National Aeronautics and Space Administration

Human Health and Performance Considerations for Exploration of Near Earth Asteroids (NEA)

82nd Annual Scientific Meeting
Aerospace Medical Association

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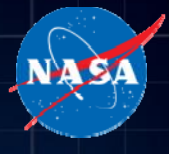
12 May 2011

Disclosure Information- *82nd Annual Scientific Meeting*

Craig E. Kundrot



I have no financial relationships to disclose.

I will not discuss off-label use and/or investigational use in my presentation

Presidential Remarks on Space Exploration

John F. Kennedy Space Center
April 15, 2010

Early in the next decade,

a set of crewed flights will test and prove the systems required for exploration beyond low Earth orbit.

And by 2025,

we expect new spacecraft designed for long journeys to allow us to begin the first-ever crewed missions beyond the Moon into deep space.

So we'll start -- **we'll start by sending astronauts to an asteroid for the first time in history.**

By the mid-2030s,

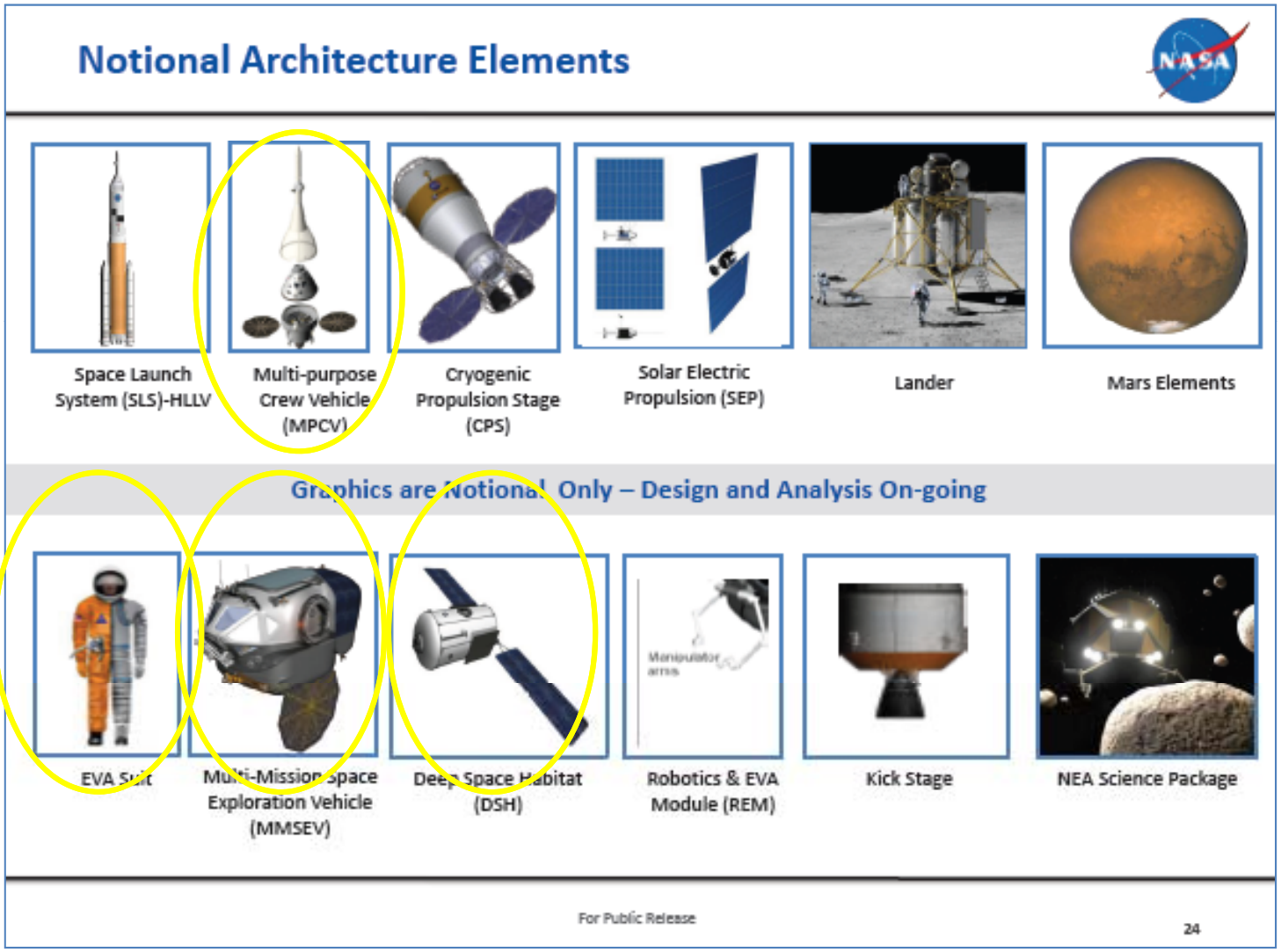
I believe we can send humans to orbit Mars and return them safely to Earth.

And a landing on Mars will follow.

And I expect to be around to see it.

http://www.nasa.gov/news/media/trans/obama_ksc_trans.html

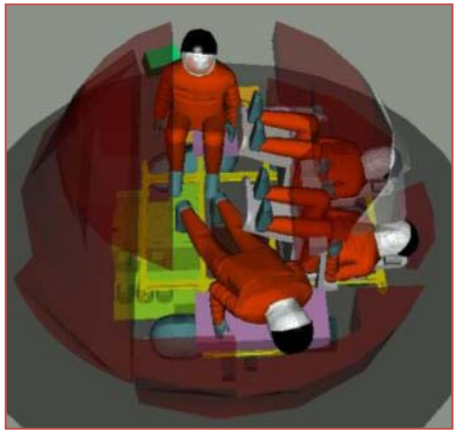
NASA Human Exploration Framework Team



www.nasa.gov/pdf/509820main_Human_Space_Exploration_Framework_Summary-2010-01-11.pdf

Human Research Program

- The Human Research Program (HRP) in the Exploration Systems Mission Directorate was created in October 2005
- Program goals
  - Perform research necessary to **understand** and **reduce** spaceflight human **health** and **performance** risks in support of exploration
  - Enable development of human spaceflight medical and human performance standards
  - Develop and validate technologies that serve to characterize and reduce medical risks associated with human spaceflight



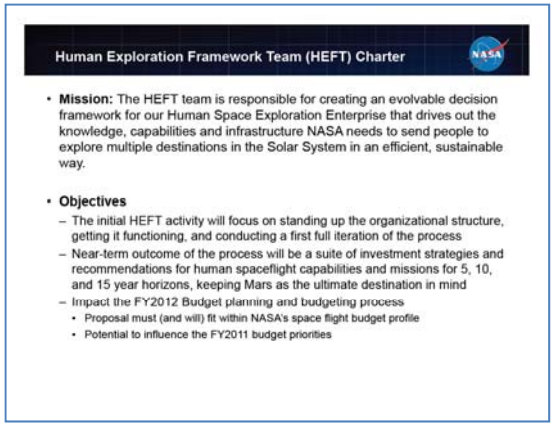
An Applied Research Program

Human Subsystem Risks

- The Office of the Chief Health and Medical Officer tracks about 60 risks for human space flight

- The Human Research Program has been working on 28 risks for missions to the Moon and Mars

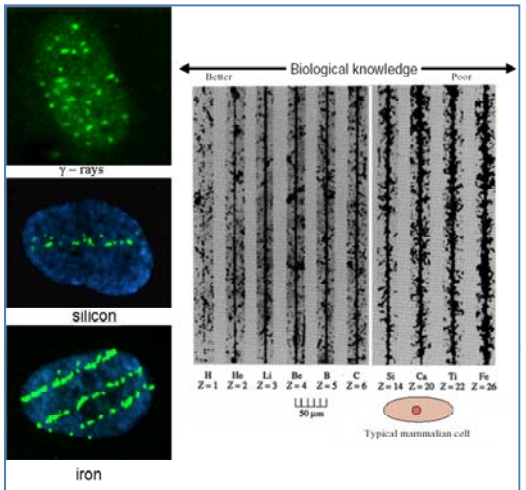
humanresearchroadmap.nasa.gov



- These 28 risks provide the basis for asteroid mission risks

Risk of radiation induced carcinogenesis

- NASA's radiation exposure standards permit a 3% risk of radiation exposure induced death (REID)
- Cancer is the primary driver of REID
- The REID standard limits mission durations in deep space to approximately
  - solar minimum
    - 5 months for males
    - 3 months for females
  - solar maximum
    - 7 months for males
    - 6 months for females
- These mission durations could increase by two months if "never smokers" are used as the reference population



Cucinotta and Durante, Lancet Oncology (2006)

Risk of inadequate food system and nutrition

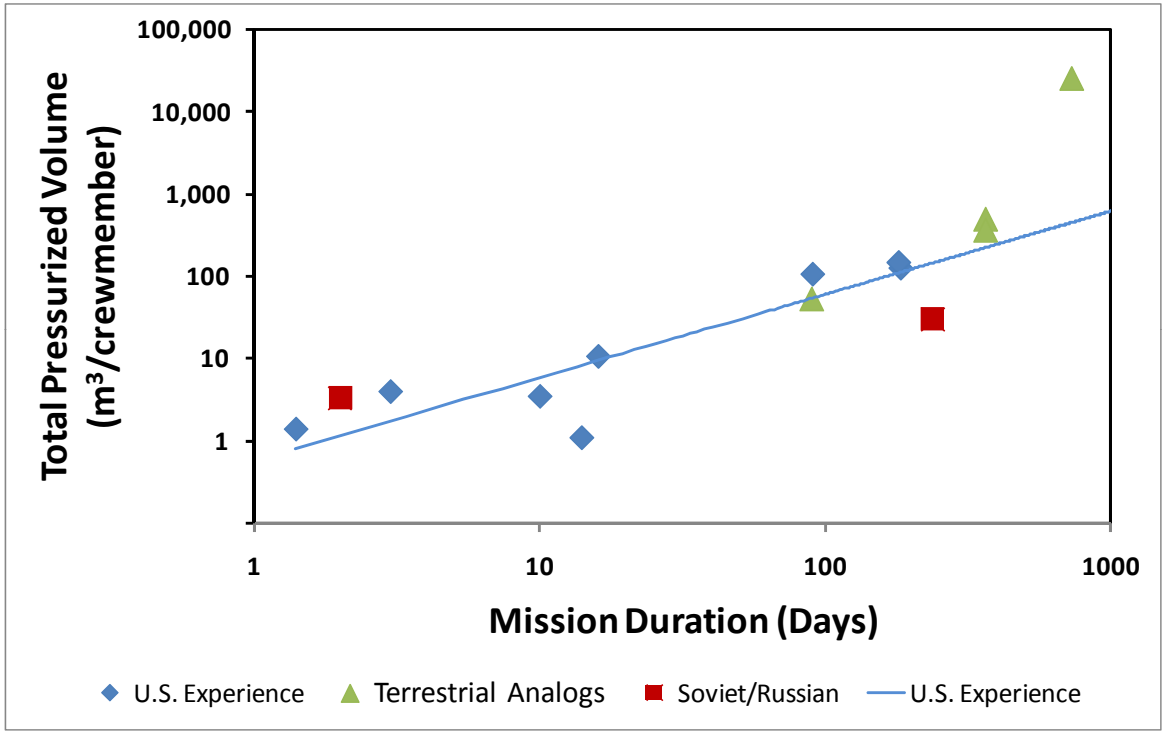
- One crew member for one year
  - 670 kg
  - 1.7 m^3

- Stability and acceptability
  - 12 month mission
  - + time prepositioned
  - + time loaded
  - + time prepared

- Related issues
  - Trash handling
  - Water recycling

Risk of behavioral health issues

- Confinement
- Isolation
- Communication delays
- Small crew size
- 1 month abort



Earth as seen from 0.05 AU →

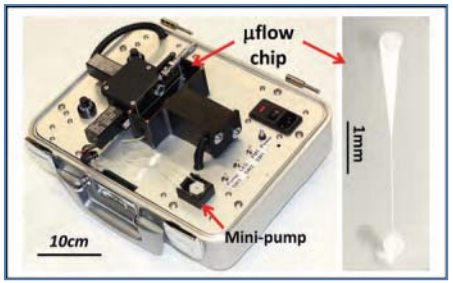
Risk of muscle atrophy, cardiovascular atrophy, bone loss

- What exercise equipment will be available?

Other risks

- Exposure to dust and volatiles
  - EVA suitport or airlock?

- Lack of treatment for ill or injured crewmember
  - one month abort?



- Decompression sickness
  - EVA glove or end effector?

Conclusion

- NASA is examining plans for a mission to an asteroid

- HRP is examining human health and performance risks for exploration missions beyond low Earth orbit

- Major risks for an asteroid mission
  1. Radiation exposure
  2. Inadequate food and nutrition
  3. Challenges to behavioral health
  4. Muscle, cardiovascular, bone atrophy
  5. Dust and volatiles
  6. Remote medical care
  7. Decompression sickness