FINAL

22 nd NOVEMBER 2011

I.A.A. Commission III

IAA MEETING AT CAPE TOWN - MINUTES

Meeting Date(s)	:	October 2nd, 2011	Page 1/12
Venue	:	Cape Town International Convention Centre, South Africa.	

Participants :

1.	JOHN C MANKINS	AIMS	Chairman
2.	S. RAMAKRISHNAN	ISRO	Secretary
3.	HORST RAUCK	GMK	
4.	HANS E.W. HOFFMANN	T-ONLINE	
5.	PAIVI JUKOLA	HUT, FINLAND	
6.	KLAUS SCHILLING		
7.	ERNST MESSERSCHMID	UNI. OF STUTTGART	
8.	GUNG IIGNOLET		
9.	SHANNON RYAN		
10.	WILLIANM SIEGFRIED	BOEING (Rt)	
11.	VICTOR VORONTSOV		
12.	KOVSTANTIN PICHKHADZE	LASPACE	
13.	VALERY ROMANOV		
14.	ANNA ROMANOVA		
15.	JUNJIRO ONODA	JAXA	
16.	MICHAEL YARYMOVCH		
17.	MARIA ANTONIETTA PERINO		
18.	TETSUO YASAKA	NIFTY	
19.	MICHAEL ARNAUD		
20.	IJAR M. DA FONSECA	INPE/BRAZIL	
21.	MIGUEL BELLO MORA	DEIMOS SPACE	
22.	JACQUES GIGOU	ESA	
23.	CHRISTOPHE BONNAL	CNES	
24.	SEISHIRO KIBE	JAXA	
25.	GANGRANDE BARREGI		
26.	ANDREAS RITTWEGER	ASTRIUM EADS	
27.	CHRISTIAN SALLABERGER	MDA CORPN	
28.	PETER SWAN		
29.	ANNA GUERMAN		
30.	SHOICHIRO MIHARA		
31.	MICHAEL MENKING	ASTRIUM EADS	
32.	MANFRED WARHAUT		
33.	JEFFREY HOFFMAN	MIT	
34.	HARIJONO DJOJODIHARDJO		

I.A.A. Commission III

IAA MEETING AT CAPE TOWN - MINUTES

Meeting Date(s)	:	October 2nd, 2011	Page 2/12
Venue	:	Cape Town International Convention Centre, South Africa.	

AGENDA

1. Review of Actions from March 2011 Meeting
2. Composition of Commission-III
3. Young Professionals Participation
4. Study Group Status Review:
   - # SG 3.9 Private Human Access to Space – Christophe Bonnal
   - # SG 3.10 Interstellar Precursor Missions – Claudio Bruno
   - # SG 3.11 Solar Energy from Space – John Mankins
   - # SG 3.12 Global Human Exploration of Space – Wendell Mendell
   - # SG 3.13 Space Elevators Concept & Technologies – Peter Swan
5. Status of IAC-2011 Symposia
6. Symposia Outlook for IAC 2011
7. IAA Summit Follow-up
8. Role of Commission-III in IAA Sponsored Conferences
9. Report to SAC
10. AoB

I.A.A. Commission III

IAA MEETING AT CAPE TOWN - MINUTES

Meeting Date(s)	:	October 2nd, 2011	Page 3/12
Venue	:	Cape Town International Convention Centre, South Africa.	

Minutes :

Subject/Description	Action	Due Date
Mr. John C Mankins, former Commission-III Chair, chaired the meeting as new Commission Chair Mr. Giuseppe Reibaldi could not attend the meeting. He welcomed all the Members and Participants to the Commission-III meeting. The Agenda for the Meeting was displayed and agreed to by the Members. 1. Review of Actions from March 2011 Meeting: It was noted that all actions pertain to the study group tasks and as such will be covered under Agenda # 4. 2. Composition of Commission-III The outgoing (2009-11) Commission-III and the reconstituted (2011-13) Commission-III composition were displayed (Annexure-1 & 2). It was noted that: M/s. Mendell W		

IAA MEETING AT CAPE TOWN - MINUTES

Meeting Date(s)	:	October 2nd, 2011	Page 4/12
Venue	:	Cape Town International Convention Centre, South Africa.	

Hoffmann H, and Sallaberger C. have been rotated out and they are replaced by three new members: M/s. Lu Y Korepanov V, and Rablu B While welcoming the new Members, the Commission acknowledged the contributions made by the outgoing Members and sought their continued active participation in the Commission meetings and activities. Members expressed their views on the new composition of Commission-III and the modus of selection of Commission Members. There was a strong request that Membership of Commission-III should reflect the subject expertise and current topics of importance under the purview of commission. There was a strong suggestion that chairs of a commission's study groups		

IAA MEETING AT CAPE TOWN - MINUTES

Meeting Date(s)	:	October 2nd, 2011	Page 5/12
Venue	:	Cape Town International Convention Centre, South Africa.	

should be included as Commission Members. It was agreed that these views of the Commission-III will be reflected in the report to SAC.		
3. Young Professionals' Participation: It was informed based on discussions in the earlier Commission-III meeting, initiative was taken to identify and invite young professionals for the Commission-III meeting. It was noted that IAA is yet to give its final view on the mode of their induction in Commission activities. The Members expressed a strong need to involve appropriate young professionals in the Commission-III tasks, recognizing that these individuals are not yet Members of IAA. It was suggested that a review of recent participants in Commission-III sessions might be a good approach to identify such young professionals.	Secretary, Commission-III	

IAA MEETING AT CAPE TOWN - MINUTES

Meeting Date(s)	:	October 2nd, 2011	Page 6/12
Venue	:	Cape Town International Convention Centre, South Africa.	

4. Study Groups Status:		
#SG 3.9 Private Human Access to Space: The status was presented by Mr. Christophe Bonnal (Annexure-3).	Secretary, Commission-III	
It was noted that the scope of study is limited to only sub-orbital flights. Extended table of contents for the study report finalized.		
Two IAA Symposia on the subject held at Arcachon during May 2008 and May 2011.		
First draft of Study Report	C. Bonnal	March 2012
Final draft of study report for peer review	C. Bonnal	Sept 2012
#SG 3.10 Inter-stellar Precursor Missions		
The study leader Mr. Caludio Bruno could not attend the Commission meeting at Cape Town.		
The draft study report has been put		

IAA MEETING AT CAPE TOWN - MINUTES

through peer review and the comments received are communicated to Mr. Bruno.		
Revised draft report incorporating modifications/ inputs from peer review to be ready for Commission-III review.	Claudio Bruno	December 2011
Release of final report with IAA approval	Chairman, Commission-III	March 2012
#SG 3.11 Solar Energy from Space:		
Mr. John Mankins reported the completion of study and release of the final approved study report.		
He informed that the study report has been printed and published under the sponsorship of SPACE CANADA.		
Two copies of the book were circulated among the Members.		
The members appreciated the high quality of the study report, specifically the comprehensive coverage of this currently relevant topic and		

IAA MEETING AT CAPE TOWN - MINUTES

complemented Mr. J. Mankins for his perseverance and the lead role he played in bringing out this report.		
#3.12 Global Human Exploration of Space:		
Ms. M. Perino reported the status on behalf of Mr. W. Mendell who was absent for the meeting (Annexure-4).		
It was noted that the study is making progress, but is delayed due to unavoidable personal problems of study lead.		
Elaboration of study planning and organization of study has been completed and the new target for readiness of first draft report is October 2012.	Wendell Mendell	October 2012
#3.13 Space Elevators Concept & Technologies:		
A status report (Annexure-5) was presented by the Study Group leader Dr. P. Swan. It was noted that the study is making good progress. A comprehensive		

IAA MEETING AT CAPE TOWN - MINUTES

outline, contents and chapters of the study report has been defined and lead authors for each section identified. Recent three events that significantly contribute to this cosmic study were highlighted: ❖ International space elevator conference (Aug 2011, Washington, USA) ❖ International Space Elevator Consortium study report published in April 2011 ❖ National Geographic magazine article on Space Elevator (July 2011 issue)		
The final version of the draft report to be ready for review during IAC-2012, at Naples.	Peter A Swan	October 2012
5. Status of IAC-2011 Symposia The status of papers in various sessions organized by Commission-III in IAC-2011 was reviewed (Annexure-6). It was generally observed that there		

IAA MEETING AT CAPE TOWN - MINUTES

Meeting Date(s)	:	October 2nd, 2011	Page 10/12
Venue	:	Cape Town International Convention Centre, South Africa.	

are quite a few last minute cancellations in IAC-2011.		
6. Status of IAC 2012 Symposia: The sessions planned are given in Annexure-7. To be reviewed during IPC meeting at Paris in March 2012		
7. IAA Summit Follow up: It was noted that there was a dedicated session (E 3.6) scheduled on 7th October 2011 on this topic, during IAC-2011.		
8. Role of Commission-III in IAA sponsored Conferences: It was recalled that in the last commission meeting at Paris, it was proposed to associate a Commission-III Member/representative in all relevant IAA standalone conferences. This proposal has to be further pursued with IAA and relevant programme Committees.	Chairman, Commission-III	

I.A.A. Commission III

IAA MEETING AT CAPE TOWN - MINUTES

Meeting Date(s)	:	October 2nd, 2011	Page 11/12
Venue	:	Cape Town International Convention Centre, South Africa.	

9. Report to SAC: Given in Annexure-8. 10. AoB: **# New Study Proposals:** It was informed that proposals for new study groups were invited on subjects identified in the last commission meeting (Annexure-9). The following additional topics were proposed for study: - Future propulsion system technologies - Innovative spacecraft architecture It was agreed that there is a need to initiate study groups on new topics under Commission-III as the current studies are nearing completion. **# Follow up of study group reports:** There is a need to get a feedback from IAA to Commission-III on the follow-up actions with respect to completed study reports.		

I.A.A. Commission III

IAA MEETING AT CAPE TOWN - MINUTES

Meeting Date(s)	:	October 2nd, 2011	Page 12/12
Venue	:	Cape Town International Convention Centre, South Africa.	

# Standing Committees on important issues: It was suggested by Members that IAA/SAC may constitute standing committees of relevant Academicians to resolve issues such as: ▪ Involvement of young professionals in Academy activities ▪ Increased utilization of on – line/internet tools for future conferences & meetings. **# Logistics and integration of IAA sessions with IAF sessions:** Members felt that there is a need for better interfacing and integration of IAA and IAF sessions to avoid conflicts and maximize participation by the Members.		

Commission III Composition (2009-11)

- John C. Mankins (USA), Chairman
- Giuseppe Reibaldi (It), Vice Chairman
- S. Ramakrishnan (In), Secretary
- Tetsuo Yasaka (J), Past Chair
- Christophe Bonnal (F), Member
- Hans E. W. Hoffmann (D), Member
- Wendell Mendell (USA), Member
- Claudio Bruno (It), Member
- Junjiro Onoda (J), Member
- Roger Lenard (USA), Member
- Christian Sallaberger (Ca), Member

Annexure - 1

Commission III Composition (2011-2013)

- **Giuseppe Reibaldi (It), Chairman**
- **Lu Y (Ch), Vice Chairman**
- **John C. Mankins (USA), Past Chair**
- **S. Ramakrishnan (In), Secretary**
- **Claudio Bruno (It), Member**
- **Junjiro Onoda (J), Member**
- **Lenard R (USA), Member**
- **Christophe Bonnal (F), Member**
- **Valeriy Korepanov (Ukr), Member**
- **Rablu B (Nig), Member**

Annexure - 2

Progress report on

IAA Study Group 3.9 "Private Human Access to Space"

Proposer(s): H. Rauck – G. Brachet **Chair:** Ch. Bonnal
Primary IAA Commission Preference: Commission 3
Secondary IAA Commission Interests: Commission 5

Overall Goal:
Identify and quantify the key topics associated to Manned Private Access to Space for both Orbital and Sub-orbital missions.

Key words:
- Technical aspects
- Legal and regulatory aspects, safety aspects
- Financial aspects, market analyses, associated business plans
- Motivations of potential customers
- Physiological and Psychological requirements, ergonomic constraints

Expected outcome of the study:
IAA Position Paper giving the keys to the topic and potentially including recommendations. Subdivision of the study into key chapters, with one "book captain" per chapter ; 7 or 8 members per chapter covering a wide range of origins (countries, agencies, industrials, searchers, operators…)

Annexure - 3

Time line:

Initially: 3 years following the initial proposal (March 2007)

Revised timeline:

- 1st IAA symposium on Private Human Access to Space (Arcachon)
  ⇨ 28-30 May 2008

  Publication of the full CD with all the papers, most of the presentations, pictures, … Distribution to all participants
  ⇨ End of September 2008

Report during IAC Glasgow ⇨ October 2008

- Publication in Acta Astronautica of the 15-20 best papers out of the 68 presented in Arcachon

  Process undergoing: 15 papers pre-selected
  - 4 rejected
  - 2 withdrawn after review
  - 14 finalized ⇨ Published AA Vol 66, 11-12

- SG: Formal invitation of members of the SG

Additional members are welcome, but may lead to problems of coherence and homogeneity (lack of efficiency; depends on the definition of a Working Group !)
⇨ Daejeon, October 2009

Extended table of contents ⇨ IPC, Paris March 2010

- IAC 2010: presentation of the status of the action

Decision taken during the meeting to hold the 2nd IAA Symposuim on Private Human Access to Space in 2011

- 2nd IAA symposium on Private Human Access to Space (Arcachon)
  ⇨ 30, 31 May, 1st June 2011

  Nice little conference (100 participants from 12 countries)
  56 presentations + 2 round tables
  Good press support thanks to presence of Astronauts, candidates, Virgin Galactic, X-COR, Astrium…
  Proceedings distributed to all participants, available upon request

- Preparation of a dedicated issue of Acta Astronautica with a selection of 15-20 most interesting papers out

  Process undergoing: Formalism towards Acta, notification to authors
  Goal is to finish before end of 2011, Publication March 2012

- Associated proposal to delay the preparation of the Position Paper. Already discussed with IAA SG

⇨ Report of the conference expected in CapeTown, September 2011
⇨ No progress since March on the content due to conference
⇨ Fist complete draft expected for Paris meeting March 2012
⇨ Final draft expected for IAC 2012 in Naples

Annexure - 3

IAA Study Group Status Report

Responsible Commission: Commission 3

Study Number and Title: 3.X Global Human Exploration: The Next Steps

Short Study Description (repeat from Study Group Proposal):

A general consensus exists that human exploration of the solar system is the next great challenge to the international community of space agencies. One important school of thought holds that a program of lunar exploration and development can be the first stage of expansion of human activities into the solar system. The principal objectives of the study will be to outline and define issues with planning for human exploration beyond low Earth orbit, comprising (a) technical issues, (b) human health and capability related issues, and (c) law and policy related issues.

The report will begin with a discussion of the rationales and drivers associated with the justification of extended human exploration. The history of plans and projects will be reviewed. Programmatic objectives will be categorized and discussed, including such characteristics as serving national political goals.

Possible system architectures will be identified and the attributes of each assessed. The advantages and disadvantages of each will be expressed in the context of potential programmatic objectives. The architectures will include space transportation systems, lunar surface elements, and philosophies of operations. Attributes will include mass flow, operational cost, difficulty of establishing the initial configurations, adaptability to changing objectives, and the effect of advances in certain key technologies. The utilization of the International Space Station for human research and potential in-space operations will be included.

Also important are discussion of the agents of exploration, i.e., governmental entities or commercial entities. Should the effort succeed in producing an ongoing and steady flow of activities, coordination and/or regulatory regimes will be necessary. With a stable (albeit small) population of humans and machines on the surface of the Moon or in cislunar space, commercial and economic issues can arise such as the exploitation of material resources.

With international involvement legal issues come to fore, and examples of these will be discussed. Lessons learned from the ISS program will be incorporated.

Progress in past six months:
Elaboration of study planning and organization

Website Study Information up to date? (Study Group Membership, Study Plan and Schedule):

Issues requiring resolution? (recommend approach):

Annexre - 4

Product Deliveries on Schedule? (If modified explain rationale):

First Draft – October 2010
Study Group Workshop No. 1 – Spring 2010
Study Group Workshop No. 2 – Spring 2011
Final Draft Report – October 2012

Study Team Member Changes? (List any Study Team Members that you wish to discontinue, and provide names plus contact coordinates of any Members you wish to add on the second page of this Study Update form.) Note: Complete contact information including email, tel. and fax must be provided for all additions. Only Members with complete contact information will be listed and receive formal appointment letters from the IAA Secretariat.)

Name of person providing Study Group Status:
Wendell Mendell, Maria Antonietta Perino, Chris Sallaberger

Status Report Date:

Study Team Membership Changes

Effectivity Date: XX/XX/2010

Name: Wendell Mendell
Current email address: wendell.mendell@nasa.gov

Name: Maria Antonietta Perino
Current email address: mariaantonietta.perino@thalesaleniaspace.com

Name: Chris Sallaberger
Current email address: Christian.Sallaberger@mdacorporation.com

Name: John Logsdon
Current email address: logsdon@gwu.edu

Name: Alain Dupas
Current email address: adupas@club-internet.fr

Name: Giuseppe Reibaldi - “ex officio”
Current email address: Giuseppe.reibaldi@esa.int

Name: John Mankins - “ex officio”
Current email address: john.c.mankins@artemisinnovation.com

Add:

Name: Andy Aldrin
Current email address: andrew.j.aldrin@ulalaunch.com

Name: Claudio Bruno
Current email address: bruno@dma.ing.uniroma1.it

Name: Charles, John B.
Current email address: john.b.charles@nasa.gov

Name: Prof. Dr. Gabriel G. De la Torre
Current email address: gabriel.delatorre@uca.es

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Current email address: shinji@csp.co.jp

Name: Messerschmid Ernst
Current email address: messerschmid@irs.uni-stuttgart.de

Name: Sias Mostert
Current email address: mostert@ing.sun.ac.za

Name: Andreas.Rittweger
Current email address: Andreas.Rittweger@astrium.eads.net

Name: Harley Thronson
Current email address: harley.a.thronson@nasa.gov

Name: John Zarneky
Current email address: J.C.Zarnecki@open.ac.uk

Assessment of the Technological Feasibility and Challenges of the Space Elevator Concept

A Cosmic Study for the International Academy of Astronautics
Editors: Cathy Swan, David Raitt, Skip Penny, Ted Semon,
Peter Swan [contact through Dr-swan@cox.net]

Subject: Cosmic Study Status Report September 2011

By Whom: Dr. Peter Swan, Co-Chair of Study

Major Topics: Overview, Outline, Schedule, Meetings Achieved, Near-term Meetings, General Summary, Individual Chapter Abstracts & Questions

Overview: The Space Elevator Community has made great progress in the last six months which is significantly assisting the IAA Cosmic Study. The big events that did contribute to individual chapters are:

- International Space Elevator Conference (Aug 2011, Redmond Washington, USA) – Focus day on carbon nano-tubes for tension strength. [yearly event with Cosmic study meetings held]
- International Space Elevator Consortium Study Report Published entitled; *"Space Elevator Survivability, Space Debris Mitigation,"* Lulu.com, Apr 2011.
- National Geographic Magazine [with over 100 million readers] featured two pages on Space Elevator in the July 2011 issue.

Outline:

ANNEXURE - 5

Schedule: The study is on track for a Spring 2013 publishing date. The study schedule is as follows:

Date	*Action*	*Type*	*Location*	*Host*
Oct 10	Study Approved by IAA	Written	Paris	IAA
Oct 10	Kick off study	Mtg	Prague	IAA
Mar 11	Outline Due	Mtg	Paris	IAA
Aug 11	Annotated outline/major questions	Mtg	Seattle	ISEC
9 Sept 11	Draft Chapters Due	Written	To Website	team
Oct 11	Discuss Chapter inputs	Mtg	Cape Town	IAA
9 Jan 12	Feedback Chapters – all review	Written	On website	team
9 Mar 12	Draft Chapters resubmitted	Written	On website	team
Mar 12	Chapters discussed in detail	Mtg	Paris	IAA
9 July 12	Final Chapters submitted	Written	On website	Team
Aug 12	Chapter overlap review	Mtg	Seattle	ISEC
Oct 12	Final review chapters/feedback	Mtg	Naples	IAA/ISEC
1 Dec 12	Final Chapters submitted	Written	On website	Team
Mar 13	Peer Review 1 Dec – 15 March	Written	From website	Team
9 Apr 13	Corrections accomplished – final	Written	From website	Team
9 Jun 13	Final Approval from ISEC & IAA	Written	From website	Team

Meetings Achieved: The study group met in Paris in March 2011 to finalize the outline and to ensure the participants were "kicked-off." Indeed the study has been aggressively initiated and the members are participating and contributing. The August meeting was held at the International Space Elevator Conference and was conducted as a two hour brainstorming session within the conference. Many good ideas surfaced and the summary has been sent to the participants.

Near-term Meetings: the next two meetings will be critical. The one in Cape Town will pull together the various chapter inputs and hopefully will have a good start at a report. After that, the Paris March meeting will try to refine the chapters and pull together the various thrusts of the study into a common aiming point.

General Summary: the status of the study group is fine. We are progressing and hopefully making progress. The real indicator is the excellent set of chapter abstracts and basic questions for the study. They are shown in the following section. The study is on schedule and should make the April 2013 date.

Individual Chapter Abstracts & Questions:

Chapter 1: Introduction

1.1.2 Abstract: This first chapter establishes Brad Edwards' space elevator baseline in 2000 and sets the stage for the rest of the study to grow from this historic baseline. In addition, the chapter describes "why a space elevator," suggests a comprehensive vision, and describes the IAA's approach for their cosmic studies. The last part of the introduction chapter lays out the book's structure with a set of chapter abstracts and major questions to be discussed within the chapter.

Major Questions:

- Why build a space elevator?
- What is being addressed in the cosmic study?
- How is the cosmic study organized?
- What is an operational view and how does it "set up" a space system architecture?

1.0 General Background
- 1.1 Why a space elevator
- 1.2 Cosmic Study Approach
  - 1.2.1 Technological Maturity (TRL's)
  - 1.2.2 Risk Matrix Chart
- 1.3 Conceptual Architecture
  - 1.3.1 OV-1
  - 1.3.2 Schedule
  - 1.3.3 What are the Elements of a Space Elevator
  - 1.3.4 Global Vision –

    1.3.4.1 Population: The Earth may not be able to support the increasing number of humans.

    1.3.4.2 Energy: We are running out of the fossil fuels that are the cornerstone of modern society.

    1.3.4.3 Pollution: Our various activities are affecting the Earth and affecting climate change.

    1.3.4.4 Local and Global Catastrophe: An asteroid hitting the Earth could be a small disaster, a city killer, or a global transformation.

A Simple Vision: We have an inspiring goal. A suggested simple vision that can change the world:

The Space Elevator gives us the road
to limitless opportunities while opening up the Solar System.

- 1.4 Feasibility Condition
- 1.5 Layout of the Cosmic Study Report

Part I – Major Elements

Chapter 2: Tether Material

Abstract: The tether must be made of a material that can withstand its environment and operational stresses. This would include all of the threats to the system as well as tensile strength necessary to support itself. It turns out that if the tether can support 45 [or Ben is this greater or smaller] MYuri { or GPa} of tension, a space elevator can not only support itself, but five major tether riders (at 10 tons each plus 10 tons payload) at a time. Materials currently being tested in the laboratory have surpassed that level and promise a tether that can withstand the environmental and operational stresses necessary. Will it be carbon nanotubes, or boron nitrite materials, or something else?

Major Questions – Tether:
Te #1 – What are the basic requirements for developing the tether materials?
Te #2 – What is the basic materials development approach?
Te #3 – Is a metre wide, paper thin tether the optimum configuration?
Te #4 -- What are the acceptable stress levels expected to accomplish the space elevator?

2.0 Estimated strength material,
2.1 Feasibility condition,
2.2 Carbon nano-tube status,
2.3 Single or dual walled,
2.4 Strength projections vs. time,
2.5 Reliability,
2.6 Robustness,
2.7 Environmental survival,
2.8 Parallel material,
2.9 Projection of suitable material

Chapter 3: Tether Riders

Abstract: The variety of climbers will surprise even the early believers in a space elevator. There will be tether weavers, repairers, safety inspectors along with logistical trams, commercial climbers, human rated climbers, hotels, launch ports, etc. However, key to their success will be the requirement to have an open standard so that all manner of climbers can work on the space elevator. The analogy would be the railroad's standard width of its rails. Anyone can put a train on the rails if they adopt the standards. A similar approach must be used to ensure compatibility between tether and climbers. The complexity of the tether interface has driven the design of tether riders and keeps its maturity level between technological development and engineering applicability.

Major Questions – Tether Rider:
TR #1 – What are the basic requirements for developing a tether rider?
TR #2 – What is the basic systems approach?
TR #3 – Is there a need for "sidings" so that different types of climbers can pass or be parked?
TR #4 -- Are there permanent locations, ie. Hotels?

3.0 Basic needs,
3.1 Mass goals,
3.2 Major components [structure, motor, power source, drive wheels, tether connection, communications, environment],
3.3 Deployment scheme,
3.4 Re-use?
3.5 General summary

Chapter 4: Power for the System

Abstract: Power will be supplied through various mechanisms leading to electrical motors that move the climbers. Ideas range from laser and radio frequency energy from the ground, to solar or nuclear power for a non-interruptible supply. Design trades will lay out options and systems engineers will move toward proposed solutions. The current concept is to launch at dawn using solar energy all day, lasers through the first night, and then solar energy the rest of the trip with short eclipses.

Baseline Power Concept

- solar energy propulsion from dawn to first night
- then laser energy from dusk till dawn
- then solar energy to the top with minimum interuptions from short eclipses

Major Questions – Energy Sources:
ES #1 – What are the basic requirements for developing an energy source?
ES #2 – What is the basic systems approach?
ES #3 – Could paper-thin flexible batteries be built into the ribbon at intervals?
ES #4 -- What are the engineering challenges, such as pointing solar arrays?

4.0 Introduction with requirements,
4.1 Types of power needed,
4.2 Delivery alternatives,
4.3 Power (Solar) arrays for laser and solar,
4.4 Systems design,
4.5 Projected improvements in materials and power generation

Chapter 5: End Station Infrastructures (Base Station & Apex Anchor)

Abstract: The two ends of a space elevator have many possible engineering paths. It turns out that one of the biggest issues is location of the base station. The trades for the Earth's attachment reach across political, investment, engineering, weather, and operational issues. A simple solution could be that a heavy ship(s) would act as a base for operations as well as to move the tether out of harms way by initiating a resonance motion. Much more will be discussed during the chapter on location and technologies. In addition, the benefits of elevating the base station to a high altitude will be discussed with a new technology that can provide that capability. Trades will be presented to show the reason for elevating the base station to an altitude out of the atmosphere. The counterweight, or apex anchor, will be the mechanism that allows the tether to maintain tension and perceived rigidity. The makeup of the apex anchor and its components must be discussed to ensure a consistent design with simple engineering solution

Major Questions – Base Station and Counter Weight (CW):
Te #1 – What are the basic requirements for the base station and apex anchor?
Te #2 – What is the basic systems approach to develop the two end points of the space elevator?
Te #3 – Should the base station be at altitude? What height?

5.0 Introduction
5.1 Counterweight Description [Apex Anchor]
[alternative sources of mass, schedule of enhancement, distance]
5.2 Earth Based Anchor
5.2.1`Base Stations:
Trades: base legs vs. continuous space elevator?
Threats, Dangers, solutions
Feasibility, Development approach, testing

5.2.1 Surface Stations
Location:Terrestrial vs. Ocean
Suggested Locations, and why
Description of Anchor Stations
Community of Activities
5.2.3 Base Legs: Stations at Altitude
Advantages – Disadvantages
Challenges of Earth's Turbulent Atmosphere
The lowest 100 km
Options Considered
Simple Ribbon vs. Bolstered Ribbon
Development of the Launch Loop
Preferred design
Surface Stations
Transfer to Main Ribbon
Technology Summary
Forces and Structural Materials
Magnetic Levitation
Winds and Stabilization
Initial Erection
Open Questions
5.3 Systems Recommendation [ground, sea, at altitude]

Note: I am using the term Base Legs as when I was thinking of the problem -- I just ran multiple carbon nanotubes ribbons down from some location... I like your use of launch loops to take the stress off the lower portion of the space elevator and enable "free reigning commerce" to take place up the base legs... if you want to use other words than base legs, please suggest them...

Part II – Systems Approach

Chapter 6: Systems of Systems Design

Systems of Systems Design: No one has made an elevator that moves along a tether for 100,000 km against gravity. The design factors inherent in this challenge are new and must be addressed by the design team. There is no reason to believe that this cannot be achieved with solid engineering processes leading to materials production and assembly in a timely manner. A systematic design process must be applied to a family of systems that will yield an operational space elevator. This system of systems design will challenge the skills of systems architects and the systems engineers.

Major Questions – Systems Design:
SE #1 – What are the Customer Needs?
SE #2 – What are the basic requirements?
SE#3 – What is the basic systems operational concept?

6.0 Introduction: This chapter will address the following questions and resolve issues that are created.

SE #1 – What are the Customer's Needs?
SE #2 – What are the requirements?
SE#3 – What is the systems operational concept?
SE#4 – What Vision will drive the team?
SE#5 – What safety factor is optimum (factor of 2 or 4)?

6.1 Process Discipline: The development of a mega-project needs discipline, especially during the initial phases, to ensure the requirements are developed early and continually refined as the knowledge base expands. To successfully mature requirements from the initial phase to operations demands a process that understands complexity, leaps of faith, commitment, passion and focus.

- Discipline & Process
- Why
- Needs

6.2 Approach: The systems engineering mission is to "Assure the fully integrated development and realization of products which meet stakeholders' expectations within cost, schedule and risk constraints." [1] The bottom line is that when the approach is properly applied to a systems-of-systems project, strong systems engineering will lead to an outstanding product.

6.3 Systems Engineering Process Tasks The basic tasks derived from the systems engineering process can be presented.

- Define the System Objectives
- Establish the Functionality
- Establish Performance Requirements
- Evolve Design and Operations Concepts
- Select a Baseline
- Verify the Baseline meets Requirements
- Iterate the Process through Lower Level Trades

[1] *SEPrimerAIAA-INCOSE_1997-08, p 3.*

6.4 Global Needs Lead to Four Basic Requirements: Global problems require large-scale solutions. There are four remarkable motivational drivers.

- Low Cost Access to Space
- Special Location Capability
- Driving Space Innovation:
- Operationalize Space:

6.5 Wright-Flyer Basic Outline: **From the four overarching needs we can develop some basic requirements. The team must lay out basic requirements for the development of a space elevator.**

- Funding Started by….
- Preliminary Design Review by….
- Flight Readiness Review by…
- Deployment Initiated by…
- IOC capability by….
    - 20 ton payload capability
    - 5 climbers with payload at any instant (surface to GEO)
    - Climbers estimated at 20 tons each
    - $100 per kilogram (when multiple Wright-Flyers operate)
    - Reliability of elevator (777 jet engine exceeds 17,000 hours)[2]

6.7 Coalescing Thought: Risk Assessment

During the study, many factors relating to the space elevator were discussed. Two techniques will be used to summarize the status of the space elevator as of the spring of 2013.

- Technology readiness level ranking.
- Risk chart [Likelihood vs. Consequence].

Chapter 7: Dynamics of Operation Tether

Dynamics of Operational Tether: An operational tether will challenge the operator along many areas. A 100,000 km space elevator will have new and exciting dynamics that can only be predicted as there is no equivalent experimental model. Many of the traditional space issues [such as the influence of the Sun and the Moon] will exist with new ones surfacing as the study goes forward. .

Major Questions – Dynamics of Operational Tether:
DT #1 – What are the basic requirements for a stable space elevator?
DT #2 – What is the basic control approaches required?
DT #3 – How complex is the computer simulation to model the dynamics?
DT #4 -- Do we need knowledge of elements location separated by 1 km, 25 km or 100 kms?

7.1 Space Elevator Mechanics Modeling Issues

7.2 Static Equilibrium of the Space Elevator

7.2 Fundamentals of the Space Elevator Dynamics

7.2.1 Planar dynamics

7.2.2 Three-dimensional dynamics

7.2.3 Fixed vs. floating platform

7.3 Elastic Oscillations of the Space Elevator Ribbon

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[2] *Schmitt, Capt. John H., personal communications. 9/18/2003.*

7.3.1 Longitudinal oscillations

7.3.2 Transverse oscillations

7.4 Perturbations of the Space Elevator Dynamics

7.4.1 Effects of aerodynamic forces

7.4.2 Effects of the non-spherical shape of the earth

7.4.3 Luni-solar gravitational perturbations

7.5 Effects of Climbers on the Space Elevator Dynamics

7.5.1 Stationary climbers

7.5.2 Moving climbers

7.5.3 Climbing Schemes

7.6 Control of the Space Elevator Dynamics

7.6.1 Control of the pendular motion

7.6.2 Control of the elastic oscillations

Chapter 8: Tether Deployment Approaches

Tether Deployment Approaches: At the present time, there are two distinct and attractive approaches for the deployment of the space elevator. Each starts at GEO and deploys a single strand of tether to be built upon. Approaches vary at this point with one building from the ground up [Edwards approach] and the other lifts itself up from the counterweight reel [Gassend concept].

Major Questions – Tether Deployment:
TD #1 – What are the basic requirements for each approach?
TD #2 – What are the basic characteristics and strengths of each?
TD #3 – What modeling approaches are needed to predict and then monitor deployment?
TD #4 -- What testing approaches are required to prepare for initial deployment?

8.0 Introduction -,[Fujii and Misra]
Overview of Chap.2.7
8.1 Approach Choices – [MK]
Bootstrap vs. weaving vs.
History of deployment of space tether
Stable Condition,
Natural Dynamics
8.2 Deployment Dynamics during Phases - [NT]
[at GEO initial, short range, long tethers, approaching
atmosphere, in atmosphere, attachment step]
Plans of space elevator construction
Dynamics of initial deployment
2.7.2.x Dynamics of a Partial Space Elevator [Mohammad Jalali Mashayekhi]
8.3 building the space elevator from simple first strand, [NT]
Momentum loss
Dynamics in building space elevator
8.4 testing of dynamics, [HAF and TW]
Methods to assure the reliability of tether deployment
Testing of deployment
1. On the ground or in space
2. Modeling of space environment (12 methods by YESII & T-Rex)
3. Design of the tether box(?) and deployment/ejection system

4. Synthesize of total system with such long length tether
5. Assessment of climber/elevator
6. Roles of numerical simulation

8.5 Cut Tether Dynamics, [PW]
Tether dynamics of severance in deployment phase
8.6 General Discussions, [All]

Major Questions to answer:
Major Topics: Stable Condition,
Natural Dynamics [Sun, Moon, resonances, etc],
Deployment
Dynamics during Phases [at GEO initial, short range, long tethers,
approaching atmosphere, in atmosphere, attachment step, building the space elevator from simple first strand, testing of dynamics]

Chapter 9: Systems Design for Environment

Systems Design for Environments: One complexity for the systems approach to a space elevator infrastructure is that it crosses so many environments. This chapter will address environments [except spa debris – see next chapter] from the surface [ocean or terrestrial], the winds and storms of our atmosphere, multiple layers of complex particles, and magnetic fields for the first 100 kms, from the lower reaches of space, to GEO and beyond.

Major Questions – Environments:
DE #1 – What are the basic requirements across the multiple environments?
DE #2 – What is the basic systems approach for each?

Chapter 10: Systems Design for Space Debris

Systems Design for Space Debris: The International Space Elevator Consortium's recent study presented the issue of space debris, its probability of collision for the space elevator (with the debris density of April 2010), and mitigation techniques. This chapter will layout the systems design issues and recommended solutions for this problem and recommend operational, technical, and policy approaches..

Major Questions – Space Debris:
SD #1 – What is the threat? [densities, probabilities of collision, sizes]
SD #2 – What are the basic requirements for protecting against space debris?
SD #3 – What are the basic approaches recommended options?
SD #4 – What can the space elevator do to improve the situation?

10.1 General Background:
Descriptions of threats for various altitudes
10.2 Definition of the Problem:
History,
Description of Debris population,
knowledge of debris locations, and
knowledge of Elevator location
10.3 Probability of Impact:
Determining probability,
Density of Objects by altitude,
relative velocities,
Probability of Collision,
Risk to Space Elevator
10.4 Mitigation Techniques:
User needs,
user requirements,

potential solutions to space debris,
Systems approach for survival

10.5 Conclusions and Recommendations:
Density reduction,
Probability of Collision,
Significant questions,
Active Player actions

Chapter 11: Space Elevator Developmental Roadmaps

Developmental Roadmaps: Organizations which take on monumental tasks require a vision with some sort of roadmap that lays out the major thrusts, hurdles, and engineering paths. The roadmap has historically been a useful tool. It allows everyone involved to help layout the path for development of a mega-project such as the space elevator infrastructure. This chapter will present a baseline roadmap which can be matured towards operations.

Major Questions – Developmental Roadmaps:
DR #1 – What are the basic requirements for developing a roadmap, what is included?
DR #2 – What is the basic approach to develop a roadmap?
DR #3 – What is a baseline roadmap current as of 2012?

11.0 Historical View, Present Status, Various approaches , roadmap #1, roadmap #2, etc., major roadblocks
11.1 Various approaches
11.2 Road Map #1,
11.3 Road Map #2
11.4 Major Roadblocks

Chapter 12: Operations Concept

Operations Concept: Operations of the space elevator infrastructure will cross many traditional arenas to include: space operations, logistical support of remote locations, maritime delivery, personnel support for remote operations and future on-orbit operations. This chapter will discuss an operational view approach and propose an Operational View # 1 [OV 1].

Major Questions – Operations Concept:
OC #1 – What are the basic requirements for developing an ops concept?
OC #2 – What is the basic component of an ops concept?
OC #3 – What is the proposed OV 1?
OC #4 – How does the logistics of the Space Elevator tie with the customers?

12.1 Introduction:
Start with Operational View – 1 [OV-1]
12.2 Scope:
Describe Space Elevator Ops in classic bus and payload paradigm
12.2 Satellite Design
How does this impact the satellite industry and on-orbit capability
12.3 Operations View of Space Elevator
the Sec 3.2 stuff after cleanup from upcoming discussion.
12.3.1-x Elements and descriptions of each
12.x+1 Satellite Delivery Operations:
From factory to support base, to ribbon platform,
mating to climber and delivery to orbit

Part III – Future Considerations

Chapter 13: Legal Perspective

Legal Perspective: A significant aspect of the legal world is that this transportation infrastructure will cross four major disciplines of law; space, terrestrial, maritime, and aeronautical. Which will dominant? Who will own a space elevator and where will it be registered and located? These are major questions that must be considered early in the development. At least two legal regimes will be proposed for developing a future space elevator.

Major Questions – Legal Perspective:
LP #1 – What are the basic requirements for Legal Acceptance?
LP #2 – What are the basic systems approach issues that must be refined to ensure legal acceptance?
LP #3 – How to select between alternant legal regimes?

13.0 Historical View, Present Status,

In this field, we must explain three dimensions, i.e. law of the sea, law of the atmosphere and law of the outer space, because Space Elevator is such three dimension architecture.

13.01 Law of the Sea
13.02 Law of the Atmosphere
13.03 Law of the Outer Space

13.1 Laws/Policies Needed to succeed,

Main issue of law of the sea is United Nations Convention on the Law of the Sea.
Main issue of law of the atmosphere is Convention on International Civil Aviation(the Chicago Convention)
Main issue of law of the outer space is United Nations Outer Space Treaties.

13.11 Law of the Sea
13.12 Law of the Atmosphere
13.13 Law of the Outer Space

13.2 Laws/policies needed to be re-arranged,

These conventions are almost impossible to change for the space elevator under the current situation of global politics. So, we must search the way compatible with the conventions in order to establish and operate Space Elevator.

13.21 Law of the Sea
13.22 Law of the Atmosphere
13.23 Law of the Outer Space

13.3 Basic International Law direction to enable Space Elevator

In order to enable Space Elevator, we must establish the international organization for Space Elevator. In the near future, I can show you the draft of the treaty.

13.31 Law of the Sea
13.32 Law of the Atmosphere
13.33 Law of the Outer Space

or

13.0 Introduction
13.1 Three Applicable Legal Regions
Terrestrial [specifically Law of the Sea]
Atomspheric [specifically Law of Aeronautics]
Law of Outer Space
13.2 Two Approaches

Option A: International Approach – create parallel organization to INTELSAT and INMARSAT. First international government funding and operation, then transfers to commercial ownership and operations.

Option B: Country Sponsored – Commercially developed and operated

13.3 Road Forward to prepare legal landscape

Chapter 14: Financial Perspective

Financial Perspective: Numerous mega-projects throughout history have failed because of a lack of understanding of the financial environment surrounding them, as well as political maneuvering and competi jurisdictions, because a common goal is not pursued with clarity. This chapter will provide a detailed overvi of the cost of construction, financing options, operational costs and resulting costs to consumers of a Spac Elevator. In addition the returns on investment will be addressed. The reality of a space elevator systems development is that it will not occur until two things happen; 1) The tether material is proven out and 2) investors will finance the creation of an infrastructure to space. Current estimates of expense are reasonable when compared to other mega-projects with potential returns in the $10s of billions.

Major Questions – Financial Perspective:
FP #1 – What are the basic requirements for developing an investor group?
FP #2 – What is the approach that must be presented to them?
FP #3 – What are the recurring operating costs such as power and maintenance?
FP #4 -- What are the non-recurring start-up costs such as the building of a base station and the launching of the original tether?
FP #5 – How much will costs be reduced over time as multiple elevators are built?
FP #6 – What is the timeline for profitability?
FP #7 – What is the initial required investment and what are possible sources for that investment?
FP #8 – What is the final cost to consumers?
FP #9 – What will be the likely profit to investor?

14.1 Basic Theme of Chapter: Numerous mega-projects throughout history have failed because of a lack of understanding of the financial situation surrounding them. This chapter will provide a detailed overview of the cost of construction, financing options, operational costs and resulting cost to consumer for a Space Elevator.

14.2 Major Questions to Answer:

1. What are the non-recurring start-up costs such as the building of a base station and the launching of the original tether?
2. What are the continuous operating costs such as power and maintenance?
3. How much will costs be reduced over time as multiple elevators are built?
4. What is the initial required investment and what are possible sources for that investment?
5. What is the timeline for profitability?
6. What is the final cost to consumers?

14.3 Major Topics: Initial launch, material creation, climber costs, laser facilities, base station, crew, cargo logistics, financing, cash flow, return on investment.

Chapter 15: Study Conclusions
Chapter 16: Study Recommendations

Appendix: History of the Space Elevator Concept - Author Information – what is an IAA

	IAC 2011 IAA Commission III Symposia - status 21/09/2011		
ref	**Symposium Title** / Session Title	**Coordinator (Symp.)** /Chairman (session)	**21/09/2011:** abstracts status, **papers upload status**
A.5.	**Human Exploration of the Moon and Mars Symposium**	**W. Mendell, C. Sallaberger**	
	A.5.1 Near-term Strategies to establish Lunar infrastructure	M-E Perino, W Mendell, *B Foing (R)*	12 accepted/ 8 confirmed, 4 withdrawn, **6 papers uploaded**
	A.5.2 Long-term scenarios for human Moon-Mars presence	U.Apel, W.H. Siegfried, *N Ghafoor (R)*	6 accepted/all confirmed **4 papers uploaded**
	A.5.3 /B.3.6 joint session on Human and Robotic partnerships to realize space exploration goals	C Sallenberger, A.r. Gross, *R. Willnecker, M Bottacini (Rs)*	10 accepted/ 6 confirmed, 2 withdrawn, **6 papers uploaded**
	A.5.4 Going beyond the Earth-Moon system: Human missions to Mars, Liberation points , and NEO's	G. Gargir, L Suchet, *G.Schwehm (R)*	11 accepted/ 9 confirmed, 2 withdrawn, **7 papers uploaded**

C.3.1			
	Space Power Symposium	**L Summerer**	
C3.1	Space-based Solar Power architectures - New Governmental and commercia l concepts and ventures	N. Kaya, J. Mankins, *J.T. Howell , L. Summerer (Rs)*	8 accepted/ 7 confirmed, 1 withdrawn, **6 papers uploaded**

D.3			
	Symposium on Stepping Stones to the Future: Strategies, Architectures, Concepts and Technologies	**J. C. Mankins, A.Pradier**	
	D.3.1: Strategies, Architectures to Establish a "Stepping Stone" Approach to our Future in Space	J.C.Mankins, MA Perino,, *W. H. Siegfried(R)*	8 accepted/ 7 confirmed, 1 withdrawn, **6 papers uploaded**
	D.3.2:Concepts, Technologies, Infrastructures and Systems for the Exploration and Utilisation of Space	W. H. Siegfried, S Hovland, *H Yamakawa (R)*	10 accepted/ 8 confirmed, 1 withdrawn, **6 papers uploaded**
	D.3.4 Space Technology and System Management Practices and tools	P.A. Swan, P. Jukola, C. *Moore (R)*	11 accepted/ 9 confirmed, 1 withdrawn, **7 papers uploaded**

D4			
	Symposium on Far Futures (Visions and Strategies for Far Futures)	**Hans E.W. Hoffmann, G.Reibaldi**	
	D.4.1 Human exploration in Deep Space	A. Dupas, P. Jukola, *J Kenol (R)*	10 accepted/ 7 confirmed, 1 withdrawn, **6 papers uploaded**
	D.4.2 Public/Private Innovative Initiatives in Human Spaceflight Round Table	H. Rauck, S Ramakrishnan, *D. Andrews (R)*	6 accepted/ 3 confirmed, 2 withdrawn, **3 papers uploaded**
	D4.4: Space Elevator and Tethers	P. A. Swan, R. E. Penny, *D. Raitt (R)*	9 accepted/ 7 confirmed, 1 withdrawn, **7 papers uploaded**

ANNEXURE – 6 & 7

	IAC 2012 IAA Symposia (Status 23/09/2011)	
ref	**Symposium Title** / Session Title	**Coordinator (Symp.)** /Chairman (session)
A.5.	**Human Exploration of the Moon and Mars Symposium**	**W. Mendell, C. Sallaberger**
	A.5.1 Near Term Strategies for Lunar Surface Infrastructure	M-A Perino, W Mendell, N *Ghafoor (R)*
	A.5.2 Long Term Scenarios for Human Moon/Mars Presence	U.Apel, W.H. Siegfried, *N Ghafoor (R)*
	A.5.3 /B.3.6 Human and Robotic partnerships to realize space exploration goals	C Sallenberger, A.r. Gross, *M. Hempsell, A. Kindrat (Rs)*
	A.5.4 Going beyond the Earth-Moon system: Human missions to Mars, Liberation points , and NEO's	G. Gargir, E. Messerschmid, *G.Schwehm (R)*

C.3.1		
	Space Power Symposium	**L Summerer**
C3.1	Space-Based Solar Power Architectures – New Governmental and Commercial Concepts and Ventures	L. Summerer, J. Mankins, *N. Kaya (R)*

D.3		
	Symposium on Building Blocks for Future Space Exploration and Development	**J. C. Mankins, A.Pradier**
	D.3.1 Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration and Development	J.C.Mankins, M-A Perino, *W. H. Siegfried, H Rauck (Rs)*
	D.3.2 Systems and Infrastructures to Implement Future Building Blocks in Space Exploration and Development	W. H. Siegfried, S Hovland, *H Rauck, P Jukola (Rs)*
	D.3.3 Novel Concepts and Technologies for Enable Future Building Blocks in Space Exploration and Development	A Pradier, A Dupas, *C Moore, J Onoda (Rs)*
	D.3.4 Space Technology and System Management Practices and Tools	J Mankins, P. Jukola, *M-A Perino, H Hoffmann (Rs)*

D4		
	Symposium onVisions and Strategies for the Far Future	**Hans E.W. Hoffmann, G.Reibaldi**
	D.4.1 Novel Concepts and Technologies	C Bruno, A Dupas, *P Jukola, H Hoffmann (Rs)*
	D.4.2 Joint Session on Global Public/Private Innovative Initiatives in Spaceflight	H. Rauck, R Villain, *S Ramakrishnan (R)*
	D.4.3 Space Elevator Feasibility and Technology	P. A. Swan, R. E. Penny, D. Raitt (R)
	D4.4 Contribution of Space Activities to Solving Global Societal Challenges	J Mankins, G Reibaldi , *P. Jukola (R)*

IAA COMMISSION III

REPORT TO S A C

2nd OCT 2011 , CAPE TOWN , SA

Annexure - 8

Commission Meeting

- Commission III Meeting held on 2nd Oct'2011 forenoon at CTCC, CapeTown, South Africa

- The number of participants was 34 in total including Commission Members

- The three newly nominated members could not be present for the meeting

MEMBERSHIP

- Participants expressed a strong request that commission membership should reflect the subject expertise of current relevance to commission III
- Suggestion to include chairs of study groups as commission members
- There is a strong need to induct appropriate young professionals to involve in commn.tasks

STUDY PROGRESS REPORT

SG 3.9 Private Human Access to Space

- Scope of study limited to sub-orbital flights
- Report format and extended table of contents defined
- Two IAA Symposia on the topic held in May 2008 and May 2011
- Report to be ready for Peer Review process by Sept 2012
- Final Report release by March 2013

STUDY PROGRESS REPORT
SG 3.10 Interstellar Precursor Mission

- Draft Report put through Peer Review process
- Comments / suggested improvements communicated to Study Lead
- Revised Report readiness by Dec 2011
- Final Report for IAA approval by Feb 2012
- Report release targetted for March 2012

STUDY PROGRESS REPORT

- SG 3.11 Solar Energy From Space

  Study completed and final Report after approval by IAA printed and published.

STUDY PROGRESS REPORT

- SG 3.12 Global Human Exploration Of Space

  Study planning and organisation process is on. There is some delay.
  Principal objective is to outline and define issues pertaining to human exploration beyond low earth orbit.
  Final Draft Report targetted by Oct 2012

STUDY PROGRESS REPORT
SG 3.13 Space Elevators Technologies

- Comprehensive outline , contents / chapters and lead authors identified for Study Report

- International Space Elevators conference held in Aug 2011 and International SE Consortium study report contribute to this Study Report
- Final Draft Report by Oct 2012, Peer Review by March 2013 , Report readiness by June 2013

IAC 2011 / 2012 SYMPOSIA

- Status of paper submission / presentation upload in IAC sessions under Commission III purview were gone through.
- Generally fair response with an average of six to eight confirmed papers per session
- Last minute drop- outs are more in IAC 2011
- IAC 2012 sessions planning reviewed. Papers status to be available during Mar’12 meeting

New Study Areas Suggested For Study Group Proposals

- Public/Private Innovation initiatives in Human Space Flight
- Building blocks for future exploration in space
- Transformational Space Access
- Potential benefits of Future space activities in solving Global Challenges
- Space Capabilities and disaster Management – Lessons learned/Future directions
- Innovative Spacecraft Architectures
- Futuristic Propulsion Technologies

GENERAL SUGGESTIONS TO SAC

- Commission III Member/ Representative to be associated with IAA stand alone Conferences on topics relevant to Commission III subjects
- There is a need to get feed back from SAC / IAA to the Commissions on follow up actions with respect to completed Study Reports and other inputs / recommendations made by Commissions

New Study Areas Suggested For Study Group Proposals

- Public/Private Innovation initiatives in Human Space Flight
- Building blocks for future exploration in space
- Transformational Space Access
- Potential benefits of Future space activities in solving Global Challenges
- Space Capabilities and disaster Management – Lessons learned/Future directions

Annexure - 9