NASA Policy and Requirements

- Support US compliance with the Outer Space Treaty
- Consistent with international consensus policy maintained by COSPAR
- Coordinated with policy and requirements of partner space agencies (increasingly), to support collaboration on joint missions
- Extent of NASA involvement in OST compliance by other US entities still TBD – one role of PPS

NASA Planetary Protection Policy

- The policy and its implementation requirements are embodied in NPD 8020.7G *(approved by NASA Administrator)*
  - Specifies adherence to the Outer Space Treaty
  - NASA obtains recommendations on planetary protection issues (requirements for specific bodies and mission types) from the National Research Council's Space Studies Board
  - Advice on policy implementation is obtained from the 'internal advisory bodies' – PPS
- Specific requirements for robotic missions are embodied in NPR 8020.12C *(approved by SMD Associate Administrator)*
  - Specifies documentation and implementation requirements for forward and backward contamination control
  - Compliant with COSPAR policy: NASA supports international missions only if COSPAR policy is followed
- Human Requirements Document
  - possible kick-off at upcoming IAA Humans in Space meeting, June '11 in Houston

Revisions in NPR 8020.12D

- Extensive revisions due to new format requirements
- $1x10^{-4}$ probability of introducing a single viable organism into liquid water on icy bodies applies to all objects
  - Recommended to NASA by PPS in 2007
  - Discussed over several COSPAR workshops, sent to Bureau in 2010
- Revisions to Mars requirements support international cooperation
  - Implementation Plan reviewed by PPO (ESA requires approval)
  - Launch vehicle hardware must avoid impact with Mars for 50 years at 1x10e-4, unless otherwise specified
  - EDL reliability must be assessed for all Mars landers; only numerical requirement is that missions carrying perennial heat sources must avoid off-nominal impact into special regions at $1x10^{-2}$
  - Removed ‘overly prescriptive’ (per SSB) language from MSR timeline
- Increased coordination with other offices within NASA on Orbital Debris and Astronaut Health

Possible US Regulatory Inputs

The National Aeronautics and Space Act of 1958 includes Section 203(c)8, that authorizes NASA:

> "to establish within the Administration such offices and procedures as may be appropriate to provide for the greatest possible coordination of its activities under this Act with related scientific and other activities being carried on by other public and private agencies and organizations."

The US Code of Federal Regulations, Title 14, in section 415.23(b)3 ("Policy review") states that:

> "the FAA consults with other federal agencies, including the National Aeronautics and Space Administration, authorized to address issues identified under paragraph (a) of this section, associated with an applicant's launch proposal"

Where paragraph (a) states,

> "the FAA reviews a license application to determine whether it presents any issues affecting U.S. national security or foreign policy interests, *or international obligations of the United States"* [italics added].

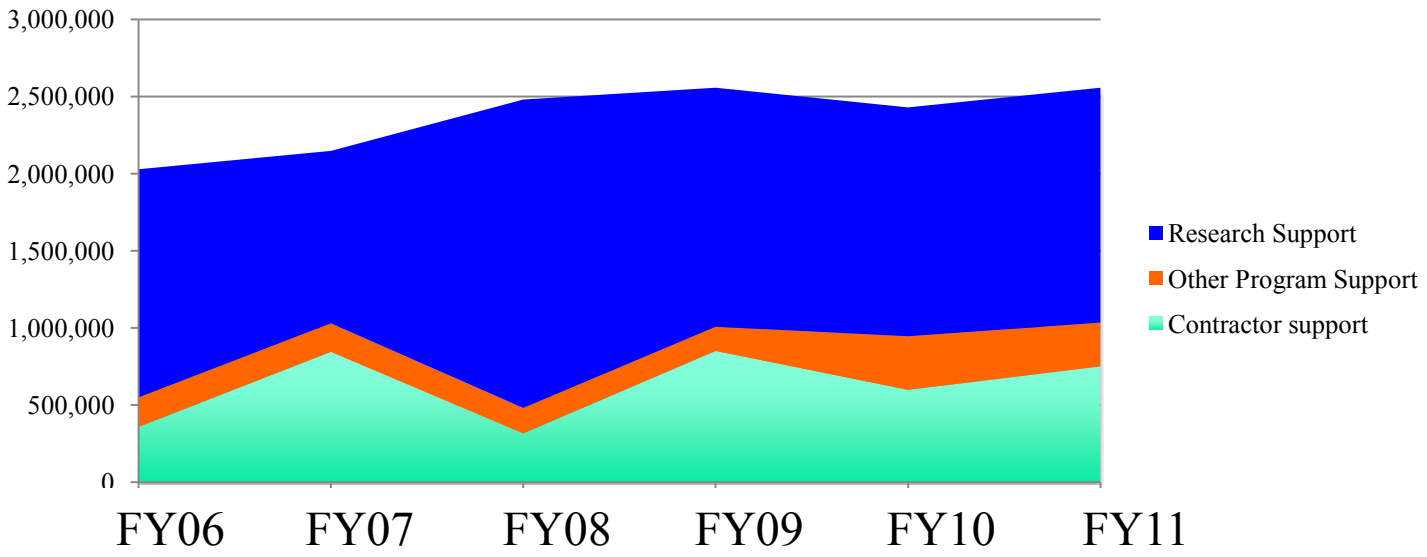
ESA Planetary Protection Policy

- Policy described in ESA/C(2007)112 *(Council Level)*
  - Avoid interplanetary contamination when the Agency is carrying out activities in outer space, mindful of Member States' corresponding obligations in accordance with Article II of the ESA Convention
  - States compliance with the COSPAR Planetary Protection Policy
  - Advice on planetary protection issues is obtained from the ESA Planetary Protection Working Group (PPWG); additional ad-hoc advice is provided by the European Science Foundation (ESF)
- Requirements described in ESSB-ST-PP-001 *(ESA approved)*
  - The Planetary Protection Officer acts on behalf of the Head of the Product Assurance & Safety Department
  - Specifies planetary protection requirements for spaceflight missions
- The European Cooperation for Space Standardization maintains technical standards/procedures to implement ESSB-ST-PP-001
  - Three standards available: ECSS-Q-ST-70-53, 55, and 58
  - Three additional standards released by 2011

Planetary Protection Program Status

- Budget profile and breakdown
  - Mission monitoring activities
  - Bioburden verification and launch certification
  - Documentation and review
- Research supported in ROSES
  - Joint ESA-NASA planetary protection activities:
  - Technology Development: bioburden detection, accounting, sterilization
  - Training courses: 2/year, more as requested
  - Other programmatic activities/concerns
  - Multi-mission support

Planetary Protection Program Budget



- 1 full-time senior advisor: Perry Stabekis is the walking corporate memory for NASA planetary protection; 1 part-time verification assay technician for mission monitoring
- Communications activities and directed work on joint development tasks

Planetary Protection Research

- $300K-$500K/year, occasional ups for high-scoring proposals
- Research Opportunities in Space and Earth Sciences
  - Characterizing the limits of life in laboratory simulations of planetary environments or in appropriate Earth analogs, particularly studies of the potential, distribution and dynamics of organism survival and reproduction
  - Modeling of planetary environmental conditions and transport processes that could permit mobilization of spacecraft-associated contaminants
  - The development or adaptation of modern molecular analytical methods to rapidly detect, classify, and/or enumerate the widest possible spectrum of Earth microbes
  - New or improved methods, technologies, and procedures for spacecraft sterilization that are compatible with spacecraft materials and assemblies
- Proposals are sought for new projects in planetary protection that are not within the scope of the Astrobiology Program
- Possible to trade with other elements, but...

Current Joint ESA-NASA Activities

- Technology Coordination
  - Vapor Hydrogen Peroxide Sterilization specification nearly complete (work done with Mars Exploration Program support)
  - Rapid Spore Assay specification nearly complete (also MEP): bioburden assay outcomes are indistinguishable and therefore numerically equivalent
  - Expansion of the Dry Heat Microbial Reduction specification (also MEP): final experiments in progress; review in early summer
  - Acceptance testing for new sampling tools: ESA component completed, NASA work in progress
  - Reassessment of ATP luciferase assay (MEP) relative to Standard Assay to identify threshold value to accept as '1 spore/area' (can't ever have 0...)
  - Coordination of language in requirements documents
- Joint Training Courses
  - One each in Europe and US per year, covering policy/requirements, implementation, and laboratory work; project/program specific training supported upon request (~3-4 in 2010)

Multi-Mission Needs

- ESA-NASA information-sharing on joint projects
  - Easily-exchangeable bioburden accounting software (post MSL) for joint missions
  - Materials outgassing characterization for contamination control in support of life detection instruments
  - Approved materials list for materials compatibility to specific sterilization modalities
  - Best practices in spacecraft cleanroom operations
- Launch Site Facilities
  - PSD is launching a bioburden-controlled spacecraft every two years for the next decade – not resource-effective to make each project identify space
- Post-Launch Support/Archiving
  - Organic Materials Archive (currently, MEP maintains an organic compounds carried on past Mars missions)
  - Biological Culture Collection of organisms collected from spacecraft assembly cleanrooms (currently within MEP)

Future Items

- Near-term needs of the PPO (next meeting, early summer)
  - Consideration of MSL landing sites given recent science results on ice
  - Assessment of NASA/US participation in the Phobos-Grunt mission given our understanding of Roskosmos' implementation approach
  - Continue the discussion, initiated at this meeting, on encouraging the MSR scientific community to consider planetary protection measurements as they can contribute to sample science
- Longer-term topics for discussion
  - Application of planetary protection policy beyond NASA activities in the context of US compliance with the Outer Space Treaty – legal aspects and coordination with other US gov't agencies
  - Introduction to the Europa Jupiter Orbiter and pilot studies on full-system sterilization: support this once-and-future implementation approach
  - Multi-mission needs and support on planetary protection, including launch site facilities
  - Joint PPS-PPWG meeting and consideration of requirements for Mars Sample Return, including areas for future work (week after Thanksgiving 2011, at KSC?)

MSL Landing Site Questions

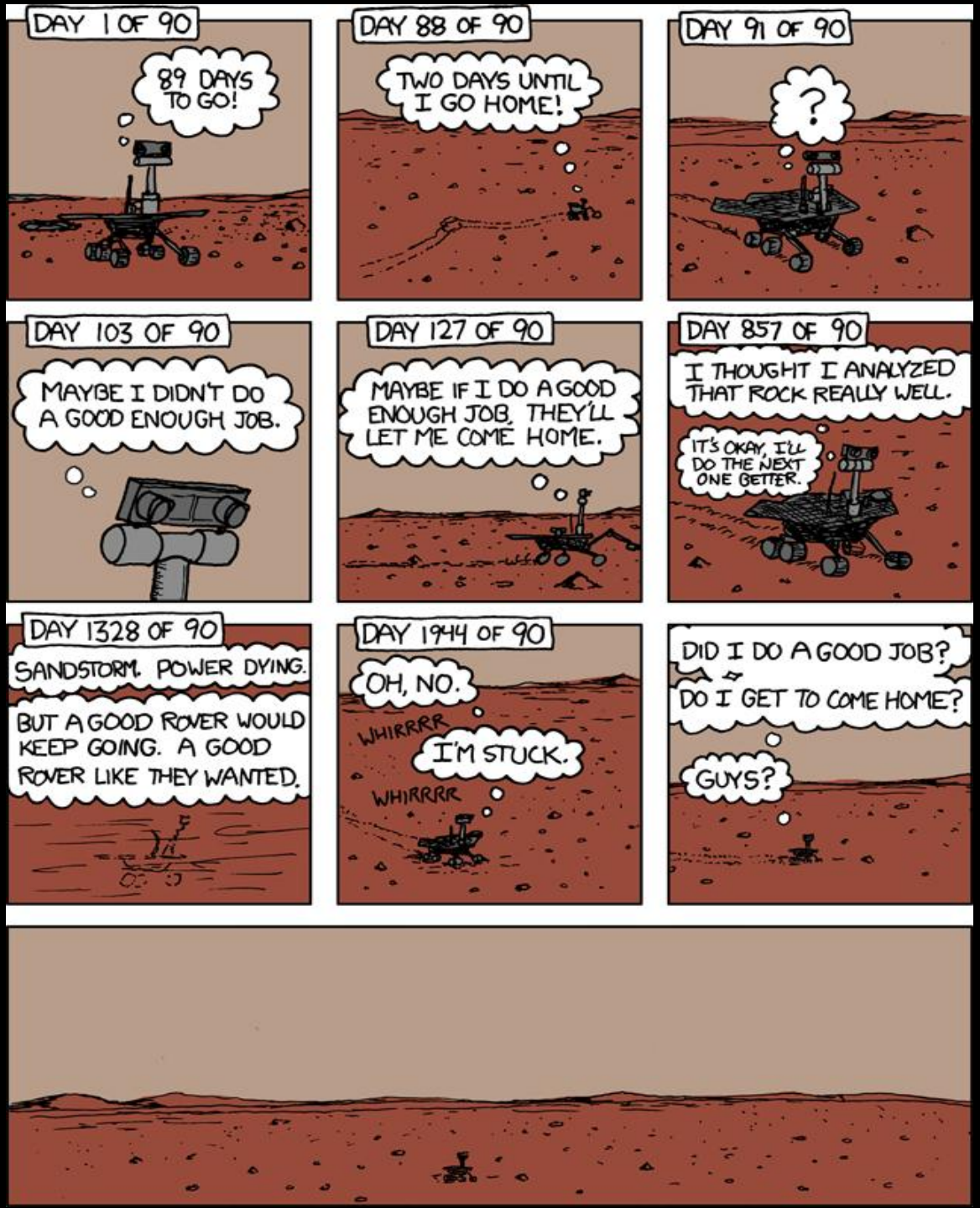
1) What is the observed temperature range, diurnal and annual, at each landing site? How would this be affected by local surface features?

2) What is the observed range of water (hydrogen?) signals over the ellipse? What is the likely complexed state of that water (in minerals, as ice, etc.)? What can be deduced about subsurface water/hydration state? How easy would it be to liberate that water given the temperature regimes observed at each site?

3) What range of density/thermal mass can be estimated for materials at each site, and how might that affect modeling of subsurface temperature or hydration gradients? What potential disequilibrium conditions (dark patches, shadows, etc.) might affect local variability?

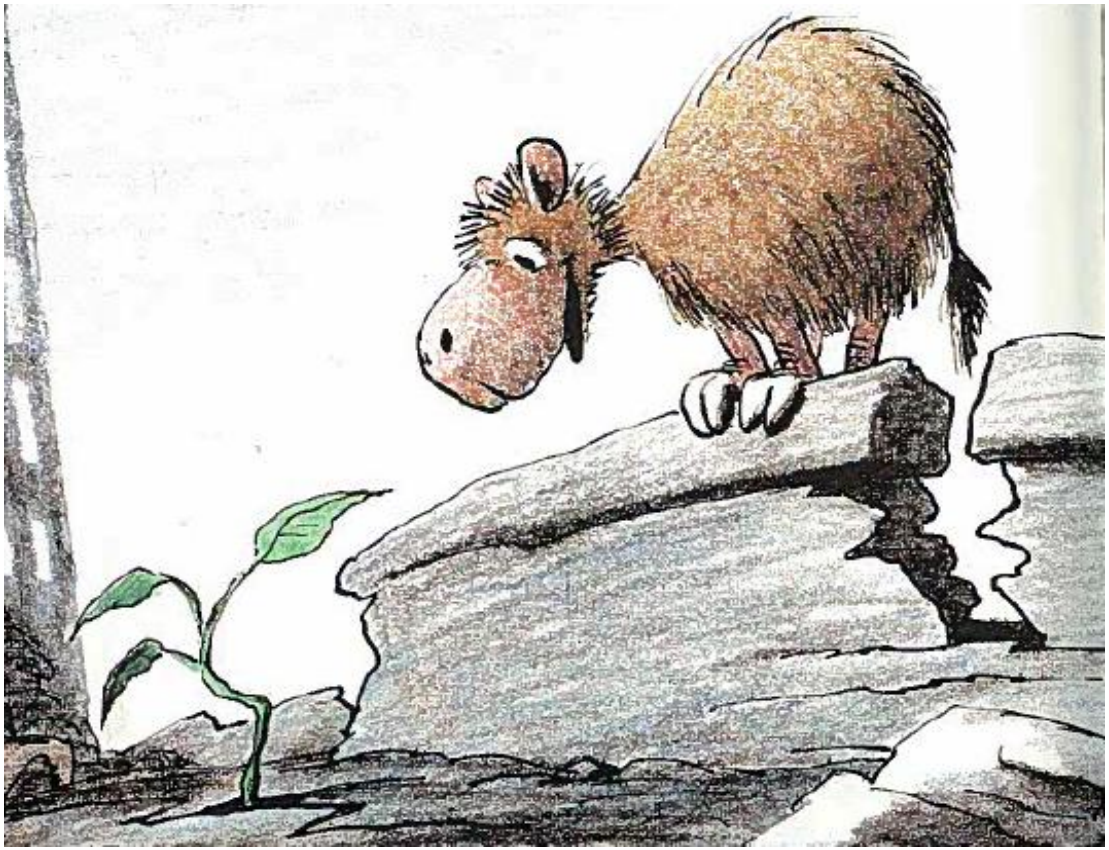
4) What are the chances that anywhere in the proposed landing ellipse might reach, even transiently, a water activity of 0.5 and a temperature of -25C, should the MSL RTG be introduced? With what duration and periodicity would those conditions exist?

Go Home Soon?


DAY 1 OF 90
89 DAYS TO GO!
DAY 88 OF 90
TWO DAYS UNTIL I GO HOME!
DAY 91 OF 90
?
DAY 103 OF 90
MAYBE I DIDN'T DO A GOOD ENOUGH JOB.
DAY 127 OF 90
MAYBE IF I DO A GOOD ENOUGH JOB, THEY'LL LET ME COME HOME.
DAY 857 OF 90
I THOUGHT I ANALYZED THAT ROCK REALLY WELL.
IT'S OKAY, I'LL DO THE NEXT ONE BETTER.
DAY 1328 OF 90
SANDSTORM. POWER DYING.
BUT A GOOD ROVER WOULD KEEP GOING. A GOOD ROVER LIKE THEY WANTED.
DAY 1944 OF 90
OH, NO.
WHIRRRR
I'M STUCK.
WHIRRRR
DID I DO A GOOD JOB?
DO I GET TO COME HOME?
GUYS?

The Point:

If you're going somewhere and want to look for life...



Bill Peet, 1974

Don't trash the place (or samples) before you have a chance to find it!