



# SCUBA2 Data Reduction Software

## "delta" Preliminary Design Review

### Review Panel Report

**HIA, UBC, ATC and JAC videoconference  
December 10<sup>th</sup>, 2003**

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## **1. Terms of Reference**

The terms of reference of the original PDR review were defined as follows:

The purpose of the meeting is to review the preliminary design for the SCUBA-2 Data Reduction SW. The preliminary design review is intended to establish that all design requirements are defined, all major risks have been identified and development specifications (performance requirements and interfaces) have been produced for each sub-element of the Data Reduction SW before detailed design commences.

The review panel is asked to consider the following guidelines as a basis for the review:

1. Does the current Data Reduction SW design, as presented by the Project Team, comply with the relevant scientific and technical specifications?
2. Does the preliminary design address the required standards with respect to good engineering practices?
3. Are there any uncertainties in the preliminary design that need clarification before progress to detailed design can be made?
4. Are the relevant interfaces suitably identified and defined so as to minimise risk to the project?
5. Is the development and testing plan realistic to deliver a working data reduction SW ready for pipeline verification according to schedule?

Confirmation that the current design addresses the formal requirements and is sufficiently advanced to PDR stage is sought in order that the Project may proceed to the next stage of the SW development with confidence i.e. the detailed design can commence.

### **1.1. *delta PDR documentation***

In addition to the above terms of reference, the PDR panel report also provided the following instructions to the team on the documentation that was to be submitted for the delta PDR:

- a) A new version of the requirements document showing: any additional requirements identified in the design documents and the review; separation of possible specifications into requirements, goals and items which are explicitly not addressed by the design. There should also be two compliance matrices for traceability. The first shows the source of each requirement, and the second shows, for each source, which requirements are relevant.
- b) A new document summarizing the design that, at a minimum, contains two compliance matrices. The first shows, for each requirement, which design elements (via a reference to the description of the design element in the design documents) satisfy each requirement. The second shows, for each design element, which requirements are addressed.
- c) A new version of the ICD document showing all interfaces.

- d) A new version of the risks document addressing:
- Depth of personnel
  - Location of work
  - Budget implications
  - Starlink support
- e) A new version of the management plan with:
- A list of tasks, showing derivation from design elements.
  - A management-level block diagram.
  - A list of external dependencies and dates.
  - A list of dependencies within the SCUBA2 DR project.
  - Resource allocations to tasks.
  - A Gantt chart summarizing all the above.
  - A true budget estimate based on the design.
  - Critical path analysis

## 2. Documentation

The documentation provided for the SCUBA2 delta PDR is summarized in Table 1. It was distributed to the panel electronically 11 days before the review on Saturday, 29<sup>th</sup> November, 2003.

**Table 1: SCUBA2 Data Reduction Preliminary Design Review Documentation**

Section	Document title	Reference number
<b>Introduction</b>		
1.	Terms of reference for PDR	
<b>Requirements</b>		
2.	Data Reduction Software Requirements Document	SC2/SRE/S210/001 issue 1.45
3.	SCUBA-2 Data Reduction SW Compliance Matrix	SC2/SRE/S210/002 issue 0.5
<b>Interface control</b>		
4.	Data Acquisition/Data Reduction Pipeline Interface control Document	SC2/SOF/IC210/01 issue 1.25
5.	Data Reduction Pipeline Data Products	SC2/SOF/IC210/02 issue 1.6
6.	Data Reduction Pipeline Algorithm Engine Interface	SC2/SOF/IC210/03 issue 1.5
<b>Detailed design description</b>		
7.	Pipeline Architecture	SC2/SOF/S210/001 issue 1.19
8.	SCUBA-2 Data Display System	SC2/SOF/S210/002 issue 1.25
9.	SCUBA-2 Data Simulation and Pipeline Testing	SC2/SOF/S210/003 issue 1.15
10.	SCUBA-2 Data Reduction Recipes and Primitives	SC2/SOF/S210/004 issue 1.19
<b>Project Management</b>		
11.	SCUBA-2 Data Reduction SW Project Management Plan	SC2/SOF/PM210/01 issue 1.5
12.	SCUBA-2 Data Reduction SW Risk Assessment and Mitigation Plan	SC2/SOF/PM210/02 issue 1.4
13.	Detailed Project Plan (Microsoft Project Format)	SC2/SOF/PM210/03
<b>Appendix 1: Supplementary requirements</b>		
8.	Science Requirements for SCUBA-2	SC2/SRE/SC200/01
9.	Operational Concepts definition for	SCUBA-2 SC2/SRE/SC200/03
<b>Appendix 2: Additional design documents</b>		
8.	Software architectural design	SC2/ANA/S100/45

9.	SCUBA-2 Data Output	SC2/SOF/S200/007
10.	SCUBA-2 Data Acquisition to Data Processing Interface	SC2/SOF/S200/008
11.	SCUBA-2 data simulation.	SC2/SOF/S200/016
12.	Map making in different noise regimes.	SC2/ANA/S210/001
13.	Image processing and least-squares reconstructions.	SC2/SOF/S200/015

Note: All documents are accessible through: <http://scuba2.jach.hawaii.edu/deltapdr.html>

### 3. Review Agenda

The Panel convened in a telephone conferenced on December 8<sup>th</sup> (two days before the review) to consider the documentation and the review agenda. It was decided to structure the review around the documentation set, with additional time dedicated to the Requirements and Project Management areas. The timetable and agenda was circulated that day, and the review held to the timetable, which was as follows (all times are HST):

- 07:30 Introduction and meeting setup
- 07:40 Requirements
  - Requirements document
  - Compliance matrix.
- 08:30 Interfaces
  - DA/DR interface
  - Data products
  - Pipeline Algorithm Engine
- 09:00 Design
  - Pipeline architecture
  - Data Display
  - Data Simulation and Testing
  - Data Reduction Recipes and Primitives
- 09:45 Project Management
  - Project management plan
  - Risks
- 10:30 Panel closed session.
- 11:00 End of review.

### 4. Meeting Minutes

The chair took the meeting minutes and the other panel members contributed additional contributions and corrections. The minutes are shown in Appendix A.

### 5. Level of confidence in the design

*This section outlines the basis on which confidence has been placed in the design.*

The panel is confident that the design as presented will satisfy the requirements of the SCUBA-2 instrument for all data reduction for a single nights data. We believe the delta-PDR process has benefited the project significantly in firming up both the requirements and the design significantly.

The panel still had reservations on the Project Management documentation as presented, but none of these warranted further review at this stage. It is clear that there are a number

of actions that can be taken to avoid compromising other areas of the SCUBA-2 project, if problems occur in the data reduction area. If the project slips in schedule, then an option would be to re-schedule the offline-processing task until after commissioning so that the other key tasks could be completed in time for commissioning. If the project budget is underestimated, a candidate task for de-scoping would be to reduce the time spent investigating the scan-map reduction with the result that a less optimal algorithm would be used for scan map reduction.

The panel also noted that many of the reservations in the project management area were possibly attributable to the lack of time Janos had spent in the current environment, the differences in handling contingencies by CFI funded projects and perhaps most importantly, the lack of clear direction and guidance he is receiving from the rest of the project. We felt that this should be rectified as soon as possible.

## **6. Specific comments on the review documentation**

This section covers the items outlined in section 1.1.

### **6.1. Requirements Document**

Complete. The new version of the requirements document included the additional requirements identified in the design documents and the PDR

### **6.2. Compliance Matrix**

Mostly complete. There was an additional compliance matrix document and, whilst it didn't have two compliance matrices, in the opinion of the panel, sufficient two way traceability was given in the matrix and the document text, that requirement tracing was now simple and sufficient. A compliance verification method column was missing and will be added (see below).

### **6.3. Interface Control Documents**

Complete. There were two additional interface control documents, and the panel felt that the interfaces were now well understood.

### **6.4. Risks Document**

Complete. The revised risks document contained additional items addressing depth of personnel, distributed location of workplaces, budget implications and Starlink support.

### **6.5. Management Plan**

Partially complete. The new version of the management plan addressed many of the points outlined in section 1.1. However, the panel had some reservations, particularly on whether the budget estimate was truly based on the design and hence reflected the true costs of the project as presented. These reservations were insufficient to warrant recommendation that the project not proceed to CDR.

## 7. Outstanding Actions from previous reviews

*This section contains a record of any relevant outstanding actions from previous reviews.*

1. Team to prepare for a delta PDR covering the points raised in the previous section, to be conducted by videoconference between the panel and the team on 12 November 2003. The new documents should incorporate or address all the comments made both before and during the meeting.
  - *Complete. However, there was a 4-week delay, and some reservations in the project management area, as noted above.*
2. The requirements document to refer to the source of each requirement.
  - *Complete.*
3. The team needs to be explicit on the external requirements to and from other parts of the SCUBA2 project.
  - *Essentially complete. Some additional external requirements were noted during the course of the review which need to be added to the requirements document before CDR.*
4. ATC and UBC to clarify which part of the SCUBA2 project is responsible for implementing dark frame subtraction.
  - *Ongoing.*
5. ATC and JAC to discuss how pointing and the focus data frames will be generated.
  - *Ongoing. Not part of the SCUBA-2 Software DR package.*
6. Tim Jenness to write up a list outlining all the requirements of the pipeline (mostly deriving from ORACDR requirements).
  - *Essentially complete. The pipeline requirements had been updated considerably. There were still some pipeline requirements that needed clarifying, and these should be added to the requirements document before CDR.*
7. Team to decide on whether there is a natural upper size to a mosaic.
  - *This was initially set at 20x20 degrees. However, in the course of the review it was decided this was subordinate to the over-riding requirement to keep the output file size below 2 Gbytes.*
8. Team to address a way to reduce the raw data file count, if possible.
  - *Ongoing. The documentation includes a note that it should be tested.*
  - *Note: some simple tests the day after the meeting indicate that performance may be unsatisfactory if the system has to detect new files on NFS mounted disks with 6000 files in a directory. The time taken to detect a new file in the test was 50-60 seconds. A similar test with 100 files in the directory took 10 seconds.*
9. Tim to clarify the use of the OBSMEM keyword.

- *The OBSMEM keyword was deleted.*
10. Wayne to send Janos an example of block diagram.
- *Complete.*
11. UBC to purchase a Polycom Video over IP conferencing unit.
- *Complete. The unit was used successfully at the delta PDR.*

## **8. Recommendations on how to proceed**

*This section contains the review panel's recommendations on how the design should be allowed to proceed to next stage.*

The panel recommends that:

1. The project proceeds to the Critical Design Review stage, currently scheduled for October of 2004.
2. Every effort be made to ensure the new software developer be in place by early April 2004.
3. The PDRA hire be brought forward and an attempt be made to find a suitable candidate in the first half of 2004. If no suitable candidates are found, falling back to the current schedule is then a contingency.
4. The SCUBA-2 project resolves any conflicts of interest in the management chain, particularly relating to the position of the Canadian project manager and the members of the Canadian Steering Committee.
5. The SCUBA-2 project put uniform management practices in place, and clearly communicates their expectations (particularly to review panels in their terms of reference).
6. As we did at the delta-PDR, we re-iterate that the project manager has both the authority and the responsibility to develop the project plan and ensure its successful execution.

## **9. Actions arising from the meeting**

1. BDK and DA team to verify whether storing data values as two byte integers is possible.
2. Team to add additional verification method column to compliance matrix.
3. Janos to highlight the staged release nature in the management plan.
4. Kate to be put on scuba2dr mailing list.
5. Kate to establish a list of people to contact about sky subtraction experience with other mm/submm cameras.
6. Janos to generate a project plan that has explicit contingency time, and a budget that is done from the design up and also includes explicit contingency. This should be

done before the end of 2003. This is to be kept separate from any documentation generated for CFI purposes, but should be used for project tracking purposes.

7. SCUBA-2 project to determine who is to supply the Data Reduction machines.

## **10. Recommendations for corrective actions**

*This section contains recommendations and reasons for corrective actions, if necessary.*

None.

## **11. Members of review team and roles**

The members of the review panel were:

1. Nick Rees (chair), Head of Software and Computer Services, Joint Astronomy Centre (n.rees@jach.hawaii.edu).
2. Séverin Gaudet, Project Manager/Software Engineer, Canadian Astronomical Data Centre (severin.gaudet@nrc-cnrc.gc.ca).
3. Kate Isaak Sub-mm scientist, The University of Wales, Cardiff (kate.isaak@astro.cf.ac.uk).

In addition, the panel invited the SCUBA2 project scientist, Wayne Holland, to act as a non-voting advisor.

## **Appendix A. Minutes of SCUBA-2 DR Software delta-PDR**

**Videoconference held December 10, 2003 between:**

- **Joint Astronomy Centre, Hilo, Hawaii,**
- **University of British Columbia, Vancouver, BC.**
- **Herzberg Institute of Astrophysics, Victoria,**
- **Astronomical Technology Centre, Edinburgh, UK.**

### ***Attendees:***

JAC: Nick Rees (Chair), Frossie Economou, Tim Jenness, Gary Davis (who only attended the management section)

ATC: Wayne Holland, Kate Isaak, Dennis Kelly

UBC: Janos Molnar, Douglas Scott

HIA: Séverin Gaudet

### ***Call to Order***

The meeting was called to order by the Chair at 07:30 HST.

### ***Announcements and overview***

The chair welcomed all participants and thanked the team for all the work they had done. He noted that all the documentation was of a considerably higher standard than at the previous review. He outlined the review process which was to go through all the documentation in turn, giving the team time to outline the major changes, covering all the points raised in writing before the review, and dealing with any matters that arose.

### ***Requirements***

Data Reduction Software Requirements Document

#### **Introduction**

All agreed that using 2 byte integers for the raw pixel data is a good idea if it is possible. It could save up to \$300,000 a year on current archive storage cost estimates. Dennis Kelly warned that he has to check it is viable.

**ACTION:** BDK and DA team to verify whether storing data values as two byte integers is possible.

#### **General Requirements**

GR 8. The “no free parameters” requirement had been discussed at PDR, and accepted.

GR10. Calibration accuracy. The 5-10% calibration accuracy requirement is system wide, and not just for the DR system. The error budget assumes that the DR system contributes

a negligible amount to the accuracy. Tests of this requirement should take this into account.

GR 14. The CDR will have more documentation on data formats. There will be a data expander that writes out data in a useable external format that won't be part of the pipeline, but an additional standalone application. This will address the SCUBA2MEM comments from John Richer.

The following additional General Requirements were identified at various times in the meeting and are included here for clarity:

1. There is a requirement to support the Linux and Solaris operating systems, with a goal of supporting MacOS X.
2. All file sizes shall be kept less than 2 Gbytes, and shall be able to be manipulated by systems with a 32 bit address space. (This may limit the file size to less than 2 Gbytes). This is also a new external DA requirement.
3. Errors should be propagated in all calculations.

### **Observing Mode Requirements**

MR 4. 10% was a FWHM. The source of the requirement should be clarified.

MR 5. There was some discussion on whether reproducibility was a goal or a requirement. The team put it as a goal because they found it difficult to quantify.

### **Pipeline Requirements**

Delete the last sentence of introduction. Details about the conditions that must be met to add additional requirements to the project should be somewhere else – either at the beginning of this document, or in the project management document, or both.

PR 1. It was agreed that the statement that the DR pipeline should not feed anything back into the DA is really an external requirement on the DA and should be removed to that section.

PR 5. Agreed that a ~30% margin is required whilst observing so that quality control information is delivered in a timely manner in most circumstances.

PR 7. It was agreed to restrict the pipeline to a single nights data. The main requirement for data reducing multi-night projects comes from surveys and so is deferred to a SCUBA2 survey data-reduction project.

There were a number of other comments by John Richer in this area. None were considered serious, but many were useful suggestions and should be considered by the team.

### **Off-line Requirements**

OR 7. The 20x20 degree requirement should be made subject to staying within the 2 Gbyte file size limit.

OR 12. There was some discussion about John Richer's comment that the pipeline should just restrict processing to the point in which the images are produced, and not have any

image analysis. This was considered unnecessarily restrictive. We need object processing for calibration processes, SNR, quality control and the like.

Once again, there were a number of other comments by John Richer in this area that were not significant enough to discuss in the meeting. The team should consider them.

### **External Requirements.**

What are the differences and similarities between the External Requirements and the External Dependencies in the management plan?

There should be an additional external requirement that the DA system should not write files greater than the 2 Gbyte limit.

### **SCUBA-2 Data Reduction SW Compliance Matrix**

Janos made a general comment that the tick mark in the document indicated the intent of compliance, not actual compliance at this time.

The panel praised the document and noted that it had made their jobs (and any other external people assessing the project) significantly easier.

The panel considered a “Compliance Verification Method” column would be useful. This shows which requirements have to be verified when (e.g. at design, by analysis, as part of testing, or during commissioning). The SCUBA-2 FPRD has an example of this format. This would clarify many of the comment on this document.

**ACTION:** Team to add additional verification method column to compliance matrix.

### ***Interfaces***

#### **Data Acquisition/Data Reduction Pipeline Interface Control Document**

The team noted that the DA is doing sky fitting because it has spare CPU cycles, and it may be useful for quicklook. It was a pragmatic decision.

#### **Data Reduction Pipeline Data Products.**

Tim pointed out that the SCUBA-2 instrument indicators were actually in the group file names (the l and s indicator after the leading g).

YYYYMMDD.frac is an “ORACDR” standard.

Log.fcf will have a S/N put in it. The rest of the parameters will be investigated as to whether variances should be provided.

Variances on the centroid would be excellent information for pointing and focus.

In general it was suggested that there should possibly be a general requirement about variance propagation. (This is shown above out of order in the minutes).

Wayne thought it was an excellent document.

## Data Reduction Pipeline Algorithm Engine Interface

There were no comments on this document.

### **Design**

#### Pipeline Architecture

The team is considering using a Java “top-end”, with SOAP for inter-task communication to handle various issues. This may help abstract the file format because Starlink are currently working on a file format abstraction, but will only support it in a Java environment.

Another problem with all Starlink applications, is the inability to be able to handle file sizes > 2 Gbytes. The team pointed out that this support may be coming in the future. The panel considered that this external dependency was extremely high risk, and so decided to add a new general requirement to keep file sizes < 2 Gbytes. (This is shown above out of order in the minutes).

There were no problems with data access from two pipelines since all the external data the pipeline uses are in the data headers, and these are obtained by the Data Acquisition through DRAMA data monitors.

#### SCUBA-2 Data Display System

Nick noted that when displaying dream mode data it would be unlikely that samples in the 25Hz data will not come out the same jiggle position because that isn't the way DREAM works. The other alternative is to move the image and leave the source stationary. Tim would look into this.

The strip-chart tool would be new to ORAC-DR, but would be based on existing applications. The tool would get the data by doing the equivalent of tail -f on the pipeline data product files.

#### SCUBA-2 Data Simulation and Pipeline Testing

The test document should refer to the list of requirements that are verified in testing in the compliance matrix.

There was some discussion on the “release early and often” philosophy. Tim said they would undoubtedly be working this way. The first milestone release would be doing quick-look on the simulation data. Later releases are less well defined at this stage, but should be covered in more detail in the management plan.

**ACTION:** Janos to highlight the staged release nature in the management plan.

Much of the useful feedback from experiences with other instruments is coming back through the scuba2dr mailing list. Kate remarked that she was not on this list but was interested in establishing a list of people to contact about sky subtraction experience with other mm/submm cameras.

**ACTION:** Kate to be put on scuba2dr mailing list.

ACTION: Kate to establish a list of people to contact about sky subtraction experience with other mm/submm cameras.

### SCUBA-2 Data Reduction Recipes and Primitives

A flowchart that showed the processes would have been useful and for CDR flowcharts should be shown.

Pointing and Focus will be dealt with between ATC and JAC, but we must ensure that the DA can leverage any DR developments in data processing.

### ***Project Management***

#### SCUBA-2 Data Reduction SW Project Management Plan

Douglas described the money available saying there is money for about 1.5 people for the duration of the project.

The advertisement for the Software Engineer has gone through the University Machinery and it will be advertised in January, with closing date at end of January. With the interviews and negotiation time, the panel considered that the person would probably be in post in April.

The second 0.5 person is tasked to how to generate scan maps. They will employ a recent graduate (not post-graduate) for 8 months full time to produce a report. They will then hire a PDRA.

It is unlikely to be able to hire the PDRA before September, because this is the normal start of the PDRA cycle in Canada.

Janos made the following comments:

- The Gantt chart in the document is a critical path analysis, which is why it is linear.
- There were a number of explanations why there was no explicit contingency in the document. The financial contingency is included in the planned salary for the people they would like to hire. Current budgeted salary is \$70 k for the SWD and \$26k for 50% of the PDRA and the estimated time duration's have implicit contingencies in them.
- This approach had come from CFI requirements which explicitly stated that contingencies should not be included in the budgeting process.

However, the panel was unhappy that the explanation of the contingencies is not in the project management document. They also felt the project should make a more formal assessment of risk.

ACTION: Janos to generate a project plan that has explicit contingency time, and a budget that is done from the design up and also includes explicit contingency. This should be done before the end of 2003. This is to be kept separate from any documentation generated for CFI purposes, but should be used for project tracking purposes.

Additional time contingency can be managed by de-scoping the project by:

1. Moving development of the off-line pipeline beyond commissioning.
2. Scan-map processing could be de-scoped, particularly if the problem appears intractable.

The team felt it was obvious that the off-line pipeline was of lower priority than the on-line one.

There was some confusion over who was paying for the data reduction machines. Some were under the impression this was part of the electronics package, but Janos said the Electronics package was only responsible for the DA systems. The team considered it was a JAC responsibility.

**ACTION:** SCUBA-2 project to determine who is to supply the Data Reduction machines.

### SCUBA-2 Data Reduction SW Risk Assessment and Mitigation Plan

Most of the panel comments on this document were covered during the discussion of the management plan. There should definitely be a greater tie-in between the two documents.

The highest impact risks were:

- Tim not available for pipeline development.
- Need to parallel the software pipeline.

Some of the monetary impacts in the risks document were impacts on the entire SCUBA2 project, not just the DR project in itself. Overall, the teams belief was that that the risks of the DR project were minimal in comparison to the rest of the project.

### ***Panel closed session***

The first part of this session was given over with a private discussion between the panel and the Project Manager. The findings are given in the main part of this document.

Overall, the panel considered that the documentation was much improved and described a reasonable and realistic design. The project management and plan still needs work and the budget linkage with the project plan is still weak.

## Appendix B. List of Pre-review comments

### *Annotations from sc2\_sre\_s210\_001.pdf*

Page 3

**Annotation 1; Label: John Richer; Date: 12/ 8/ 2003 12: 01: 23 PM**

Why do we need to store 4 bytes per sample? Is this 16 bits of data and 16 bits of quality/ flags, or is it all data? At 200Hz, the noise per sample is of order 0.3-0.5 Jy at 850 micron (I think), so 16 bits looks plenty of resolution even on planets ( $2^{16} * 0.3$  is about 20,000Jy). This looks like you are storing twice as much data as necessary in the raw data taking mode.

This also raises the question: what data are stored? I could not find a clear statement if the 200Hz data are always taken and archived, or whether only the 1Hz averaged data are stored in the data files and archive. I guess there is a separate data format document somewhere, but it should at least be referenced here.

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**Annotation 1; Label: Nick Rees; Date: 12/ 3/ 2003 3: 12: 10 PM**

GR3. OMP interface is really FPR 5.2.6, I think.

**Annotation 2; Label: Nick Rees; Date: 12/ 3/ 2003 3: 12: 25 PM**

GR 4. Ditto this is FPR 5.2.6

**Annotation 3; Label: Nick Rees; Date: 12/ 3/ 2003 3: 12: 42 PM**

GR 7. This is not FPR 6.1 (which is a documentation requirement).

**Annotation 4; Label: Nick Rees; Date: 12/ 3/ 2003 3: 14: 05 PM**

GR 0?. I suggest a JAC requirement to just support Linux/ x86 and Solaris/ SPARC.

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**Annotation 1; Label: John Richer; Date: 12/ 8/ 2003 12: 02: 28 PM**

GR8. There must be a reason for 'with no free parameters' part, but I don't fully see what it is. For example, if you are looking a field containing a very bright source, might it not be useful to specify a clip level to a despiking algorithm? Or would this be done by duplicating the recipe and hardwiring another value?

**Annotation 2; Label: John Richer; Date: 12/ 8/ 2003 12: 03: 03 PM**

GR9. I am assuming the implication here is 'by the software developers' and not by Joe Astronomer. But this should be clarified.

**Annotation 3; Label: John Richer; Date: 12/ 8/ 2003 12: 04: 59 PM**

GR14. I have a general comment here which relates to getting at data at various stages of reduction.

I think the requirement should be that it is possible to write data at any stage of reduction to a file format which can be read by other programmes. I am thinking here of people implementing new analysis algorithms, and often fairly raw pixel data with associated coordinate and time information are required for this.

With SCUBA, the SCUBA2MEM task performed some of these functions. We need something like this for SCUBA2 as well.

As to the export data format, this could I suppose be NDF (I assume the SCUBA2 internal data format is NDF?), but I think the project should consider alternatives. FITS is obvious, but perhaps it's time to look at VOTable, though I appreciate it may be too soon as the standards are still evolving, as I understand it.

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**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 8: 43: 35 AM**

MR4. I am not totally clear on what 10% means. Since it is a resolution requirement, I assume it is 10% of FWHM. Is there a flux-conservation or encircled energy requirement for photometry? What about other measures like Strehl?

**Annotation 2; Label: Nick Rees; Date: 12/ 4/ 2003 8: 44: 49 AM**

MR5. Is this really just a goal? I would have thought that reproducibility was paramount.

**Annotation 3; Label: John Richer; Date: 12/ 8/ 2003 12: 06: 04 PM**

MR 6. I don't understand the meaning of 'lossless' in this context. This requirement needs elaborating!

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**Annotation 1; Label: Nick Rees; Date: 12/ 3/ 2003 4: 38: 27 PM**

PR 0. .. no additional requirements without consultation and adequate suitable rescheduling or compensation etc.

**Annotation 2; Label: Nick Rees; Date: 12/ 3/ 2003 3: 51: 18 PM**

PR5. I would like a 30% safety margin for typical observing.

**Annotation 3; Label: Nick Rees; Date: 12/ 3/ 2003 4: 41: 26 PM**

PR 9. Quantify "Robustly and accurately"

**Annotation 4; Label: Nick Rees; Date: 12/ 4/ 2003 8: 48: 03 AM**

PR 1. This is really an external requirement on the DA (or OCS), not a negative requirement on the

DR. As always, I am also unhappy with it, since there is always some sort of feedback as part of QA.

**Annotation 5; Label: John Richer; Date: 12/ 8/ 2003 12: 07: 41 PM**

PR 1. Meanwhile, PR17 says the pipeline will estimate SNRs from the data taken so far to see if a programme is complete -is the implication that these SNRs are fed back only to operators/ astronomers and not to the telescope? This may be OK, but PR17 should then be clarified.

I would suggest putting these modified requirements adjacent to one another so the intent is clear.

**Annotation 6; Label: John Richer; Date: 12/ 8/ 2003 12: 07: 31 PM**

PR 2. I'm sure this anthropomorphic requirement could be phrased better! Does it mean, for example, that in an FTS measurement, the individual lags/ frequencies are processed completely separately? If so that is an implementation detail and not a requirement.

**Annotation 7; Label: John Richer; Date: 12/ 8/ 2003 12: 08: 32 PM**

PR3. Does this mean recipes to reduce data used to measure the flat field and 'the array setup' whatever that is? Unclear to me how to read this one.

**Annotation 8; Label: John Richer; Date: 12/ 8/ 2003 12: 10: 34 PM**

PR4. If this is a requirement document, I don't think it is acceptable to have lists of requirements prefaced by 'e. g. '. It needs to be specific. If you want specific data reduction modes for different data types, they should be enumerated here explicitly, rather than vaguely alluded to. It is also unclear to me for example what is special about deep imaging. Be explicit -or leave the requirement out.

Extra comment: have people thought about things like 'shift and add' for SCUBA2 data? When anomalous (or more properly, dynamic) refraction is strong, typically near twilight, and we have a bright source in the field, shift and add might be quite attractive for the STARE/ DREAM modes. I would like to see this added as a requirement explicitly if it makes sense.

In fact a measurement of the dynamic refraction by this method would of itself be interesting to characterise the atmosphere - better than the phase monitor I would say. With about half a Jy sensitivity in 1/ 200s at 850 micron, the signal to noise on Uranus say will be about 100, so you should be able to centroid to about 0.2 arcsecond. I don't of course know how well the telescope drives behave on short timescales, but they should be fairly smooth.

This information *could* be usefully fed back to the control system to help the OMP, which would violate PR1, but I think this is worth considering.

[ALMA is a different beast, but there the control system/ scheduler requires some pipeline functions to be running to schedule the telescope].

**Annotation 9; Label: John Richer; Date: 12/ 8/ 2003 12: 11: 19 PM**

PR 5. On a 128-node Linux cluster? or a non-specialised workstation? Hopefully the latter, but the hardware assumption needs stating if this is to be a useful requirement.

**Annotation 10; Label: John Richer; Date: 12/ 8/ 2003 12: 12: 47 PM**

PR 7. I can understand the need for this one, to simplify the software, but it's a shame the pipeline can't fetch data for the whole project. And I think this then makes PR17 irrelevant -because one needs the sensitivity on the full set of data obtained to date.

How much more difficult does it really make the pipeline if it is capable of looking at previous night's data? The offline system has to do this anyway.

**Annotation 11; Label: John Richer; Date: 12/ 8/ 2003 12: 25: 54 PM**

PR 9, 10 & 11. These three requirements are all aiming at a similar target, but I think could be combined and simplified. At the moment I think there is some duplication in them. PR9 is also vague -as 'noise' is not defined.

I suggest trying to simplify and rewrite these. I guess the intent here is to propagate full noise information through the variance array (?) so that in final images the thermal noise can be estimated.

In my reading, PR11 is implied by PR10 -how can you calculate the noise without counting the contributing pixels? But I agree it must be explicit that the variance and weights must be accessible.

If retained, 'sub-map' should be defined.

**Annotation 12; Label: John Richer; Date: 12/ 8/ 2003 12: 26: 46 PM**

PR 12. 'might be used', 'something strange' are hardly requirements -I wouldn't know how to code them! Either delete or firm up.

**Annotation 13; Label: John Richer; Date: 12/ 8/ 2003 12: 27: 18 PM**

PR13 Again, 'certain parameters' is no good: state explicit which ones and how the ranges are defined.

**Annotation 14; Label: John Richer; Date: 12/ 8/ 2003 12: 28: 16 PM**

PR 15 I suppose this is saying that 'It must be possible to process the two frequency channels independently'. Why not leave it at that? An implementation could then, if it wishes, do a joint analysis if that is superior, but would degrade gracefully if for example only 450 micron data are available. If such a joint analysis is in the offline system anyway, and it is fast enough, it seems odd to exclude it from the online system.

**Annotation 1; Label: Nick Rees; Date: 12/ 3/ 2003 4: 43: 18 PM 3**

OR preamble. This is a requirement. Why isn't it numbered?

Annotation 2; Label: John Richer; Date: 12/ 8/ 2003 12: 29: 33 PM

PR 17 See my notes above on PR1 and PR17.

In addition, is SNR rather than just noise the correct criterion for the OMP? For detection/ non-detection experiments, the SNR criterion may never be satisfied!

Annotation 3; Label: John Richer; Date: 12/ 8/ 2003 12: 30: 11 PM

PR 20. I don't quite understand this one -it needs elaborating. Is it saying the pipeline should run a source extractor on a newly-reduced image and compare the catalogue with one produced earlier?

This is surely an OFF-line requirement only; it also violates PR7.

**Annotation 4; Label: John Richer; Date: 12/ 8/ 2003 12: 32: 32 PM**

OR 3 As before, maybe worth specifying what hardware is intended here ... a several-node Beowulf?

Also, does it apply to the 200Hz data or the 1Hz averages?

**Annotation 5; Label: John Richer; Date: 12/ 8/ 2003 12: 32: 45 PM**

OR 4 This isn't really a requirement but something that could appear as a statement of intent or note, in italics. Could go in the preamble to this section.

**Annotation 6; Label: John Richer; Date: 12/ 8/ 2003 12: 33: 14 PM**

OR 6 The two 'carefully's should be deleted. Or replaced with some specific requirement on how well mosaics need to be made.

**Annotation 7; Label: John Richer; Date: 12/ 8/ 2003 12: 33: 56 PM**

OR 8 This needs clarifying. I can see two extremes here: on the one hand, it means publishing a full API for the code and details of how to write fast (compiled) algorithms down at the pixel/ astrometric level, plus supplying the necessary software engineering for people to build their own extensions. On the other hand, it means publishing a simple high-level scripting-style interface to a set of well defined tasks, perhaps exposing more parameters to the user. These imply different levels of effort.

My personal view is that if users wish to get down to the pixel level, the way to go is to have a well defined data export format and let them play with the data in whatever environment they wish.

A simple high-level interface to the reduction code would be nice too, but depending on the implementation of the package could be expensive.

Page 9

**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 9: 13: 12 AM**

DR 8. This is not really a requirement. A requirement may be that the QL system will be able to display xxx frames/ sec and is allowed to drop frames at greater rates than this.

**Annotation 2; Label: John Richer; Date: 12/ 8/ 2003 12: 34: 34 PM**

OR 11, 12, 13 & 14. These 4 requirements are already satisfied by many existing software packages provided SCUBA2 can export its data in a convenient form. I don't think SCUBA2 should be funding support for these algorithms ... they are part of the scientific analysis of images. If you go down this route, you can start adding a semi-infinite number of requirements -for example, requirement such as 'the software should contain an interface to the DUSTY model to allow direct comparison with

SCUBA2 data with models'... and this would lead to madness. I think the scope of the project needs to be carefully delimited, and I would delimit it at the point at which final images are produced.

**Annotation 3; Label: John Richer; Date: 12/ 8/ 2003 12: 34: 52 PM**

If there is a clear data export format, I think users will be able to do all this themselves. I don't think this is helpful here as a requirement.

Page 11

**Annotation 1; Label: Nick Rees; Date: 12/ 3/ 2003 4: 59: 53 PM**

ER2. The simulations should generate data files that conform to the final SCUBA2 DA/DR system interfaces so they can be used for all types of sub-system testing. They should consist of data taken in all observing modes, and cover the anticipated parameter space.

***Annotations from sc2\_sre\_s210\_002.pdf***

Page 4

**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 8: 35: 54 AM**

GR 10. Relative calibration precision should be verified during testing with simulated data.

**Annotation 2; Label: Nick Rees; Date: 12/ 4/ 2003 8: 36: 36 AM**

GR 7. and GR 8. These are verified during integration and test.

**Annotation 3; Label: Nick Rees; Date: 12/ 4/ 2003 8: 38: 41 AM**

Should try and have complete FITS header and file structure defined by CDR

**Annotation 4; Label: Séverin; Date: 12/ 8/ 2003 1: 13: 31 PM**

I don't understand how on these and other requirements the implementation is blank but the compliance is checked. Am I missing something?

Page 5

**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 8: 40: 18 AM**

This should also be verifiable from test data..

**Annotation 2; Label: Nick Rees; Date: 12/ 4/ 2003 8: 45: 39 AM**

MR 5. Again, verifiable from testing.

**Annotation 3; Label: Séverin; Date: 12/ 8/ 2003 1: 14: 02 PM**

Doesn't this fall out of the ICD?

Page 6

**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 8: 49: 53 AM**

This should be quantified and tested in the test procedures. 6

***Annotations from sc2\_ sof\_ ic210\_ 01. pdf***

Page 4

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 1: 43: 30 PM**

p4. 2.2. solution: test this straight away...

Page 9

**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 10: 10: 33 AM**

Section 3. Is the DA system the correct place to do the sky fitting? Isn't this possibly a DR functionality? 7

***Annotations from sc2\_ sof\_ ic210\_ 02. pdf***

Page 3

**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 10: 21: 45 AM**

Section 2. Reduced data. I think there should be an instrument/ waveband indicator in the group file name. Users could get confused if the group files have the same name.

Page 4

**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 10: 27: 29 AM**

UT date in QC files. Is YYYYMMDD.frac a standard in this area? I have never seen it before.

Page 5

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 1: 46: 28 PM**

Quality Control Parameters.

- multiple points -what about error bars on derived parameters eg. log. fcf, log. peak etc. 8

***Annotations from sc2\_sof\_s210\_001.pdf***

Page 5

**Annotation 1; Label: Nick Rees; Date: 12/ 8/ 2003 1: 51: 34 PM**

3. Algorithms

Drama code should separate the DRAMA I/ F from the algorithm. All algorithmic code should be implemented as a portable library. Hence it would be trivial to implement the WFCAM model, for example.

Page 6

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 1: 50: 44 PM**

5. Modifications required for SCUBA2

Two independent pipelines -certain things that both pipelines will need to access at the same time. is it clear how the filehandling for this will be achieved (eg. wvm data)? cf. scuba, where one pipeline, two wavelengths.

***Annotations from sc2\_sof\_s210\_003.pdf***

Page 3

**Annotation 1; Label: Nick Rees; Date: 12/ 5/ 2003 4: 17: 01 PM**

Introduction.

Many of the requirements can only be verified before delivery by simulation testing. There should be discussion on tests to check that calibration accuracy and resolution etc are not degraded (GR10 & MR 4).

Page 5

**Annotation 1; Label: Nick Rees; Date: 12/ 5/ 2003 5: 05: 02 PM**

Algorithm development

Is it worth doing some variant of extreme programming -just generating some simplest possible algorithms first, and seeing how they work? (e. g. Implement the full pipeline, but just implement sky subtraction using the array median first, before implementing fitting planes or higher order functions).

**Annotation 2; Label: Nick Rees; Date: 12/ 5/ 2003 5: 06: 10 PM**

Schedule

Again release little and often, with the early releases well defined, may be a good idea.

**Annotation 3; Label: Kate Isaak; Date: 12/ 8/ 2003 1: 55: 31 PM**

3. Reduction Algorithms

Can you make use of some of the experience of SCUBA users for at least some of the plane-sky subtraction algorithms

***Annotations from sc2\_sof\_s210\_004.pdf***

Page 4

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 2: 02: 31 PM**

Introduction

It would have been nice to have a figure showing the dataflow...

Page 8

**Annotation 1; Label: Nick Rees; Date: 12/ 5/ 2003 4: 07: 37 PM**

Pointing and Focus

Somewhere it should be noted that the pointing and focus algorithms used by the DA system should be the same code as that used by the DR system. Otherwise, if the DR generated results is better than the DA generated one, we will be obliged to feed back the value from the DR (as sometimes happens at present). If the DA value is better, what is the point of the DR? If they are the same, but use different code, we have to support two code bases.

***Annotations from sc2\_sof\_pm210\_01.pdf***

Page 1

**Annotation 1; Label: Séverin; Date: 12/ 8/ 2003 1: 21: 01 PM**

General comments:

- This document is much improved over the previous version. However, it is still missing some information.
- There is no contingency in time nor in budget
- The risks identified in the Risk Mitigation Plan should be part of the contingency and of the schedule.
- The MS Project plan should reflect costings and these costings should be in the budget as separate line items.
- With contingency, the budget will be exceeded. A discussion on possible scenarios should be included (de-scoping vs. increasing the budget).
- If de-scoping is an option, a prioritization of the tasks should be clear so that others can assess the "scope" of the de-scoping.

**Annotation 2; Label: Séverin; Date: 12/ 8/ 2003 1: 07: 20 PM**

General comments on the MS Project plan

- missing dependencies, e. g., ARR, commissioning
- for CDR, there seem to be tasks and milestones missing, e. g., internal delivery of documents, internal review of documents, rework of documents, milestone release of documents for review.
- the schedule does not have much in the way of internal reviews and code re-working post review
- the dependencies in the "Simulator" set of tasks should point to DR tasks not to other simulator tasks. For example, does task 12 depend on task 11? But task 43 may really depend on both 11 and 12.

Page 3

**Annotation 1; Label: Séverin; Date: 12/ 8/ 2003 12: 22: 27 PM**

These 3 parts are not clearly reflected in the MS Project plan.

Page 4

**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 5: 06: 34 PM**

Supported OS's. Something about this should go in the requirements document. What are the OS requirements? Currently, if pushed, the JAC would only require Linux. What does the user community require? Is Linux as a requirement and anything else a goal?

**Annotation 2; Label: Nick Rees; Date: 12/ 4/ 2003 5: 13: 42 PM**

DR Software Interfaces.

There is, of course, a very important Human interface, and the data products have to interface to other, commonly used software easily.

Where is a SCUBA2 block diagram with the DR system in context?

**Annotation 3; Label: Séverin; Date: 12/ 8/ 2003 12: 22: 16 PM**

- All these external dependencies should be in the MS Project plan.
- It is not clear if the DR team has consulted with the Primes on these dependencies to see if the dates are reasonable or if these dates are internal to the DR team.
- The panel's report should make it clear to the "higher-ups" that agreement on these dates should occur shortly after PDR to allow the DR team to re-work the schedule if necessary

Page 7

**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 5: 16: 10 PM**

Gantt chart.

This is all very linear. Is there any common infrastructure software? The CDR also will create overload in the middle of next year.

**Annotation 2; Label: Séverin; Date: 12/ 8/ 2003 12: 22: 04 PM**

Are there any external dependencies on the critical path?

Page 8

**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 5: 08: 27 PM**

I feel successfully hiring suitable developers is clearly a milestone. How likely is it that SWD will be in place on January 1st?

Page 9

**Annotation 1; Label: Séverin; Date: 12/ 8/ 2003 12: 16: 18 PM**

All these due dates should flow from the MS Project plan. These tasks are there but not developed to the extent they are here. This table and the project plan should mesh.

Page 10

**Annotation 1; Label: Nick Rees; Date: 12/ 4/ 2003 5: 09: 21 PM**

What are typical Canadian PDRA and Software Engineer salaries?

**Annotation 2; Label: Séverin; Date: 12/ 8/ 2003 12: 23: 31 PM**

- Are the personnel costs coming from the MS Project plan?
- It would be nice to turn your footnote into an explicit item, i. e., the personnel costs reflect the whole cost and add a line subtracting the JAC salary contribution.
- It would be nice to see a line for each position (SWD, PDRA, TJ)

**Annotation 3; Label: Nick Rees; Date: 12/ 8/ 2003 11: 57: 37 AM**

Where are the contingencies in both cost and effort? The risks document identifies several hundred thousand dollars of risk, plus associated manpower, even after mitigation. Even after multiplying by some probability factor, there needs to be a significant contingency, that should be factored into the costs.

***Annotations from sc2\_ sof\_ pm210\_ 02. pdf***

Page 3

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 2: 04: 00 PM**

Overall:

- What is the definition of italicised text (presumably indicates modifications from pdr document)?
- I guess there is no place in this document to describe what the ongoing action as of data of delta-pdr is? (one does get a better picture of at least some of this in the project plan, admittedly....)

Page 4

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 2: 04: 35 PM**

DR\_ SW/ 1

- (guessing from reading personnel list elsewhere that this has been done?)
- this is pretty close to being on the critical path, I would have said, in that problems in observing modes need to identified upfront.

Page 5

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 2: 05: 20 PM**

DR\_ SW/ 2

Again, what is ongoing action? (Elsewhere it is mentioned that something will go out on Dec. 8th 2004 (sp.) advertising the position -would be good to have on the same sheet)

Page 6

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 2: 05: 51 PM**

DR\_ SW/ 3

mitigation action is going to depend on the two above, to some extent,...

Page 7

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 2: 06: 08 PM**

DR\_ SW/ 4

ok, but are the delays really correctly evaluated?

Page 8

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 2: 06: 26 PM**

DR\_ SW/ 5

- this has an effect on the programme, surely, and is detailed in TR-1?

Page 9

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 2: 07: 01 PM**

DR\_ SW/ 6

- as above
- impact -> is it practical to do the parallelising by slipping into schedule. Which personnel will do this, and won't it take these people away from other parts of the project?

Page 12

**Annotation 1; Label: Kate Isaak; Date: 12/ 8/ 2003 2: 07: 30 PM**

DR\_ SW/ 9

- again, don't fully understand why this is not on the critical path. Surely if certain observing modes means all observing modes then there are serious problems?