RADIOISOTOPE POWER FOR IN-SITU VENUS MISSION CONCEPTS. B. K. Bairstow[1], Y. H. Lee[1], A. Austin[1], [1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA, 91109 (brian.k.bairstow@jpl.nasa.gov, young.h.lee@jpl.nasa.gov, alexander.austin@jpl.nasa.gov)

Exploration of the surface and lower atmosphere of Venus is very challenging, in part due to corrosive environments, high pressures that can reach into the tens of bars, and lack of available solar power. At altitudes below ~75 km, the low insolation and high temperatures would make solar power infeasible. Batteries and thermal batteries are potential power storage systems, but are only suitable for shorter-duration missions with relatively low total energy needs. In-situ power extraction from wind or thermal would produce low power and need further development. Only with Radioisotope Power Systems (RPS) would it be possible to provide tens to hundreds of watts of power for years below the cloud layer of Venus.

The RPS program conducted an architecture study to better understand the need for RPS for future Venus mission concepts, and to identify requirements for RPS at Venus. The study included the following objectives:

- What is the science justification for in-situ, long-life explorers on Venus?
- What measurements and types of instruments would be needed to realize the science goals?
- What are the mission requirements needed to utilize a Next-Generation RTG in a pressure vessel?
- Create draft mission architectures to achieve the notional science goals with the use of an RPS-powered pressure vessel.

The study team developed notional science goals with an RPS-enabled mission in mind, considering what Venus in-situ science could be enabled by a long-duration power source that can operate in the low altitude (zero to ten km) Venus environment. Below are the considered science goals:

- Notional Surface Science Goals
    - Measure seismic activity
    - What is the interior structure of the planet?
    - What is the history of the planet?
    - Measure weather over a long duration
    - Characterize and understand super rotation
    - Measure momentum exchange
- Notional Atmosphere Science Goals
    - Characterize and understand super rotation in the deep atmosphere (<10 km)
    - Characterize and understand the boundary layer

Based on these notional science goals, desired measurements and potential instruments were identified.

The study participants then brainstormed several potential architecture concepts – four surface lander or rover concepts, and three balloon concepts – before focusing on a draft architecture for a long-lived (greater than one year) Venus surface lander using a pressure vessel and power from a conceptual Next-Generation Radioisotope Thermoelectric Generator (Next-Generation RTG).

The study found that the Venus explorer concept's power requirements would be strongly sensitive to heat rejection requirements. If all components could be made robust to the Venus environment, then a mission could be possible with <100 W_e. However, due to inefficiency in cooling, if any components require cooling the mission would require 100-1000+ W_e. The study also identified requirements that may drive Next-Generation RTG design decisions.