" radius to look so close to the 60" radius of the "Deployable LGS" looks bad. May not be able to do anything about this.

+ Fig. 3. "Optional window depending on environmental cleanliness". I would suggest instead some sort of tube with seal between the AO bench enclosure and the LGS enclosure. [updated figure]

+ Fig. 3. "LGS enclosure/baffle (1 atm @ ambient temperature)". Note that the ambient pressure on Mauna Kea is not 1 atm. Are you planning to pressurize; I hope not. [updated figure]

**+ Fig. 3. Need to confirm focal plane tilt.** [written Reni]

+ Fig. 3. Do we really need an intermediate focal plane and the extra resulting optics and distance? If there a way to instead put the field stops in the initial focal plane? This shouldn't be hard I wouldn't think for at least the fixed asterism (basically a fixed 4 hole aperture mask up front which rides on the focus stage). As you can see I am still interested in seeing if this package can be made smaller despite the fact that good progress has been made in shrinking it back down recently. [The intermediate focal plane results due to packaging constraints. The PnS sensors have a pick off relay that creates a focus and the packaging constraints on the fixed sensors is such that there is again a pick-off plane]

+ Fig. 3. This may just be the schematic but it might be preferred to have smaller incidence angles on FM1 and the TT mirror. [Schematic is not to scale]

+ Fig. 3. Is it really necessary to have the slow TT and FM4 in the patrolling WFS? Why the need for the slow TT? Even if you had to have the slow TT then couldn't it be FM3 instead? [Need is because the NGAO Optical Design Version 7’s LGS output is not telecentric; packaging of the WFS prevents us from placing the slow TT at a point other than were it is. Also it is ideal for it to be near a focus].

+ Fig. 3. It would be nice to have an overall length dimension on each WFS (at least to the CCD). [updated figure]

**+ Fig. 3. This will likely come up later in the document, however I suspect that there is not sufficient benefit to having different plate scales for the fixed and patrolling LGS WFS. I would suggest that we optimize for the fixed case and use this same plate scale for patrolling. This would likely have an advantage for commonality and sparing, and hence cost.** [see discussion on pixel scale choice]

+ Fig. 3. "Translation (...) (to compansate Na distance)" Note misspelling of "compensate" [updated figure]

+ Fig. 3 caption. Suggest change to "Patrolling WFS channel, the central fixed WFS channel and one fixed 10" radius channel". [updated document]

**+ Please add a Zemax printout with the key information (one of the standard zemax products) as an Appendix for each case, and please post the Zemax files with the same KAON number and perhaps identified as the particular appendix.** [Will post on Twiki and add as appendix to the PDF doc.]

+ Fig. 4 and 5. These aren't too useful given the scale. Perhaps Fig. 4 could be what it currently is and then you could have a Fig. 5 and Fig. 6 that only show the WFS from the input focal plane to the detector? Actually why not move Fig. 7 to Fig. 4 and then have Fig. 5 and 6 as I described in the previous sentence?

+ Fig. 4 and 5. "The entrance window the NGAO cold enclosure is not shown." This sentence should be written more clearly since I am not sure what it means. [updated document]

**\* Sect. 3. Has any consideration been made yet to the support structure? Your note seems to imply that some work has happened.**

\* Sect. 4. 2nd para. Ends incompletely with "as shown in". [updated document]

\* Sect. 4.1.

**+ 1st para. 4th sent. "As the working F/# at the LGS pick-off is 13.56 at 22 degrees off-zenith". This f/# doesn't make sense to me so perhaps I am missing something (what the reimaging lens does?). However, The AO output f/# for an object at infinity is f/13.66 (assuming the 10.949 m telescope pupil) so I would have expected the LGS focus to be slower.** [LGS relay and the AO relay aren’t the same, the LGS path f# at the LGSWFS assembly input is not 13.66, in Version 7 it varies from 13.55-13.57 between 180-90 km. This means that the LGS part of the relay isn't 1:1. The exact plate scale was determined by setting the object distance to correspond to the Na-layer distance at 22 degrees off zenith and observing the image position when the object is placed at 1 arcsec on sky.]

**+ 1st para. 4th sent. "indicating contributions to sensor subaperture PSF FWHM (which are 2.355 times larger than the spot diagram RMS) of 35 to 63 milliarcseconds" It looks to me like you failed to multiply by 2.355 and also shouldn't this be 2.355 times the spot diagram RMS "radii"? If I take the initial spot diagram rms radii of 25 um and divide by the plate scale I get 35 mas (it would be 82 mas if I had multiplied by 2.355).** – [Rich D. wrote this part, will clean up].

+ Fig. 8. It would be useful to see the bottom of this spot diagram plot where the rms radii should be listed to confirm what was said in the text. Four of these spot diagrams are at a radius of 15"; might be better to show the ones at 10". Actually I would be tempted to plot only a couple of sample spot diagrams at 10" and 60" in order to also allow you to look at say 30" and 45". [Rich D. wrote this part, will clean up].

+ Last sentence. For the reader's benefit you should translate what 6 um means. What is this in arcsec? How does this compare with the requirement (may need to make one)? [updated document]

**+ Fig. 9 & 10. Perhaps even more important is whether the subaperture image shifts with respect to the expected position (with no aberrations) as a function of off-axis distance. - [-need to do-]**

+ Figure 10. Suggest text change to "de-centered in the orthogonal direction with respect to Figure 9" [updated document]

\* Sect. 5.1.1

+ 2nd sent. "(sans charge diffusion)". We also need to address the real case of "with" charge diffusion. Can you discuss how this would affect the result? Should be able to get some number from Sean. [The math is to figure out what the detector plate scale needs to be, so it doesn’t use charge diffusion. The EBS models charge diffusion and so will the final system when transfer curve calibration is performed on the as-built system.]

+ 3rd sent. Suggested rewrite "and patrolling WFS (right column)". Where can WFE Budget v1.48 be found? [-kinda done-]

+ 4th & 5th sent. The jumps in logic aren't obvious to me so perhaps this could be made clearer. I also can't find any of the numbers you mention "1-D tilt error is 50 mas and the diffraction limited sub-ap spot size is 699 mas" in Fig. 11. I don't then see how you jump from these numbers to a particular "p" in table 1. Could you also explain the heritage and use of table 1 some more? [updated document]

+ Fig. 11. Should clean up caption. Capitalize first word. Suggested rewrite "that of the Patrolling (TT sharpening) LGS WFS spots" [updated document]

**+ Fig. 11. This table doesn't make intuitive sense to me and I wasn't able to find WFE Budget v1.48 to see the calculations. [-will post WBS before review-]**

**+ Fig. 11. "Diameter of point source laser at Na layer: 1.02 arcsec". This is larger than the 0.9" assumed at the LGSF mini-review which was already bigger than what I thought was reasonable and Neyman's analysis seems to indicate that we might want to design for something smaller. So, this number needs review. [Rich D. to investigate]**

**+ Fig. 11. It is not obvious to me why the subaperture tip/tilt corrected FWHM is poorer for the patrolling LGS. [Rich D. to investigate]**

**+ Fig. 11. It is not obvious to me why the elongation contribution is larger for the patrolling LGS. [Rich D. to investigate]**