Pierre Auger Observatory

Surface Detector Electronics Upgrade Project Risk Analysis

Abstract:

The purpose of this document is to identify the SDEU project risks, to make an assessment and an analysis of these risks to evaluate the impact on the performances, the cost and the schedule. The document describes also the mitigation foreseen to reduce the risk impact.

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ACRONYMS

n/a	non applicable
PAM	Product Assurance Management
PBS	Product Breakdown Structure
PCB	printed Circuit Board
PR	Physical Requirements
QAM	Quality Assurance Management
SDE	Surface Detector Electronics
SDEU	Surface Detector Electronics Upgrade
TBC	To Be Confirmed
TBD	To Be Defined
TBW	To Be Written
TDR	Technical Design Report
UB	Unified Board
UUB	Upgraded Unified Board
VM	Verification Matrix

DOCUMENT CHANGE RECORD

Issue	Revision	Issue Date	Changes Approved by	Modified Pages Numbers, Change Explanations and Status
06	A	22/04/13	P. Stassi	DRAFT for approbation
06	B	25/04/13	T. Suomijärvi	First issue
06	C	28/11/14	P. Stassi	Minor update

1 INTRODUCTION

The purpose of this document is to identify the SDEU project risks, to make an assessment and an analysis of these risks to evaluate the impact on the performances, the cost and the schedule. The document describes also the mitigation foreseen to reduce the risk impact.

1.1 Reference Documents

RD1 SDEU Development Plan, WP10LPSC02_SDEU_Dev_Plan.
RD2 SDEU Specification, WP10LPSC03_SDEU_Specification.

1.2 Process description

1.2.1 Risk management policy

- Identification of the set of resources or work packages with potential risks, taking into accounts the project goals and constraints.

- Definition of scheme for ranking the risk impact on schedule, resources and performances, according to the requirements of the project:

Impact on :	Severity value	Criteria
Schedule	1	No effect
	2	Low delay (1 to 3 months)
	3	Significant delay (3 to 6 months)
	4	Big delay (>6 months)
Resources	1	No effect
	2	Low over cost (1 to 10%)
	3	Significant over cost (10 to 30%)
	4	Strong over cost (>30%)
Performances	1	In accordance with requirements
	2	Not all requirements has been met
	3	Some requirement not met
	4	Non-compliance with requirements

Table 1.2.a –Risk severity scoring

- Establishment of scoring schemes for the likelihood of occurrence for the relevant tradable:

	Value	Criteria
Likelihood	1	No occurrence (never)
	2	Extremely rare (almost never)
	3	Rare (maybe)
	4	Frequent (surely)

Table 1.2.b –Risk occurrence scoring

- Establishment of a risk index scheme to denote the magnitudes of the risks of the various risk scenarios.

Likelihood					**Risk Index: combination of Severity and Likelihood**
Occ=4	Low	Medium	High	High	
Occ=3	Very Low	Low	Medium	High	➔critical path
Occ=2	Very Low	Low	Low	Medium	
Occ=1	Very Low	Very Low	Very Low	Low	
	S1	**S2**	**S3**	**S4**	**Global Severity (average)**

Table 1.2.c –Risk index scoring

Global Severity index is the average number of the severity values of the risk impacts on schedule, cost and performances.

"Low" and "Very Low" risks can be considered as acceptable risks. The bolded frame cases are representing the critical path.

1.2.2 Risk identification and assessment

The risks can be defined in four classes:

- **EXTERNALS** risks, trigged by external sources, like administration, funding agency, etc..
- **TECHNICAL & SCIENCE** risks, directly linked to the technical and science activities in the project.
- **SUB-CONTRACTORS & INDUSTRY** risks, linked essentially to construction and manufacturing activities.
- **HUMAN & ORGANIZATION** risks, related to the project organization and the human resources.

Data from all the four classes are used for this part.

Identification:
- Identification of the risk scenarios, including causes and consequences, according to the risk management policy.
- Identification of the means of early warning (detection) for the occurrence of an undesirable event, to prevent propagation of consequences.

Assessment:
- Determination of the severity of consequences of each risk scenario.
- Determination of the likelihood of each risk scenario.
- Determination of the risk index for each risk scenario.
- Determination of the magnitude of risk of each risk scenario.

1.2.3 Risk acceptance, reduction and mitigation

- Analysis of the acceptability of risks and risk reduction options (according to the risk management policy).
- Determination of the appropriate risk reduction strategy.

Acceptable risks:
- Application of the risk acceptance criteria to the risks.
- Identification of acceptable risks and/or the risks that will be subjected to risk reduction.

Non acceptable risks:
- Determination of preventative and mitigation measures/options for each unacceptable risk.
- Determination of risk reduction success, failure, and verification criteria.
- Verification of risk reduction.
- Identification of the risks that cannot be reduced to an acceptable level.
- Identification of the reduced risks for which risk reduction cannot be verified.

2 RISKS IDENTIFICATION AND ASSESSMENT

The SDEU project structure and constraints are described in the RD1 document, including the resources and the work packages definition (see below).

Work Packages definition:

#	***Names***
WP1	Analog PMTs signal processing
WP2	Trigger development
WP3	Time Tagging development
WP4	Slow Control development
WP5	UUB H/W Design & Integration
WP6	UUB S/W development
WP7	Calibration & Control tools development
WP8	Assembly, Deployment and Validation
WP9	Simulation and Science Validation
WP10	Project Management

Table 2.a – SDEU Work Packages

N#	Risk Description	Occurrence	Impact severity on schedule	Impact severity on resource	Impact severity on performance	Global impact severity (average)
1	Risk of instability of the need for the project: (Change of priorities, instability of demand, insufficient strategic analysis).	**2**	2	2	2	**2**
2	Risk of problems associated with the project partners (abandonment, non-priority project, regulations and different standards, economic and social situation, political instability, fiscal instability).	**2**	3	2	1	**2**
3	Funding risk: change of research policy medium/long term, alternative funding, unfavorable budgetary arbitration, absence or discount in question of multi-year funding.	**2**	2	3	1	**2**
4	Risk of poor expression or lack of understanding of the scientific need.	**1**	2	2	2	**2**
5	Risk of evolution of the scientific need after the start of the project.	**3**	3	3	2	**2.6 (3)**
6	Risk of missing, incomplete, insufficiently accurate specifications.	**2**	3	2	2	**2.3 (2)**
7	Risk of innovative technical solutions, not validated in the laboratory or industrial.	**3**	3	2	1	**2**
8	Risk of technical solutions used to boundaries (insufficient margins), or non-mature (no feedback) or exotic.	**3**	3	2	1	**2**
9	Risk of uncontrolled material production, reception, testing, maintenance.	**3**	3	2	2	**2.3 (2)**
10	Risk associated with the transport of components, subsystems or system.	**3**	3	1	1	**1.6 (2)**
11	Risk of non-implementation of the quality assurance by the manufacturer (traceability, monitoring, non-conformity management, change management).	**2**	2	1	2	**1.6 (2)**
12	Risks related to the internal interfaces of the project: lack of definition, requirements volatility, poor or no coordination..	**3**	2	2	2	**2**
13	Risk of wrong announced date of one or more phases of the project, consequences: a) Interference between several phases of the project (e.g. R & D and production). b) Interference with other projects.	**2**	2	1	1	**1.3 (1)**
14	Risk on the sustainability of human resources: retirement, mobility project of people having knowledge not easily replaceable.	**3**	3	2	1	**2**

Table 2.b – SDEU project risks assessment

The table 2.b is showing the list of the selected and applicable potential risks for the project.

The likelihood of occurrence and the impact severity on schedule, resources and performances are quantified. Le last column on the right is an average calculation of the 3 preview impact severity values (schedule, resources and performance).

Likelihood					**Color = Risk Index**
Occ=4		*CP*	*CP*	*CP*	High
Occ=3		7 risks	1 risk	*CP*	Medium
Occ=2	1 risk	5 risks		*CP*	Low
Occ=1		1 risks			**Very Low**
	S1	**S2**	**S3**	**S4**	**Global Severity**

Table 2.c – SDEU Project risk matrix (CP = Critical Path)

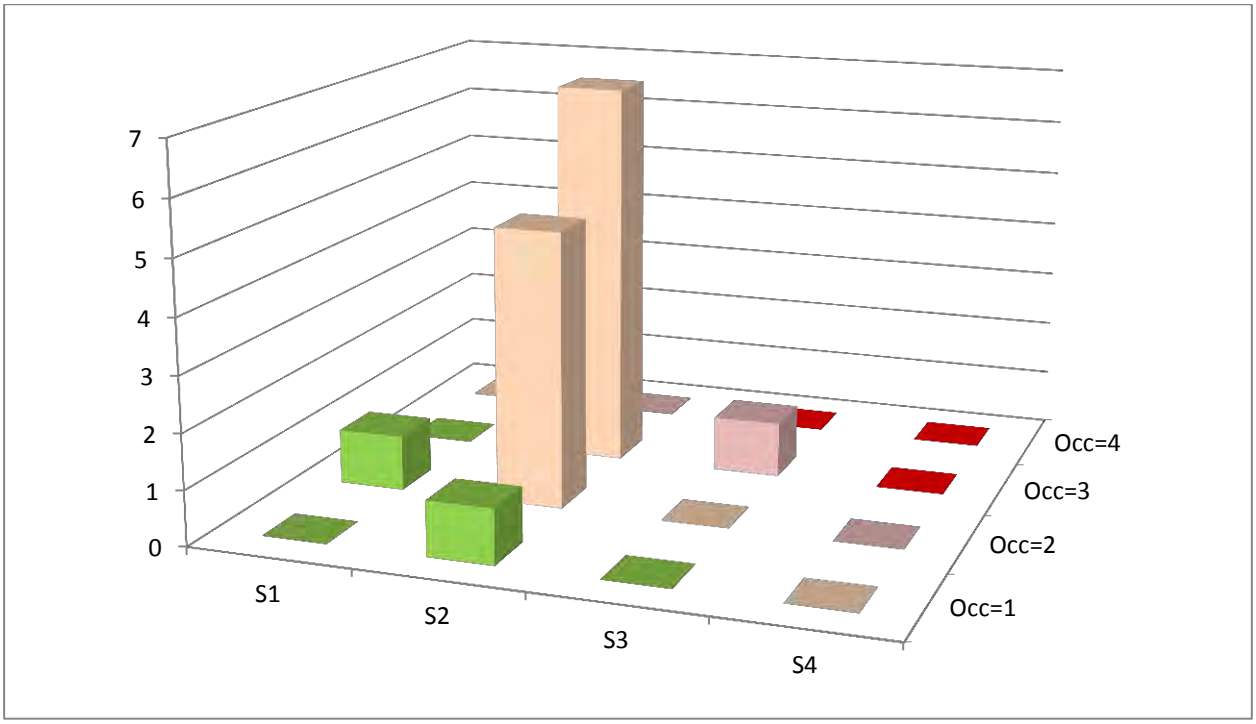

Figure 2.d – SDEU Project risk 3D matrix

The table 2.c and the figure 2.c are showing the distribution of the number of risk as function of the risk index (Very_Low, Low, Medium and High) which is function of the likelihood of occurrence and the global severity value.

No risk scenarios are in the critical path (*CP* cases for table 2.c)

3 RISK ACCEPTANCE, REDUCTION AND MITIGATION

3.1 Risks acceptance

N#	Risk Description	Risk Index	Can be accepted	Can be reduced	Comments
1	Risk of instability of the need for the project: (Change of priorities, instability of demand, insufficient strategic analysis).	**Low**	N	Y	
2	Risk of problems associated with the project partners (abandonment, non-priority project, regulations and different standards, economic and social situation, political instability, fiscal instability).	**Low**	N	Y	
3	Funding risk: change of research policy medium/long term, alternative funding, unfavorable budgetary arbitration, absence or discount in question of multi-year funding.	**Low**	N	Y	
4	Risk of poor expression or lack of understanding of the scientific need.	**Very Low**	N	Y	
5	Risk of evolution of the scientific need after the start of the project.	**Medium**	Y	Y	Cannot be accepted after design phase
6	Risk of missing, incomplete, insufficiently accurate specifications.	**Low**	N	Y	
7	Risk of innovative technical solutions, not validated in the laboratory or industrial.	**Low**	Y	Y	
8	Risk of technical solutions used to boundaries (insufficient margins), or non-mature (no feedback) or exotic.	**Low**	Y	Y	
9	Risk of uncontrolled material production, reception, testing, maintenance.	**Low**	N	Y	
10	Risk associated with the transport of components, subsystems or system.	**Low**	N	Y	
11	Risk of non-implementation of the quality assurance by the manufacturer (traceability, monitoring, non-conformity management, change management).	**Low**	N	Y	
12	Risks related to the internal interfaces of the project: lack of definition, requirements volatility, poor or no coordination..	**Low**	N	Y	
13	Risk of wrong announced date of one or more phases of the project, consequences: a) Interference between several phases of the project (e.g. R & D and production). b) Interference with other projects.	**Very Low**	Y	Y	
14	Risk on the sustainability of human resources: retirement, mobility project of people having knowledge not easily replaceable.	**Low**	N	Y	

Table 3.a – SDEU project risks acceptance

This table is showing the index for the selected risk scenarios and if they are acceptable and reduced. Note that even if a risk is acceptable a reducing solution must be studied.

3.2 Risks reduction, mitigation and verification

N#	Risk Description	Mitigation	Reduction verification criteria
1	Risk of instability of the need for the project: (Change of priorities, instability of demand, insufficient strategic analysis).	Organize regular meetings and communication within the Pierre Auger Observatory community.	Reduction of the engineering change requests.
2	Risk of problems associated with the project partners (abandonment, non-priority project, regulations and different standards, economic and social situation, political instability, fiscal instability).	Organize work packages with multiple partners, with overlapped competences.	Multiple solutions are proposed for each design issue.
3	Funding risk: change of research policy medium/long term, alternative funding, unfavorable budgetary arbitration, absence or discount in question of multi-year funding.	Organize work packages with multiple partners, with different funding possibilities.	Funding easily available.
4	Risk of poor expression or lack of understanding of the scientific need.	Organize regular meetings and communication between scientists and designers and propose a accurate TDR.	TDR accurate and quickly available.
5	Risk of evolution of the scientific need after the start of the project.	Avoid too early specific design, leave margin in functionalities and allow design adjustment possibilities, especially for detector upgrade. Use engineering change request process.	Several key-point meetings and reviews organized every year.
6	Risk of missing, incomplete, insufficiently accurate specifications.	Spend time to produce a unique and stable specification document in collaboration with all people of the project.	Specification document accurate and quickly available.
7	Risk of innovative technical solutions, not validated in the laboratory or industrial.	Avoid as much as possible too much innovative design	Time reduction for R&D phases.
8	Risk of technical solutions used to boundaries (insufficient margins), or non-mature (no feedback) or exotic.	Reuse inheritage of recent designs like, Northern Auger, AERA, etc.	Time reduction for design phases.
9	Risk of uncontrolled material production, reception, testing, maintenance.	Have a strong, agreed and applied production and validation plan. Apply QAM plan.	Clear tracking documentation.
10	Risk associated with the transport of components, subsystems or system.	Use sure and safe proven transportation procedures, domestic and international.	Reduction of the casualties
11	Risk of non-implementation of the quality assurance by the manufacturer (traceability, monitoring, non-conformity management, change management).	Include quality assurance criteria in the selection process of the manufacturers.	Manufacturer quality assurance plan available.
12	Risks related to the internal interfaces of the project: lack of definition, requirements volatility, poor or no coordination..	Organize regular internal meetings and communication between WP and system engineering.	Delay reduction in the global schedule.
13	Risk of wrong announced date of one or more phases of the project, consequences: a) Interference between several phases of the project (e.g. R & D and production). b) Interference with other projects.	Establish a realistic schedule, frequently updated, agreed by all people involved in the project realizations.	Delay reduction in the global schedule.
14	Risk on the sustainability of human resources: retirement, mobility project of people having knowledge not easily replaceable.	Organize work packages with multiple partners, working in team with overlapped competences.	Increase of the number of persons involved in the WPs.

Table 3.b – SDEU project risks reduction verification criteria

This table is showing the mitigation solution selected and the corresponding success verification criteria.

4 CONCLUSIONS

- The SDEU risk analysis and assessment is showing that no risk scenarios are in the critical path.
- The higher identified risk, #5, "*Risk of evolution of the scientific need after the start of the project*." Can be reduced without too much extra effort, avoiding too early specific design, leaving margin in functionalities and allowing design adjustment possibilities, especially for detector upgrade. Also using engineering change request process. The risk reduction can be verified by the organization of several key-point meetings and reviews every year.

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