Panel 1 Observations

- **General Observations:**
  - Human missions to Near-Earth Asteroids can serve as an analog for the crew transits to and from Mars orbit and its moons
  - Proper testing and validation of systems is needed prior to human missions which are truly beyond Earth's grasp, such as NEA missions.
  - Humans exploration in-situ at the Near-Earth Asteroid improves the mission return, such as specifically science, operations, repair, etc.
  - There is substantial value in having a robust target set. Additional discovery of Near-Earth Asteroids prior to the human mission will improve the number of potential targets.
  - Define the role of human spaceflight in planetary defense

Panel 1 Findings

Near-Earth Asteroid Discovery and Characterization:

- Issue 1: Currently there are few known Near-Earth Asteroids with low delta-v which also provide short mission duration
- Issue 2: In order to reduce operational risk and maximize science, proper characterization of potential asteroids is needed prior to the crew mission
- Impact to the GER:
  - Earth-based observational opportunities should be considered a part of the GER to increase discovery rate.
  - A prize based approach may also provide incentives to include more public participation
  - A space-based survey mission would increase the discovery rate of NEAs and should be considered part of the GER
  - The GER inclusion of robotic precursor missions increases the possibility of maximizing the value of sending humans to a NEA
    - If direct contact of the NEA by the crew is required, additional in-situ robotic precursor missions should be included in the GER to characterize multiple NEAs prior to the human mission. Multiple are required to provide adequate backup opportunities. The number of acceptable backups is future work.
  - Characterization pre-mission also enables better science (you know what type of science instruments to take with the crew)

Panel 1 Findings

- **Near-Earth Asteroid Exploration by the Crew:**
  - Issue 1: There were two uniquely different strategies provided for exploration of the NEA with crew
    - Direct interaction by the crew – some suggested this maximizes science return by being able to bring the crew directly to the field with the ability to respond directly and quickly to the environment
    - Other approaches utilize tele-robotic/tele-presence exploration with the crew remaining at a distance from the NEA
    - Combination of all of the above
  - Impact to the GER:
    - Begin further assessments of the destination activities and capabilities required to effectively explore NEAs

Panel 1 Findings

- **Near-Earth Asteroid Mission Scope:**
  - Mars is being used as the long-term goal for development of the GER
  - Issue 1: Constrained budget approaches tend to drive towards low technology, short missions which are less Mars-centric.
  - Issue 2: There is a strong desire to deploy elements to L1/L2 to show near-term progress.
  - Impact to the GER:
    - Suggest showing better linkages and growth path between near-term missions in cis-lunar space and eventual Mars missions.
    - Affordability is important. How can we structure the GER with fewer elements or more commonality? (e.g. Orion and MMSEV commonality)
    - Need to better refine the interactions relationship NEA mission duration, amount of advanced propulsion technology required and how that relates to eventual Mars missions including mission duration.
    - Address differences between multiple low-technology NEA missions with fewer crew versus larger crew with more technology

Panel 1 Findings

- **Strategic Pathway and Strategic Communication:**
  - Issue 1: Better messaging is required to explain why humans should fly to a Near-Earth Asteroid
  - Issue 2: Carrying two different strategic paths has value in the early formulation phase (especially those areas where there is commonality), but that strategy carried too long can be counter-productive. Mission focus will eventually be required.
  - Impact to the GER:
    - Improve overall Near-Earth Asteroid message (Why NEAs? Why humans? Why robots? How does it lead to Mars?)
    - Establish additional strategies associated with Mars exploration which may include exploration of or from the moons of Mars.