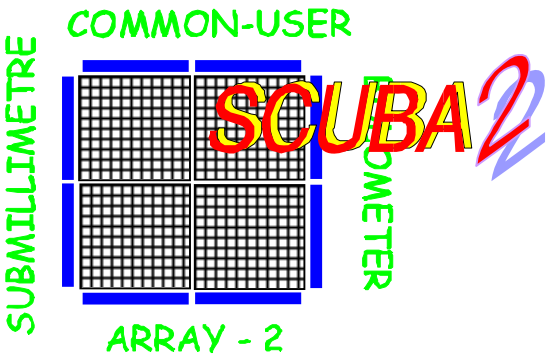

SCUBA-2 FTS Project Office
University of Lethbridge
Physics Department
4401 University Drive
Lethbridge, Alberta
CANADA
T1K 3M4

Tel: 1-403-329-2771
Fax: 1-403-329-2057
Email: brad.gom@uleth.ca
WWW: http://research.uleth.ca/scuba2/

Document Title: FTS-2 Risk Assessment

Document Number: SC2/FTS/PM500/001

Issue: Version 3.1

Date: 7 November 2006

Document Prepared By:	Brad Gom FTS-2 Project Manager	Signature and Date:	06/06/05
Document Approved By:	David Naylor FTS-2 Project Scientist	Signature and Date:	06/06/05
Document Released By:	Janos Molnar SCUBA-2 Canadian Project Manager	Signature and Date:	06/06/05

Change Record

Issue	Date	Section(s) Affected	Description of Change/Change Request Reference/Remarks
0.1	23/06/03	All	Initial document
0.2	25/06/03	Risk assessments	Changed the assigned probability and severity of some items. Added blackbody to the list.
1.0	16/07/03	All	First release document
2.0	06/06/05	All	PDR version
2.1	07/07/05	All	Minor reformatting
3.0	7/11/06	All	CDR version, added risk FTS/6, updated all risks
3.1	7/11/06	All	Minor updates to risk ratings and costs

Introduction

The SCUBA-2 Fourier Transform Spectrometer (FTS-2) is a medium-risk, high-reward project. This project has a limited and fixed budget and an inflexible delivery date, which is not ideal for a project with such a degree of technical development and risk.

After the initial review of the instrument requirements, projects typically start with a high level of risk that is then reduced by the implementation of mitigation steps within the project plan, changing the requirements or developing a better understanding of the engineering/programmatic challenges.

To help manage risk the project management team has adopted the standard UK ATC risk management strategy which:

a) identifies the key risks in the project
b) assigns a hazard (severity) level to each risk on a scale of 1 to 5 (5 is very high severity and would be terminal to the project if it occurred - infinite schedule delay).
c) assigns a probability of occurrence of the risk (0 to 4) (5 is > 50% probability),[1]
d) multiplies the two numbers to come up with the risk level (Impact)
e) tracks, with regular updates, all risks with a level of 6 or higher (9 is regarded as high risk)
f) assigns cost and schedule impact to all tracked risks
g) puts in place risk mitigation steps designed to bring the risk down to the acceptable level, estimates the risk level after the implemented steps and forecasts the date when the risk will reach the acceptable level and is eliminated

Although successful to date, it is entirely possible that some extremely difficult technical problem might yet be uncovered that would put the delivery date too far back or require large amounts of new funds to overcome. The risks applicable to FTS-2 will be tracked separately and are described in the following tables.

[1] If probability of occurrence is higher than 0.5, the risk will be treated as certainty and be part of the development plan

Risk Number	**FTS/1**		**Status**	**Cleared**
Date Logged	**June 2003**		**Date Cleared**	**June 2005**
On Critical Path	**Yes**		**WBS Ref. No.**	**x.x**
Owner	**David Naylor**			
Original Risk Factor	**Prob: 2**	**Severity: 4**	**Impact (P*I) = 8**	**Cat = High**
Mitigated Risk Factor	**Prob: 0**	**Severity: 4**	**Impact = 4**	**Cat = Low**
Date when risk is forecast to be passed:	September 2005			

Description of risk:

Manufacture of large (>300mm) beam-splitter hasn't been demonstrated before, may not perform to the original specifications the first time.

Impact on project cost, schedule or quality if risk realised without mitigation:

Potential for delays in work-packages due to re-work of beam-splitter.

Schedule Delay: 3 months
Cost: $US 60,000

Mitigation action:

1. Use extensive modelling of manufacturing process
2. Run trial manufacture ahead of schedule
3. Plan for 2 batches of beam splitters with potential rework.

Hence the re-assessment is that the Probability and Impact have been reduced by 50%.

March 2005 update:

a. Revised dual-port design has reduced the required beamsplitter diameter to 200mm
b. Recent retooling of Cardiff equipment allows for manufacture of current diameter
c. A backup plan using currently available wire-grid polarizers is possible

Hence the re-assessment is that the Probability has been reduced to a minimal level.

November 2006 update:

Final optical design confirms that the beamsplitter size will be within Cardiff capabilities.

Impact on project cost, schedule or quality if risk realised with mitigation action:

Schedule Delay: 3.0 months
Cost: $US 20,000

Risk Number	**FTS/2**		**Status**	**Live**
Date Logged	**June 2003**		**Date Cleared**	
On Critical Path	**Yes**		**WBS Ref. No.**	**x.x**
Owner	**Brad Gom**			
Original Risk Factor	**Prob: 3**	**Severity: 2**	**Impact = 6**	**Cat = Med.**
Mitigated Risk Factor	**Prob: 2**	**Severity: 2**	**Impact = 4**	**Cat = Low**
Date when risk is forecast to be passed:	July 2007			

Description of risk:

Single source for beam splitter won't deliver on time

Impact on project cost, schedule or quality if risk realised without mitigation:

The beam splitters can only be sourced by one shop, which has many commitments. Other priorities may delay the delivery of prototypes, seriously impacting FTS-2 development schedules.

Schedule Delay: 3 months
Cost: $US 60,000

Mitigation action:

1. Get early commitment for timely delivery
2. Keep close contact with supplier.
3. Use different beam splitter (from other source) for prototype development

Hence the re-assessment is that the probability has been reduced by 33%

Impact on project cost, schedule or quality if risk realised with mitigation action:

Schedule Delay: 2.0 months
Cost: $US 40,000

Risk Number	**FTS/3**		**Status**	**Live**
Date Logged	**May 2003**		**Date Cleared**	
On Critical Path	**Yes**		**WBS Ref. No.**	**x.x**
Owner	**David Naylor**			
Original Risk Factor	**Prob: 3**	**Severity: 3**	**Impact = 9**	**Cat = High**
Mitigated Risk Factor	**Prob: 1**	**Severity: 1**	**Impact = 1**	**Cat = low**
Date when risk is forecast to be passed:	August 2007			

Description of risk:

High mass of moving mirrors in the FTS may lead to N1 mirror's misalignment during operation

Impact on project cost, schedule or quality if risk realised without mitigation:

Without proper design observing modes can be limited, leading to unrealised potential for FTS-2

Schedule Delay: none
Cost: none

Mitigation actions:

1. Reduce mass of moving mirrors as much as feasible
2. Limit observation modes, constrain FTS mirror acceleration

Hence the re-assessment is that the impact has been reduced to a minimal level

May 2005 update:

a. Step and Integrate mode is now planned as a contingency operating mode, so accelerations during operation will be minimized

Hence the re-assessment is that the Probability has been further reduced

November 2006 update:

Lab testing during integration phase will determine acceleration limits.

Impact on project cost, schedule or quality if risk realised with mitigation action:

Schedule Delay: 0 month
Cost: $US 0
Quality: reduced scanning speeds, reducing observational efficiency.

Risk Number	**FTS/4**		**Status**	**Live**
Date Logged	**June 2003**		**Date Cleared**	
On Critical Path	**Yes**		**WBS Ref. No.**	**x.x**
Owner	**DN**			
Original Risk Factor	**Prob: 3**	**Severity: 3**	**Impact = 9**	**Cat = High**
Mitigated Risk Factor	**Prob: 2**	**Severity: 1**	**Impact = 2**	**Cat = low**
Date when risk is forecast to be passed:	January 2008			

Description of risk:

Dynamic blackbody load cannot be realised, thus signal swings during FTS-2 scans cannot be nulled.

Impact on project cost, schedule or quality if risk realised without mitigation:

Without signal nulling the scan speed is limited due to the flux jumping in the SQUID feedback loops.

Schedule Delay: none
Cost: none

Mitigation actions:

1. Limit observation modes, constrain FTS mirror velocities

Hence the re-assessment is that the probability remains significant, but the severity has been reduced to a minimal level

January 2005 update:

a. Revised dual-port design does not require a dynamic blackbody source to null the atmospheric loading. Dual-port operation should null the atmospheric signal in both bands and keep the signal dynamic range within the bolometer/SQUID limits.

Hence the re-assessment is that the probability has been reduced to a minimal level.

November 2006 update:

Testing will be required during commissioning to determine the extent of this effect when using the newly included ambient load within the interferometer.

Impact on project cost, schedule or quality if risk realised with mitigation action:

Schedule Delay: 0 month
Cost: 0
Quality: Elimination of single port mode, or reduced scanning speeds and observational efficiency.

Risk Number	**FTS/5**		**Status**	**Live**
Date Logged	**June 2003**		**Date Cleared**	
On Critical Path	**Yes**		**WBS Ref. No.**	**n/a**
Owners	**DN**			
Original Risk Factor	**Prob: 2**	**Severity: 5**	**Impact = 10**	**Cat = High**
Mitigated Risk Factor	**Prob: 1**	**Severity: 4**	**Impact = 4**	**Cat = Medium**
Date when risk is forecast to be passed:	January 2008			

Description of risk:

Critical staff leaves the project

Impact on project cost, schedule or quality if risk realised without mitigation:

Design complexity requires extensive and long learning curve for new staff to get up to speed.
Worst case scenario would be if critical staff left at the start of module test and system integration

Schedule Delay: 5 months
Cost: $US 100,000

Mitigation action:

1. Create stable and rewarding work environment.
2. Minimise work overload and eliminate burn-out.
3. Demand detailed and clear design documentation at every stage of the design
4. Store all design information in clearly structured and easy to use secure database
5. Duplicate responsibilities

Impact on project cost, schedule or quality if risk realised with mitigation action:

Schedule Delay: 2 month
Cost: $US 40,000

Risk Number	**FTS/6**		**Status**	**Live**
Date Logged	**November 2006**		**Date Cleared**	
On Critical Path	**Yes**		**WBS Ref. No.**	**n/a**
Owners	**DN**			
Original Risk Factor	**Prob: 4**	**Severity: 2**	**Impact = 8**	**Cat = Medium**
Mitigated Risk Factor	**Prob: 3**	**Severity: 1**	**Impact = 3**	**Cat = Low**
Date when risk is forecast to be passed:	January 2008			

Description of risk:

Slippage in SCUBA-2 project delays FTS-2 commissioning beyond current timeline and/or budget.

Impact on project cost, schedule or quality if risk realised without mitigation:

Current development and salary budget expires in Jan 08. Possible scenarios are:

a) FTS delivered on schedule but commissioning delayed past Jan 08. Cost to the project would include commissioning and travel cost only.
b) Slippage identified early enough to allow FTS-2 project to be paused (required negotiation with CFI and another funding source to cover salaries in the interim period).
c) Slippage is too great, or a) or b) can't be realized before critical staff leaves project (risk # FTS/5)

Schedule Delay: ? months
Cost: $US 22,000 – 40,000

Mitigation action:

1. Find a way to multiplex FTS-2 commissioning with SCUBA-2 commissioning
2. Deliver FTS software ahead of instrument; JAC provides software effort during delayed commissioning.
3. Ensure any slippage in SCUBA-2 schedule is identified as early as possible.
4. Find other funding as backup for delayed commissioning.

Impact on project cost, schedule or quality if risk realised with mitigation action:

Schedule Delay: ? month
Cost: $US 0 - 22,000