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MoM for weekly Plan meet of 21 May 2014 (follow-up of some pending topics from different areas) :

## 1. Documentation related :

1.1 Follow-up on level 3 (NTR) -- pending for long : from 30 Apr & long before (SSK): to check status of report on design of OF system -- SSK to try and couple this with work on paper for MWSky. Needs urgent update -- was to be ready by 24 Mar! first version has been sent by SSK, but it is a 10 page report ! YG and SSK to discuss on how to reduce the length to fit MWSky requirements and what should be planned for a bigger paper. YG has sent detailed comments and suggestions for modifications for MWSky system; OF system NTR to be looked at separately?; need to be taken up for discussion.

==> YG to follow up with SSK on the MWSky paper; to take up OF system NTR based on output from OF Tx & Rx detailed design doc. Follow-up after 1 or 2 weeks.

1.2 Detailed design doc -- pending for long : from 7 May & before (SSK/BAK) : follow-up on subsystems to be converted :

(i) OF Rx system to be completed (Satish Lokhande) : first version has been circulated -- some improvements and additions suggested (e.g. to give reason for 10 dB attn, to give comparison with expected values from SFA report; to mention some precautions and practical issues during assembly etc). Update version is long overdue -- was agreed to be circulated after Satish returning from leave.

(ii) OF Tx to be started.

SSK was to look into this and get it started -- status update is required.

==> ANR will check with Satish and send update re OF Rx (and Tx). Regular follow-up next week.

## 2. FE & OF related :

2.1 Update on results from test range -- pending from 30 Apr & before (HRB/GSS/SSK) :

(i) phase centre tests for 250-500 CDF : to report on expt with 10 to 20 cm height change in 250-500 feed on one antenna to see how much change in sensitivity is seen. Tests done on c6 with feed having shortened support legs of the cone (instead of shortened stool) -- comparison of results for 1180, 1280 (default) and 1380 : 1280 & 1380 show slightly better sensitivity at low freq (250-400) but at higher frequencies they match with 1180 (which is quite flat throughout freq range); agreed to try for 1480 to see if there is a monotonic behaviour; also compare with simulation results of GSS. See also 2.1(ii)(c) below. Need update from latest round of tests.

==> consolidated results tend to show that the latest level at 1180 height does show a slightly better response; agreed that 1080 and 980 (which are possible with further cutting of feed legs) to be tried at medium priority level and results to be reported back.

(ii) calculation (based on reference paper) of the expected deflection & comparison with measurements to check if there is significant loss of sensitivity -- GSS to develop refined version more relevant for GMRT, and to see if further expts with 250-500 or 500-1000 feed are useful : cross check of results from code (0.3 dB for

0.5 lambda) wrt curves from Kildal paper was confirmed; for GMRT specific case of 250-500, to get efficiency factor as a function of freq over the band, after porting the data for the feed pattern -- after correcting error in the code, better result (9.9 dB vs 11.6 dB expected) was achieved; follow-up action included trying to use a realistic phase response (instead of 1.0) by reading data from a file etc. Results (reported on 19th Mar) showed better match between measured and expected deflections for the 250-500 system : 327 -- 12.8 dB vs 12.4 dB; 400 -- 12.8 dB vs 12.2 dB; 450 -- 12.4 dB vs 11.4 dB; 500 -- 11.2 dB vs 11.0 dB (some re-work needed for lower frequencies?); computed results (based on change in efficiency due to shift of phase centre) shows likely drop in sensitivity by about 1.4 dB from 250 to 500 -- this can now be folded into the net sensitivity / deflection curves made by GP. Present action items :

(a) GSS has sent a table at 5 MHz steps to GP, who is working on including it.  
(b) GSS is working on plans to extend this to 550-900 system.  
(c) Meanwhile, comparison of computed results with measurements for good antennas (other than C6) with default height of 1280 and for C6 (with reduced height of 1080) show that computed values are actually better at high freq end for 1080 ht, which is different from the observations which are showing droop at high frq for 1080 (in conflict with first results reported in 2.1 above !) Agreed that GSS should continue with computed curves for different heights (with maybe 10 pts across the band) and compare to see where the max response is and how it falls off with height and freq. and HRB to produce one more round of measured values.

==> for (a) GSS has given data with 4-5 points in the band (not clear if these are measured or calculated values), GP has done interpolation and has got a curve that falls off with increasing frequency, but has been asked to keep the eff constant below 250 -- these need to be understood and resolved; for (b) waiting for some of the improvements related to lightning protection etc to be completed; for (c) fresh measurements need to be done.

(iii) status of phase centre checking for ver1 550-900 CDF and CSIRO feeds -- waiting for results with new VVM set-up, after installation of new encoder + notch filter for mobile band :

(a) protection circuit for encoder and improved corrosion protection to be decided: Inteltek will get back on mechanical issues (such as proper alignment of shaft etc) and lightning protection (could also check with our servo team); grounding issues may also need to be checked; water proofing may be needed -- to discuss with HSK also. better grounding/isolation and proper alignment : to outline final plan of action. Waiting for Inteltek to respond about mechanical alignment and lightning protection; to follow-up about grounding and water proofing, including in-house efforts by Bagde and Ajee.

(b) new results from tests of ver2 550-900 CDF show : reasonable E-H match at 610 and then degradation in shape and matching at 700 & 800; partially supported by older measurements from Dec 2013 (with slightly different set-up).

Action items : (b.i) compare simulation vs measurement at 610 -- HRB has circulated initial results and some comments had been given on the same; (b.ii) to repeat with more frequency steps and then noise source instead of CW signal  
Also to complete the phase centre of ver1 550-900 CDF and CSIRO feeds...  
To check latest results, including CW tests with 50 MHz step have that have been done.  
Also : test range results for dipole v2a and v2b with cone v2 show that the degradation of pattern with frequency is worse for v2a than with v2b.

==> for (a) surge protector to be put in next few days; plans for improved water proofing + new side covers (with HSK); proposal from Inteltek for re-alignment of encoder placement -- proposal due shortly; measurements on 550-900 CDF yet to be done; same for CSIRO feed.

==> Regular follow-up on all items after 2 weeks.

## 2.2 RF dump tests for new feeds -- from 30 Apr & before (HRB/GSS/SSK/PAR/NK)

(i) new data and results for 130-260, 250-500, 550-900 (HRB/SSK/NK) :

(a) follow-up on regular tests (250-500 band) : to check if monthly overlay plots now available with off-source and on-off plots for comparison; new data from April onwards will have integration to reduce fluctuations & quick summary of the results; to check if Mar and Apr data are available for discussion.

(b) follow-up from analysis done by NK and plans for interferometric tests at 130-260 -- results from new round of data available -- can be discussed.

==> for (a) April data was a wash-out due to technical problems of shifting from manual to automated system; things are working from May onwards and initial results from May data will be circulated in the next few days; also, to maintain a log of the action taken on individual antennas based on the findings from these tests; quick review of March data showed a few peculiar problems -- to cross-check these with the May data.

for (b) initial results from tests by NK mentioned, but may be more useful to have a more detailed discussion about it sometime -- also, sensitivity of W1 appears to be significantly lower compared to that of C10 and this needs to be investigated; finally, a third feed is now available in the lab and can be put on an antenna after initial tests by HRB.

(ii) scheme for (re)calculation of expected values across the broad bands to be finalised (and added to measured curves) -- (SSK/GP/HRB) : curves now being done with constant QH value and with variation of T\_Ina with freq incorporated; model for the main BPF has also been put in : the deflection peak now matches fairly well across the band, but the curve rise and fall at the edges of the band is not quite matching : due an offset in freq or setting issue in the test equipment? this is not yet resolved; follow-up action to be discussed (including possibility to try it for Lband); also to add the efficiency factor in the code, as discussed in item 2.1 above.

(a) SP and HRB need to sit together to resolve and produce the final plots which show that the frequency shift is resolved

(b) report on status of adding the efficiency factor.

==> for (a) the matter appears to be resolved as having been due to difference in frequency resolution step; newer plots look ok (?).

for (b) efficiency factor has been done for 250-500 (see above for some unresolved issues there). Can think about trying for Lband and gathering the missing information required for doing this, including BPF etc.

==> Regular follow-up on all items after 2 weeks.

## 2.3 Follow-up on 550-900 MHz band filters -- from 30 Apr & before (ANR/SSK) :

(i) comparison of product obtained from ICON with in-house effort and finalisation of plans : technical comparison of individual filter responses shows in-house design to be slightly better; but need to complete integrated unit for insertion loss etc before taking a final decision, including plans for mass production. Tests with integrated unit using new PCB show insertion loss increases to 3 dB now and some change in slope on higher side; to complete chassis and full integration and then repeat the tests and make detailed comparison with ICON results. Some results have been circulated : detailed comparison shows that performance is very similar except for some out of band bumps (at 30 dB level) and slightly slower roll-off ; tried with AC coupling capacitors (no improvement); new board fabricated which after

retuning gave much better roll-off; PCB fabrication for this being explored with 2 parties (Argus & Shogini); meanwhile, some realistic cost estimate for in-house production vs ICON design have been done (it appears that getting things done with ICON will be much more expensive) -- to refine this process and reach a conclusion for mass production. Sample PCBs from Argus and Shogini have come -- first test results (without chassis) show ~ 5 MHz shift in 2 sub-bands but better roll-off : to put in the chassis and then confirm the results; to discuss detailed comparison of final in-house product (from Argus and Shogini) and ICON product and decide the course of action.

Final plots show same IL but the higher sub-bands have slightly shifted centre and widths which cross the main BPF upper cut-off; hence, agreed to retune the filter in-house and get modified versions done with Shogini quickly and then take a final decision. To check status of this effort.

==> modified filter files are expected soon from Shogini -- to check again after 2 weeks.

2.4 Total power detector for FE & common boxes -- from 30 Apr & earlier (GP/ANR/SSK): follow-up on plans for final scheme : 20 dB coupler for CB and 10 dB coupler for FE (at final output) with common 20 dB amplifier (Galli-52 instead of Sirenza); feed-thru vs connectorised arrangement also resolved; after lab tests (including monitoring via MCM channel) in FE and common box, sample units installed in C4 FE box and E2 common box. Current action items being followed :

(i) data from 2 units installed on E2 (in common box) shows basic things working ok: more sophisticated tests with on and off source tracking to be done (alongwith digital backend recording, if possible) -- first round of testing showed 11 dB deflection (for 12.4 dB expected), flat-top on-source waveform to be understood; new tests with noise on-off to be reported upon (also if weaker source like Crab has been tried); to try and get some fresh data and see if E2 can be used for night time tests. also to check what is the rms of noise vs least count of adc.  
==> no updates on these aspects, as most of the attention has been on FE units.

(ii) plans for building 70 units for CB : all PCBs and chassis are now in hand; need to decide plan and schedule for mass production and installation on upgraded antennas; agreed to work out an algorithm such that new units are made ready to match the typical / expected consumption rate of going into boxes; assembly of 5 sample new units gave some problems : old vs new flux (resolved); but no more units have been assembled.  
==> matter is at status quo for some time, due to work on FE units.

(iii) for FE version : 2 units had been assembled and found to give identical performance as per specs; problem of feed-thru vs connector was resolved in favour of feed-thru (as per original chassis design); all testing completed in the lab.

(a) first units put on C4 in original 250-500 FE box -- showed random fluctuations, not correlated between the two poln channels; not clear if it is malfunctioning of detector or due to wrong identification of monitoring channel -- not resolved yet;  
(b) meanwhile next units put on C13 -- one channel appears to be working fine and data is available but only from one test run, showing some problems in the form of dips; to repeat and check if the problem is real or not and then decide the course of action; also, to check if C13 Common box monitors are working or not; and if both can be recorded simultaneously.

(c) Also, new units being assembled (for batch of 20) are showing unexpected change in detector voltage upon connecting input cable etc. -- this was due to the grounding problem which was resolved; manual correction done for 10 units (5 antennas, of which

2 are on antenna and 1 more is getting ready); final PCB has to be modified for the mass production.

(d) RC time constant : some feedback from vendor, but not fully satisfactory; no further work done in the lab so far; existing ckt has 10k series resistor (as per data sheet).

==> for (a) no change in status; for C13, one channel working ok, other channel identified but likely to be FE box problem -- needs to be confirmed; both CB channels are working, but power levels / fluctuations may not be proper; agreed to plan for bringing down FE and CB from C13, provided spares are available for replacing for about one week, and debug the system on the bench. for (d) need to do a bit of follow-up work in the lab.

(iv) status of ITR, which was ongoing, but was halted pending above problems.

==> no scope for progress for now.

==> Regular follow-up on all aspects after 2 weeks.

2.5 Spares for L-band feeds -- from 30 Apr & before (SSK/ANR) : we have 32 feeds, 2 not working (1 dismantled for making drawings of new feed); all were device failures; now some LNAs have been successfully assembled by Gopi and C3,W1,E2 & E5 have been fitted with these and found working ok. Also, one spare feed has been assembled and installed on W1 and working fine.

==> to update about status of feed that was on W1 (ANR)

(i) Spares : Agreed to have at least 5 LNAs ready and available as spares : 10 nos of LNAs had been assembled, tuned and made ready (done); new order for amplifier device needed to make sure enough spares available. Gopi to update about the order.

==> awaiting update from Gopi (ANR to check).

(ii) check status of alternate LNA designs : to try and see if design used for 550-900 can be modified for 1-2 GHz use ; to also check the design done by Abhay Kulkarni -- ANR now looking into this design to see if it can be improved for our needs; design files had been obtained and were being checked by ANR. Status?

==> no change in status.

(iii) RFCM-type card status (3 nos of old RFCM cards are ready) : status of new RFCM card -- all tests cleared and 10 nos of this PCB obtained for current LBand spares, and 1-2 were being assembled for quick testing and components were being procured for the others : 1 card out of 10 fully assembled and tested and working fine; to ensure components for remaining are procured and they are made ready (gradually). All components are available and remaining 9 cards will be assembled; to check the status after 4 weeks (i.e. mid-May).

==> work is in process; can check again after 2 or 4 weeks.

(iv) finalisation of plans for having total of 8 working spare feeds -- from mechanical to electronics :

30 antennas have working Lband feeds; 31st is being assembled back after being dismantled for making drawing -- completed and installed on W1; 32nd is there in Pune wshop and can be shifted back; 3 new feeds were made in 1st round of work; all 3 are in Pune wshop and have been tested for RL with probes; but 2 of them have wrong size of horn and needs to be replaced; all 3 need new covers as old ones were not suitable (may be done in workshop, but not decided yet); in addition, 3 more feeds from Akvira have come : OMT + horn + cover ; also 2 horns have come and can be fitted in the 2 older feeds. Hence, total of 8 spares can become available.

Following issues need to be resolved:

- (a) Weight of 3 latest feeds is 18 kg more than earlier feeds -- to check which change in design aspect has caused this increase and whether it can be rolled back.
  - (b) shortfall in electronics for these to be checked and addressed : to confirm that all electronics needed for 4 more spares is available
  - (c) plans for assembling and making completely working feeds to be discussed.
- ==> no progress on (a); for (b) will confirm by next week and for (c) need a bit more discussion with mechanical about availability of feeds; FE can attempt one feed per month to be made ready.

==> Regular follow-up on all aspects after 2 weeks.

2.6 Characterisation of new FE+OF systems -- from 30 Apr (PAR/SSK/SN) :

(i) Summary of L-band results & performance (along with new data from Dec & later):

- (a) stability of power levels -- can be checked with existing data; also can this be coupled with regular program for monitoring in the control room?
- (b) antennas with large (~ 18 dB) slope across 400 MHz (e.g. C13, W1, S2...) to be checked and reported -- can this be closed after checking with new data from Dec? updates to the above 2 items are long awaited !
- (c) ripples and funny bandshapes to be characterised and compared with antenna base measurements to try and identify source of problem (S6 correction is done). FE team to complete analysis of existing data from Dec etc alongwith the new data taken, and report the integrated results. URGENT !
- (d) to check if new data / results, including on-off plots, are available and discuss conclusions from these.

==> automated dumping is still not working due to high freq isolation problems with the switch... agreed to try and generate off and on-off results for May data onwards for only full band settings (no sub-band settings).

(ii) Summary of 250-500 band performance :

- (a) stability of power levels and bandshapes; variation from antenna to antenna : some improvements in monthly plots have been suggested, including adding on-off deflection plots -- to check and follow-up on this, using the latest data as an example -- see earlier agenda item on this.

==> see discussion in earlier agenda items.

(iii) to characterise the recommended attenuator settings for different bands :

completed for Lband, 250-500, existing 610, only 130-260 / existing 150 -- to discuss once if values given to control room are optimal (e.g. 7,7 for Lband sub-bands) : from tests done by YG and DVL, this appears to be sub-optimal and need to be discussed; FE team to test the power levels at OF o/p and cross-check against SFA values; also, at 1390 the problem appears to be somewhat less and may be related to having extra 10 dB gain stage; FE team to confirm which antennas have this modification. VBB does not have a record of which antennas have the 1390 modification! Resolved the matter into 2 action items : (i) for FE/OF team to give measured values of power level in comparison with SFA and (ii) YG to follow-up with SSK about the notebook !

==> need a bit of relook at SFA to see if expected operating power levels are specified or not.

==> Regular follow-up on all aspects after 2 weeks.

2.7 Releasing existing 610 MHz system as part of the wideband upgrade -- from 30 Apr (SSK/ANR) : Preliminary tests of existing 610 feed through the wideband

path show that ~ 100 MHz usable bandwidth may be possible as part of phase-I uGMRT. Agreed that only RF filter needs to be changed to new 550-900 BPF (alongwith mobile band and TV notch filters) -- two sample units had been made ready and were put in FE ch1 of C8 & C12; initial RF deflection tests look encouraging : extra 10 MHz on lower side and 20 MHz on upper side, leading to a total BW of ~ 120 MHz (~ 565 to ~ 690 MHz) + some lower level response (5 dB down) upto 780 MHz; action items :

(i) to carry out 2nd round of interferometric tests to characterise the performance; YG & DVL to report on this. data taken just before MTAC was corrupted by ionospheric scintillations; new data taken one week ago showed problem of low correlations in GWB; waiting for new, reliable data set to be taken.

==> no major update on this, except that new data is being taken after sorting out issues related to GAB and GWB.

(ii) to discuss finalisation of PCBs for the filters :

(a) we have 100 PCBs that can work for either 175, 540 or satellite filter; of these 12 nos are wired up for 540 filter; 2 nos used for satellite filter; will need a total of at least 120 nos of 540 filters for all GMRT (60 each for 2 bands); to order components for 120 nos of 540 filter (including 3 month old indent for inductors) -- status of this needed;

==> inductors have come; new requirements for inductors and capacitors (for 120 nos of filters) have been indented; can check after 4 weeks. note that available no of PCBs have been reduced to about 60 now; so we need to order more of this PCB.

(b) 80 nos of chassis are available; remaining 20-40 nos to be made (likely to be outsourced; 100 nos chassis ordered for 610 as well as 250-500 (with workshop) -- need status update on this.

==> the 20-40 and 100 nos are on hold as lightweight, smaller, rail chassis are being made : 20 nos have been asked for; 80 nos of older chassis may be sufficient for 610 system; hence, no need to order more chassis for 610 related work.

(b) for mobile filter, 60 nos + 10% spare are needed; only 2 PCBs are available; about 50-60 chassis are available; to see if 10 PCBs for 5 antennas can be ordered for this, given available substrate material (which is also needed for other PCBs) -- using one board; remaining PCBs can be done later on; more epsilon10 substrate material needs to be ordered; 2 PCBs have been ordered (with 850 MHz lower cut-off); to check present status of all this.

==> agreed to order ~ 10 PCBs which fit on one substrate board; also to order more substrate material, after taking stock; for new filter 2 PCBs have come; to test and report results wrt previous design and circulate for discussion 2 weeks later.

(iii) to check how many antennas can be done with present hardware and plans for the same, following the path of the 250-500 upgraded antennas : confirmed that 4 nos of 540 notch filter is ready; 8 nos of mobile notch filter is ready; 10 nos of BPF are ready (if chassis is there); spare FE box is also there; to try to target one antenna in next few weeks, depending on schedule of 250-500 notch filter installation.

==> one antenna has been done (E2); next antenna to be done in next couple of weeks.

==> Regular follow-up after 2 weeks.

2.8 Status of new CSIRO feeds : from 30 Apr & before (ANR/JNC/HSK) : to report on performance of the newly manufactured feeds -- new results are slightly better compared to ver2 (casting) but not as good as the original ver 1 (machined by Godrej) -- to decide follow-up action.

==> no updates; to follow-up after 2 weeks again.

2.9 Calibration scheme with radiator at apex of antenna -- from 30 Apr & before

(SSK/PAR/SRoy/DO/YG): to follow-up on detailed discussion meeting in August : to schedule follow-up action appropriately, breaking the issue into smaller, more tractable items :

(i) testing of dynamic range of old vs new electronics with parallel set-up on 2 antennas, C4 (new electronics) & C1 (old electronics) -- SRoy to work with FE team on this -- first round of tests done and preliminary results show the following : appears that 1 dB compression pt has improved by 6 to 8 dB (from -6 to -10 dBm to about -1 to 0 dBm); change in phase (and also ampl?) with change in elevation shows cyclic variation -- may be due to position shift? needs to be explored further; change with time shows... (?) present action items :

(a) short report to be circulated -- PAR had done a quick version, with an update -- need to discuss these.

(b) to check the change in 1 dB compression pt against SFA numbers.

(c) to repeat on another antenna with new electronics and one with old : W1 had been identified, and work for RF cable and antenna mounting related arrangements was completed and tests were to be done.

(d) later to try for other wavebands when new transmitter antenna arrives.

(e) to get the plots done for the variation with antenna position (elevation etc) and then work on interpretation.

(f) later, to move to finer aspects of variation with time (see item (ii) below).

PAR has circulated short summary, followed by an update. Need discussion on this to see where we stand, and what should be next step.

==> email updates from PAR : for (a) report is being updated; (b) being checked; for (c) experiment has started; for (d) mount has been made ready and tests will be done shortly; for (e) fresh tests on W1 started.

(ii) SRoy has done the basic calculations but needs to cross check against the beam width of the feed to estimate the amount of deflection / shift between feed and transmitter at apex required to produce the measured change in signal level.

==> test done by Subhashis last week for rotating the feed : power falls by a factor of about 4 with about 600 counts from the 0 reference position (-700 to +200 arcmin range) : fitting a gaussian to the voltage pattern (asymmetric) gives a HPBW of about 21 deg (about 15 deg for power pattern); this gives about 2 deg for 0.5 dB change in power. SRoy to refine the calculations (including other antennas) and also check Raybole's new report on this matter.

(iii) finer aspects of variation of ampl and phase with various external parameters (DO to work with FE team on this) -- need an update on the status of this.

==> not discussed.

(iv) other longer ranging goals :

(a) procurement of new broadband antenna : suitable unit (from Aronia) has been identified and ordered : 2 nos have been received (with slightly different freq coverage) -- looks like will work from 100 MHz to few GHz (hence OK for our use).

(b) testing with broadband noise source : feasibility of connecting noise source and radiating has been checked by PAR -- test can be done with set-up at W1, which should have been ready by now; to check the status.

==> no significant updates

==> Regular follow-up on all aspects after 2 weeks.

2.10 Walsh switching arrangement in FE -- from 30 Apr & before (SSK/SCC/PAR) : Some tests have been done on the bench by FE group; first draft of report has



been circulated.

(i) to devise a simple test using Lband system + radiation from apex to demonstrate the working of the system (on any antenna) -- agreed to try and couple this with the new test set-up at W1; agreed that CW test can be done to check functioning of modulation scheme when other tests are done at W1; FE team tried 4 antenna test including C13 but could not get a definitive answer; to try again, including checking the Walsh bits at antenna base. Status update needed.

==> appears that the problem was due to improper test cable used at antenna base; new cable with all cores connected is being made for this now; will be ready to test later this week; further, it was found that Walsh eeprom IC has been removed from all antennas by BE team; restored in W1 now and tests to be completed and reported upon shortly. To have regular follow-up after 2 weeks.

2.11 New filters for Lband -- from 7 May & before (ANR/SSK) : Sample Lband full-band BPF had been designed -- has no slope with freq and better insertion loss, and maybe a better option than the existing main BPF; similarly, prototype design of new sub-band filters (with better insertion loss) has also been done.

(i) Latest results show that the LF cut-off for the new filters may be much sharper than for existing one -- implication of this needs to be discussed.

(ii) Should we go ahead with the main BPF as a low priority job -- PCBs (stripline) does not need much work for assembly -- can be given for manufacture; new chassis will be needed; population can be done as and when a FE box comes down. PCB order for 70 nos can be sent using existing eps10 board; both pols can be combined in one chassis requiring 35 nos only -- drawing to be finalised for rail-type chassis; to check if existing chassis can be re-used;

(iii) : sub-band filters can be taken up at even lower priority later on.

To discuss the matter in detail and decide plan of action -- item summarised in Friday discussion session : to discuss and decide follow-up action, including note for GSG etc.

==> discussion from Friday meet was reviewed and follow-up action agreed : FE team to generate a formal note describing the new proposed BPF (at Lband FE) + LPF (at antenna base) combination for the final scheme, clearly showing the difference wrt existing system, for final approval via GSG. Regular follow-up after 2 weeks.

### 3. RFI related matters :

3.1 RFI testing of Miltech PC + peripherals for antenna base -- from 30 Apr and earlier (PAR/SSK/SN):

(i) Stand alone testing of new i5 Miltech PC to check improvements from earlier version : Miltech PC alone shows better performance than earlier version (although all the extra screws not put by vendor!);

(ii) Integrated testing new i5 Miltech PC with peripherals -- using new shielded ports, connectors, shielded media converter + cables, Rabbit card (with Akvira make shielded box) showed good performance (interim report with block diag & conclusions/recommendations has been circulated) : the combined unit with Rabbit + switch + PC + media converter (with shielding fabric) + shielded CAT5 cable + shielded + filtered connectors on Rabbit box shows very good performance.

(a) RFI team to make the final report and circulate;

(b) summary of items and information for Ops Group to take over from here.

==> on (a) final report will be done shortly; for (b) email and f2f communication ongoing between RFI and Tel group; to aim for about 70 (60 + 10) nos of shielded boxes for antenna base requirement. Regular follow-up after 2 weeks.

3.2 RFI tests of ethernet switches for antenna base -- from 30 Apr & earlier (SN/BAK/SSK): Testing the available switches for RFI (as per 29 May discussion); plans for design of RFI box for ethernet switches :

(i) procurement & testing of switches : sample units from Cisco, HP, Dlink and DELL had come and have been tested for RFI -- conclusion from final report is that D-link is much better than others (but it is 2x more expensive than next best option of CISCO by 20K); also, use of shielded CAT5 cable provides significant improvement; agreed to wait till RFI enclosure is ready and do full test with CAT5 for both D-link and CISCO and take a final decision; meanwhile BE group can borrow the units for testing in GAB system. first version of RFI enclosure has been received on 10th Mar, and is under integration in the lab; 2 nos RFI enclosures completed with mouting of filtered and shielded adapters, eth cables, AC pwr line filter, shielding for fan etc; all the 4 available switches tested one by one in these enclosures (on 20-21 March) and draft report was discussed : first results look very good; isolation is about 70 to 35 dB from 100 to 1400 MHz; further, improvement is seen with switch + shielded CAT5 only (without box) and this is best for CISCO -- this could be the final option for all use at GMRT? To be confirmed after the final report is out.

As per PAR, same switch that works well for both situations is the D-link and that CISCO will not work well for just CTA5 shielding -- this point needs to be resolved with PAR separately.

(ii) design of RFI enclosure (see item 6.6 below)

can wait for final report and also final integrated test of switch + PC + Rabbit card + media converter ++

pending for final report from tests (see above) before moving forward.

==> no change in status... to follow-up after 2 weeks.

3.3 Follow-up on UPS RFI -- from 30 Apr & earlier (SSK/PAR/RVS) :

(i) procurement of units from Miltech (RVS) : both 1 and 3 kVA units are under discussion :

(a) tests of 3 nos repaired 1 kVA units from Miltech showed significant RFI -- updated report comparing original Miltech 1 kVA test reports (with same load conditions) have been circulated; Miltech has offered to fix the problem with these units and electrical group had sent these back (transfer of order from servo to electrical?) -- need to check status of delivery of these units back to GMRT. Miltech is not delivering these and we are on the verge of cancelling this order; to confirm final status and close this item accordingly.

(b) Miltech has offered improved version for 3 kVA unit -- order has been placed for the same and unit is expected by early-mid Feb : Miltech will deliver along with improved 1 kVA units -- was expected by 25 Mar, but did not happen and there is no clear update from Miltech about delivery. May need to be canceled, like the order for 1 kVA units -- need final status update on this from RVS.

==> no updates from RVS.

(ii) UPS units from Ador : 2 nos of 3 kVA was purchased, tested for RFI & cleared; units are in use in C9 and C10. RFI team has added comparative statements at the end of the 2nd report quantifying the repeatability; bigger units : agreed to order 2 nos of 4.5 kVA units with Ador, with option of 2 single phase o/p with different isolation transformers (3 + 1.5 kVA); units were delivered but failed the RFI tests -- lots of discrete lines seen; Ador had taken the units back for modifications -- need an update on the status of these.

==> no updates.

(iii) to discuss if we should go back to 3 kVA as the default choice, with or without split outputs.

==> no discussion held.

==> Need follow-up on relevant matters urgently in next 1 or 2 weeks.

3.4 Discussion relating to Industrial RFI survey -- from 30 Apr & before (PAR/SSK) : revised docs (from 2009 and 2012 discussions) had been circulated by RFI group and were discussed in 5 June meeting (is the document too exhaustive?) : follow-up action identified :

(i) a form had been prepared for use in the survey and had been discussed in detail and agreed that it is suitable for use; need to finalise plans for entering existing data into this form : one possible candidate (trainee) had been identified and work was ongoing -- 30% was completed; to check latest status.

==> no updates.

(ii) plans for starting survey asap with 2 teams (with extra manpower), lasting for one month, using SoI maps, form etc, to be finalised : 1st week of April was agreed as the start date -- check if this is confirmed by both sides; vehicle requirement (2 nos) to be discussed with admin, as well as accommodation request of DIC members; one more engineer needed for the job has been found? To check which of the above are finalised and can be closed; date was deferred to 1st week of May due to elections; start date further pushed till end of elections; to aim to complete in 2 weeks, but may stretch longer. extra manpower : one person has been identified and paperwork is getting done.

==> joint meeting with DIC proposed in first week of June -- looks like item is getting delayed out of hand; need to find some way of actually moving forward !

==> YG to discuss with PAR and organise follow-up in next 1 or 2 weeks.

#### 4. Operations :

4.1 Identification of appropriate ethernet switches for antenna base (and GAB)

-- from 30 Apr & before (SN/PAR/BAK) : Ops group to work with Comp team and RFI group to plan for trying some of the 16/24 port switches for antenna base use :

(i) tests show that the shielded enclosure appears to be working well (see item 3.2)

RFI team to start handing over the information and material to Ops Group; for the switch itself one round of discussion between PAR and YG and then a final call on the matter.

==> can initiate the discussion between RFI and Ops group (with mech group as needed) to initiate the hand-over.

(ii) plans for BE teams need for switches in GAB system (in receiver room) :

agreed to use 8-port switches for now though they are worse in RFI than the 24 port ones tested for antenna base use, and take a final decision later on -- agreed that

all groups can use the same layer-2 switch finally; same for the SMPS power supply

-- 2 nos ok for now; need some discussion on this matter, for long-term planning :

to work out the max data rate on this switch network (for looking into the communication failure problem); other possible reasons (including socket error

checking) discussed, changing to star connectivity from daisy chaining -- matter

under investigation; to try the new 24-port switch (maybe CISCO unit) after MTAC.

Switch testing by BE group can start after MTAC as per earlier agreement;

other items may need a more detailed discussion -- to be done this week.

RFI team to be asked to refresh about relative RFI performance of 8 port and 24 port switch; BE team to take CISCO unit and give it a try as replacement of one 8 port switch and think about replacement of 3 switches.

==> no updates.

==> Regular follow-up after 2 weeks.

4.2 New, improved Miltech PC -- from 30 Apr and much earlier (CPK/SN/PAR) :

(i) 2 units of Miltech PC with two changes (more screws on panels + panel mount pwrline filters instead of chassis mount) were under test : one unit was given for RFI testing (see item 3.1 above); 2nd unit being used for basic software installation and testing of different aspects -- need status update on this;

==> we are generally ok with all aspects of the machine and matter of suitability of this model can be closed (there may be a thermal shutdown safety issue but it works ok at antenna base).

(ii) one earlier i3 unit had failed -- was to be checked by Sumit -- need status on this.

==> this is still pending.

Only open item is to organise a discussion about whether we need 30 nos of this PC or not !

==> YG to discuss with Ops group and organise follow-up in next 1 or 2 weeks.

4.3 Development of M&C software -- from 7 May & before (JPK/RU/SN/NGK) :

(i) M&C software with TCS -- updates from PoC phase : to check status of report and demo of specification driven approach : is final version of report done ? when is the demo scheduled ?

==> SN to circulate the final version sent by TCS to all team members and stake holders and try to achieve closure by end of this month; JPK to write to Subhro to firm up date for pending demo.

(ii) taking up EPICs based PoC version for putting additional functionality : to check status of this activity.

==> basic loading (and unloading) of the EPICs has been done successfully on the machine; now need to connect Rabbit card and test existing PoC software and then go to the new addition to be done; Naresh and Yogesh to coordinate about putting the Rabbit card in the lab.

(iii) plans for tasks for next phase of work for new M&C software : architecture definition and UI definition tasks to be started -- to check if task definition is refined enough for finalising and sending out the indents.

==> architecture definition work is defined and ready to go out for tendering; UI definition work is in last stages of definition.

(iv) follow-up on interface of FE with new M&C system -- Naresh + Charu & Sougata + Rodrigues were working on this; will have full set-up of FE + Common box, but will start with M&C of common box using Rabbit card : initial h'ware connectivity may not be too much work as 32 lines have to be mapped to 16 lines on interface card; low level software for bit pattern setting may be enough to demonstrate basic connectivity; after that, packaging will be the issue. Team had reached the point where able to set bits using the set-up of Rabbit talking to interface card; bit pattern from MCM to interface card coming out as expected; after that, the signal does the desired downstream cards (e.g. band selector card) -- looks like the correct bit pattern is not being set -- needs some further investigation. appears that the basic set-up is now working, and tested (by Rodrigues + others).

To take stock and decide follow-up action.

==> follow-up from last week's demo : basic difficulty of communicating via Rabbit to FE appears to have been resolved with demo of some commands by Rodrigues et al; to check if all the available commands can be exercised; to decide the set of high level commands for FE system; for many of these Naresh already has the placeholder to accept the commands and action to be taken has to be programmed, in Rabbit software -- can be initiated.

==> Regular follow-up after 2 weeks.

## 5. Back-ends :

### 5.1 Documentations :

(i) Detailed design doc -- pending for long : from 30 Apr & before (BAK) : analog back-end was being done by Hande; 2nd version had been circulated and it needed some additions -- introduction to LO PIU section by NDS -- to complete the document to PIU level; next level of document will go down to chassis level and will take till mid-May; to check current status.

==> to resolve the matter between NDS and BAK; next level doc work has not started.

(ii) ITRs for analog back-end systems and digital systems to be taken up :

analog back-end : Sandeep and Navnath to look into; pkt corr first level has been done and circulated -- waiting for feedback; GWB first version (by Reddy + Irappa) has also been circulated -- authors are working on a second version with additions; need to discuss contents and decide follow-up action.

==> work ongoing, to circulate as soon as possible.

==> Regular follow-up after 2 weeks.

5.2 : Power supply for GAB : from 30 Apr and before (NDS/BAK) : Two options are possible : linear vs SMPS. Agreed to produce comparison note with all pros & cons. Meanwhile, a few SMPS units can be bought, as the cost is very small. Still waiting for comparison note !

==> note is in internal circulation, waiting for Ajith to give his comments. to check again after 2 weeks.

5.3 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from 7 May & before (SHR/SSK/BAK) : (NOTE : GWB-I is existing released system !) : agreed to make 4 T7500 nodes with C2050/C2075 Fermi GPUs + remaining 4 T7500 nodes as host machines (to take care that these are the ones that transient pipeline uses presently so that sharing is possible); this should have ALL basic modes : total intensity and full polar IFR modes; IA + PA BFR modes with process\_psr pipeline attached; full GUI support; to come up in trial code section without affecting the presently released mode.

(i) testing of GWB-II interferometry mode with different LO schemes in GAB to clear which modes work properly and which don't -- DVL + YG to provide an update.

==> it is clear that fixed LO vs FSW is behaving differently and needs to be fixed by GAB team.

(ii) beam modes in GWB II : new version with separate kernel (outside phase shift kernel) for beam formation has been developed (compute load is 7% increase on 2050 GPU); IA mode tested; PA mode completed and tested; phasing implemented & tested;

610 MHz with 200 MHz LPF -- to test with different setting in pmon to check S/N effects; process\_psr pipeline has been completed and released; first version of SOP has been released; pending action items :

(a) GUI changes for beam mode support have been made by NSR but need to be tested and cleared by SHR;

==> cleared and included in new SOP.

(b) GUI changes for flexible phasing to be checked with SHR & NSR;

==> tbc

(c) beam mode still working with fixed channel and time factors -- need to be made general purpose;

==> this is still pending.

(d) float to int conversion logic has been implemented for scaling but needs a cross-check -- agreed to add one scaling factor under developer control and study the algorithm in detail later on.

==> this is still pending.

(e) availability of psr\_mon on nodes 53 and 54 for recorded data is there; for shm attach needs some work;

==> this is still pending.

(f) header for beam mode data : to be taken up in the present situation and incorporated alongwith the PA mode; to discuss further to see if it should be introduced at the time when sub-array is being tested.

==> pending.

(g) SOP to be made ready : NSR to be asked to update SOP to include PA mode; also to check the directory structure etc being used by beam mode data acquisition systems

==> some of the suggested changes can be done more easily and will happen shortly; others may be done at the time of GWB-III set-up.

(iii) spikes in channels that are power of 2 : this problem needs to be discussed, understood and fixed. SHR has started looking at it, but no clear clues yet. may help with test using digital noise source; effect is seen in packetised corr also; now checking offline with raw voltage data acquired through Roach board, and with digital noise generated on Roach board; KDB has digital noise source + GWB spectra now running and some of the issues can be investigated.

==> testing with noise generated in digital domain does not appear to show the problem. not clear what is the best thing to do now.

(iv) SOP update : new SOP has been circulated by Nilesh -- some aspects need to be checked and updates may be needed.

==> see item above.

==> Regular follow-up after 1 or 2 weeks, depending on item.

5.4 GPU corr (GWB-III) : next gen system -- from 30 Apr & before (SHR/SSK/GSJ/BAK) :

New improvements needed for finalising the design for the full 32 ant, dual pol system : 4 new DELL machines are in the rack and wiring + cabling is complete, running with analog noise source; new code with 2 x 10 Gbe I/ + improved logic for assigning specific threads to each core + env variables is completed (tested for 200 MHz / 8 bits and 400 MHz / 4 bits, 16 inputs and working ok with no pkt loss); ongoing action items :

(i) improvements in GPU code using K20 card (SHR/SSK) : cross-check on FFT code (done and can be closed); calibrating MAC performance vs data reshuffle load (done and no further improvements look possible; can be closed); pending action items :

(a) looking at XGPU code (with Pradeep & Vinay of nvidia) -- GMRT corr code is now

running on their machine (using K40) -- to update on latest status of discussions and interactions with Vinay.

==> Vinay has isolated the two MAC codes and it appears that xGPU is running a bit faster; this needs to be confirmed, and follow-up action decided.

(b) trying sample PA beamformer code to estimate load etc. -- will come when PA beam mode is released in GWB-III -- to confirm that load is less than 7% for both beams? old estimates are for C2050, ratio may change on K20.

==> can leave it pending for some time.

(ii) other improvements in code :

(a) issue of net\_sign[] flipping (LSB/USB modes of correlator) to be resolved : needs some change in GPU & DAS code; for GWB-II, it was agreed to not fix this problem in GWB code, and a patch was provided for LTA files -- this has been done and tested ok; to fix the code ab initio in GWB-III.

==> pending for now.

(b) long-term items like provision for control of FPGA and other peripherals (like sig generator) for different modes -- details of existing provisions to be discussed and plans for final configuration to be finalised: agreed to identify one PC for control of all the peripherals related to GWB; this m/c can / is interfaced to online via a socket and GUI can send commands via this -- already done for loading of FPGA files, needs to be extended for other applications.

==> pending for now.

(iii) to start testing 400 MHz BW mode -- how best to conduct these tests? all changes in the main code to handle 4 bits etc have been done (but not put in GWB-II) and now need to be incorporated in GWB-III and tested; need a discussion on this -- agreed to defer for some time. Are we ready for this now?

==> all the hardware wiring is done; need to check the power cabling; to confirm this and see if we can initiate the testing with the new, improved code.

(iv) Layout and racks (GSJ/BAK) : layout diagram to be updated and long-term plan for racks to be initiated; 3 different kinds of President racks discussed -- to try and finalise after one more round of discussions including RVS (also, new vendor Jyoti Tech); meanwhile, agreed to get 2 nos of cyber racks on urgent basis : 2 nos of cyber racks ordered with President -- to check delivery status; for the "cool" racks, not much response from President; some response from Jyoti Tech; need to follow-up and decide course of action; meanwhile, 3 nos of half-height racks were getting ready -- two nos are populated with the 4 new nodes each, the other will have 8 Roach boards; clk and input cabling to be finalised; dialogue ongoing with President but no firm date of delivery -- to check with purchase dept about follow-up; meanwhile, to initiate dialogue with Jyoti Tech for 2 similar racks. 3 half-height racks are almost ready, except for some wiring; host nodes to be kept separately.

==> no updates as relevant members not present.

(v) procurement of accessories like network cards, disks, cables etc to be looked into -- 20 nos of CX4 based dual 10 Gbe cards to be purchased -- these are compatible with T620, may give some trouble with R720 (for 2 GPUs). indent submitted and only party quoted -- in last stages of clearance for placing the order. Status?

==> no updates.

(vi) new purchase of Roach boards etc : follow-up on status of order -- expected date of delivery was given as June ! GJS had followed-up with Mo Ohady about this with a request for fast delivery -- appears that our boards are going to be tested soon

by Mo, so shipment should happen soon; to follow-up and see if a firm date can be got.  
==> no updates.

(vii) purchase of 4 new host machines for GWB III : to decide configuration of host machines (disk i/o to be kept in mind) within next few days; also to check if SSD is a viable option now for recording of data. Needs update urgently !

==> SSD vs SATA discussion has pros and cons; it may be possible that one class of server may be there that supports both; to check if we can shorten this process by choosing basic server that meets the requirements using SATA disks.

==> lots of items with no updates; need urgent follow-up on some in next 1 or 2 weeks.

5.5 Walsh modulation : prototype set-up on Roach board -- from 30 Apr (SCC/BAK): plans of BE team for implementing prototype scheme -- basic unit for switching using sq wave signal from GPIO pin tested ok; was put in main PoCo correlator and was being tested; walsh waveform delay functionality has been added now and can set delay from 1 to  $2^{32}$  clk samples (!); with this, variation of correlation with delay has been tested; to generate final plot showing this behaviour (done?); to aim for a robust algorithm for hunting for the peak and detecting; can also think of a test case of showing cross-correlated signal goes away with modulation with square wave in one channel; Walsh pattern being put in the Roach2 : ok, as very few slices are needed; issue of accuracy of the oscillator being used in the Walsh generator; what about synchronisation of starting?; Identified 3 possible action areas for work:

(i) to complete the Walsh modulate and demodulate set-up in the lab -- almost ready.  
(ii) to optimise the hunting algorithm;

(iii) to demonstrate cancellation of unwanted signals in ADC card and/or GAB

==> no update as SCC on leave. to follow-up after 1 or 2 weeks.

5.6 RFI filtering -- from 30 Apr (KDB/BAK/YG) : to add the first version of the real-time RFI filtering block (after some modifications) into the packetizer of GWB-I (in one input out of two with different options like replace by median or by constant or by digital noise source sample or clip to threshold via s'ware registers) -- basic tests done; to try with real antenna signal split into 2 copies and check both self and cross outpus; to report about performance of the same, and then to look into optimisation of resource usage. tests completed with GWB-II and being planned for BOTH channels; bit of discussion and agreed to see if a time domain test using either corr self powers or 2 IA beam signals can be tried.

==> some tests with varying sigma have been tried but some issues with very high sigma values ( $> 5$ ). to check again after 2 weeks.

## 6. Other items :

6.1 New python assembly design -- from 30 Apr (HSK/SSK) : FE group wants the python configuration in E6 to be adopted for all antennas -- this needs to be discussed with mechanical group and finalised; FE and mech have dicussed about plans for modified python assembly that will give additional protection to cables; mech group had circulate a short note on their view of the matter, alongwith photos; this was discussed and existing vs E6 system was compared; Action item :

(i) modified E6 design with hinge-like support to be put on one central square ant -- short-term solution -- ready to be installed and tested : FE team to check status and identify "weak" antenna for this work : could try to do in next few weeks, just after MTAC? still pending to identify an antenna with FE group ?



==> item still not resolved between FE and mechanical teams !!

(ii) IGUS cable wrap -- new technology prototype to be developed and tested on quadripod; also option of hose without wire impregnation -- long-term solutions.

1] hose without wire impregnation

2] Entire hose assembly under procurement (long-term solutions).

Quotes for both items received : item 1 is Rs 10k for 10m (4 antennas);

item 2 is 60k each -- will try on the quadripod test range. Need status update about placing of order.

==> quotation received; follow-up in progress

==> to check status after 2 weeks.

6.2 Coexistence of 50-90 MHz RRI feed with 250-500 CDF on same face of turret -- from 30 Apr and before (HSK) : Mech group to check for possible solutions and report back, after looking at the drawings (awaited from RRI). Update from mech group about reverse engineering for making the drawings -- mech group has circulated a brief note : discussion showed that it is not compatible with 250-500 CDF (either cone has to be truncated or its height has to be raised by 30 cm to avoid conflict) -- may work with 550-900 CDF; mech group to try a solution for co-existence with Lband feed; dipoles removed from 2 antennas have been collected (slightly damaged, but can be repaired); will shift reflector to Pune workshop for testing with Lband feed there; possible solution has been worked; sample arrangement to be shifted to GMRT next week; needs a more detailed discussion along with FE team about possibilities for installation and follow-up tests, and also possible simulation to check the effects ?

==> set-up has been shifted to GMRT; need to work out mechanism for follow-up of the same, with FE team. YG to initiate discussion and regular follow-up after 2 weeks.

6.3 Problem of access to FE boxes with 500-1000 CDF feed -- from 30 Apr & before (HSK) : Update on new solution being designed by Mech group -- tested in situ and found working ok; agreed to use this for present; for future where bigger and heavier boxes will come into play, mech group will think of an improved solution, including an option for removing one feed and bringing the stool inside the basket; quick status update from mech group, with detailed follow-up later on. Action items agreed upon : first to check with new heavier box and see if existing solution is practical; if not, then to work on new option; meanwhile, a few alternative options are being explored by mech group, with target of 1800 mm height for boxes with max weight up to 150 kg (?), quotes received from some parties -- follow-up to be discussed. Item has been introduced in SMEC for broader follow-up -- HSK to circulate the relevant material.

==> relevant documents will be circulated for discussion in SMEC shortly; to check status after 2 weeks.

6.4 Fabrication of 6 spare L-band feeds -- from 30 Apr & before (SSK/HSK) : Order to Akvira for 3 nos (with enclosure) + 2 extra horns. Hence, total of 6 feeds will be ready + 1 dis-assembled unit + 1 old feed at Pune -- so total of 8 spare feeds will become available.

Feeds inspected at Akvira site - many corrections / suggestions for improvements have been made [e.g. improved probe mount : press-fit vs. screws; M4 -> M5; etc]; delivery expected (after these modifications) by end-March'14; one assembly made ready at NCRA w/shop and sent to GMRT last week; 3 sets have been delivered at GMRT; fabrication of 3 enclosures is under process. To check latest status of this.

==> procurement of 3 enclosures is still in progress; to check again after 2 weeks.

6.5 Design of RFI enclosure -- from 30 Apr & before (HSK/PAR) : (see item 3.2) inputs for front panel design given to R. Lolap for completion of drawing; prototype was to be fabricated in w'shop, but is now outsourced (?) -- getting ready for placing order (somewhat excessive cost due to all-machining design -- ok for prototype unit, but different solution can be looked at for mass production) -- to expedite the delivery as much as possible : order has been placed; delivery of 2 nos delivered to NCRA Stores on 3rd Mar -- delivered at GMRT now; waiting for test results before deciding follow-up action...  
==> no change in status.

6.6 Improved software for work requests -- from 30 Apr and before (HSK/SJ) : To review the current process of taking job orders for better facilitation of the tasks with end users like electronics groups. YG discussed offline with HSK : to look to fill the lacunae in the process with maybe new development of in-house version? Aagreed to try and get this done in-house with Joardar -- can be taken up after completion of ongoing tasks related to electrical -- to confirm plans and status : work not started yet; needs a discussion with Joardar.  
==> no change in status, as Joardar and team are busy with other works at present; YG to take up for discussion with Kale and Joardar and bring up 2 weeks later.

=====