Minutes for the BSCC Meeting on October 20, 2016

Photo courtesy of Dennis Edgington

You're looking at a very accomplished engineer who had the job of being MOM, Mission Operations Manager, for the New Horizons mission to Pluto that culminated in a successful flyby in July 2015. Her job and that of her team is not over. The spacecraft is being directed to a flyby of another large Kuiper Belt Object (KBO) much farther away from Earth.

Pluto is about 32 astronomical units (AU) from Earth. 1AU = the distance between the Earth and the sun. It took the spacecraft 9.5 years to reach Pluto. Even though the Hubble Telescope has imaged much of the universe in vivid detail, its image of Pluto because of poor illumination was grossly pixelated (16 x 16) conveying little information. As you will see when you go to the website http://pluto.jhuapl.edu , the pictures and data collected by New Horizons will

keep scientists busy. All of this data had to be collected in a single flyby of Pluto while the spacecraft was traveling at 8.5 miles/second. Its closest approach was 7800 miles from Pluto.

Since there would be no "do-overs", the mission planned for 249 contingencies for things that could go wrong. Every member of Mission Operations had to have a backup. There were approximately five groups of backup generators. If a disaster occurred at Mission Control, a team of backup operators was prepared to drive (planes could be grounded) to JPL on the West Coast where there is a backup control room. There are two computers on the spacecraft. Even when New Horizons is hibernating to save fuel, one of those computers is monitoring everything and is prepared to troubleshoot and repair or work around any problems.

And things can go wrong. The day after Alice Bowman's presentation, the Washington Post reported that "a European and Russian robot that that was supposed to touch down on Mars on Wednesday [Oct. 19] probably crashed on landing." The article went on to say "A NASA spacecraft also stopped communicating Wednesday, although it problems may be less dire. The Juno probe, which entered orbit around Jupiter in July, went into safe mode several hours before a flyby. A software glitch may have prompted Juno to reboot its main computer."

The New Horizons stopped communicating a couple of days before its closest approach to Pluto. Fortunately, the mission team's contingency planning and practice sessions helped them and the spacecraft recover in time for the flyby. Telemetry between Earth and Pluto took 4 hours 25 minutes in each direction. Downlinks took about 2 hours at 2000 bps. To accomplish this rate, both of the transmitters had to be used simultaneously. They transmit on different frequencies. The 2000 bps rate was used during the flyby so that Pluto's atmosphere could be analyzed as the atmosphere altered the transmissions.

When the spacecraft stopped communicating, there was time for only about four communication roundtrips before closest approach to Pluto. Fortunately, the

pre-programmed troubleshooting and repair sequences built into the spacecraft probably brought it back online more than the efforts of Mission Operations.

The spacecraft was powered by a plutonium-powered Radioactive Thermoelectric Generator (RTG). Plutonium has a half-life of 87 years. At launch, the RTG was generating 240 watts. When it arrived at Pluto it was generating 201 watts. The heat was recycled to heat the interior to approximately room temperature. The temperature of outer space is approximately 4K (4 degrees centigrade above absolute zero). It supplied the 30W required to power all seven instruments including the radio transmitter. The signal received during the flyby was only a millionth of a billionth of a watt. Data had to be stored and compressed in memory until it could be downlinked at 10 bits per second. The first downlink occurred on August 1, 2015. The last downlink was October 23, 2016, three days after Alice Bowman's presentation to us.

Go to http://pluto.jhuapl.edu , download the visual aids software, and experience the complexity and thrills of this mission.

Also, go to https://en.wikipedia.org/wiki/Pluto for more information about Pluto.

Thanks to Barbara Parthasarathy's husband for suggesting, arranging, and hosting this presentation. He's a scientist or engineer at Johns Hopkins Applied Physics Center but is not a member of the New Horizons team.