Dear Mr. Sheron:

In response to your letter, the activities listed below are ongoing or planned activities within the NASA Office of Safety and Mission Assurance that are related to efforts documented in the draft report on U.S. Nuclear Regulatory Commission Long Term Research: FY 2009 Activities:

- NASA conducts space missions utilizing radioactive material (Pu238) for the production of electricity. Prior to conducting these missions, a safety analysis and risk assessment is developed as part of the nuclear launch approval process. One aspect of these evaluations is an estimate of potential public consequences that can occur from accidents or abort conditions during the mission. In conjunction with these analyses, NASA is currently investigating particle resuspension models particularly for local climate conditions associated with the launch site at the Kennedy Space Center in Central Atlantic Coastal Florida. In addition, NASA is developing a plan to hold a workshop, in the spring of 2008, concerning Plutonium Exposure and Health Effects Information with members of the former Soviet Union. An anticipated result from this workshop is an estimate of the plutonium dose effect relationship for internal plutonium cancer risk that can be helpful for questions involving space nuclear powered vehicles, nuclear terrorist incidents, nuclear cleanup, and specific occupational hazard policies.

- NASA will conduct probabilities risk assessments (PRA) of future missions as a means to understand the safety of space systems for the crew and for successfully completing mission objectives. The nature of these missions requires the conduct of a phased mission analysis where the system undergoes changes in configuration to meet mission phase objectives. Nuclear power plants also undergo phases of operation called "operating modes" where the system changes from a shutdown condition to a fully operating state. The development of one integrated model that will evaluate the safety of these systems as they transition between phases (modes) provides advantages to both agencies. There is an opportunity for collaborating in the enhancements of the Saphire PRA tool that will accurately address the analytical difficulties of a phased mission analysis.

- Software is a vital component to NASA endeavors, from human space flight to robotic science missions. NASA has an extensive effort for software verification and validation. However, NASA has just initiated an investigation of how to input software failure models into integrated PRAs to evaluate the impact of software on the safety of flight systems. The goal is to understand the importance of software failure modes so that designs can either prevent catastrophic events and/or mitigate potential severe consequences. Collaboration on a digital Instrumentation and Control research facility where integrated programmable controllers, digital actuators, and data acquisition devices (along with flight software) can be tested would be of mutual benefit.

- NASA has just completed an initial draft of guidance for the use of human reliability analysis (HRA) methods as applied to PRAs of space systems. Understanding the actions of humans during space flight is distinct from terrestrial human machine interactions

(HMI) compounded by environments and performance shaping factors associated with acceleration, microgravity, and the psychological and physiological changes in human capacity. NASA has initiated a review of space flight simulator and actual flight data associated with HMI and HRA in an effort to gather information to quantify human actions. A modular reconfigurable human factors research simulation capability could provide a valuable resource for NASA to evaluate HRA models as applied to HMI associated with these systems.

- NASA presently uses a continuous risk management approach to identify, analyze, plan, track, and control technical and programmatic risks (safety, performance, cost, and schedule). The present approach is directed at individual risk elements. This approach is currently being expanded to include integrated Agency-wide risk management where the total risk associated with decision alternatives will be input into the decision-making process. The approach uses formal decision analytical methods to derive a performance index based on an aggregate risk profile that includes safety, performance, technological readiness, operations and infrastructure, schedule, and cost. Subsequent to the selection of a path forward, individual risk metrics are used to conduct risk management with respect to acceptance, avoidance, transfer, and control.

- During each space flight, NASA records data concerning anomalies and faults (leaks, corrosion, short circuits, cracks, workmanship error, etc.) that do not lead to undesired outcomes or mission failure. These data reside in several databases throughout the Agency. Presently, NASA has embarked on a precursor program that will utilize these data to determine failure and risk implications. While not all anomalies or faults lead to failures, a risk assessment based methodology is being developed to gain insight into the risk significance of these occurrences based on reoccurrence and importance to severe consequences. This effort has implication in re-licensing of older facilities with respect to indications associated with aging and for advance facilities where the accident response of new technologies may not be completely understood.

Over the past few years, technical leaders from NASA have interfaced and exchanged information with technical leaders from your organization on a number of activities of joint interest. We hope to continue our collaboration which, I believe, has been mutually beneficial. If you have ideas on how this collaboration can be enhanced, please let me know and I will be happy to initiate further discussion between our two organizations to pursue these ideas.

Bryan O'Connor
Chief, Safety and Mission Assurance