2014 Sensorimotor Risk Standing Review Panel

Research Plan Review for:
The Risk of Impaired Control of Spacecraft, Associated Systems and Immediate Vehicle Egress Due to Vestibular/Sensorimotor Alterations Associated with Space Flight

Final Report

I. Executive Summary and Overall Evaluation

The Sensorimotor Risk Standing Review Panel (from here on referred to as the SRP) met on December 17 - 18, 2014 in Houston, TX to review the current status of the Risk of Impaired Control of Spacecraft, Associated Systems and Immediate Vehicle Egress due to Vestibular/Sensorimotor Alteration Associated with Space Flight (Sensorimotor Risk) in the Integrated Research Plan (IRP). During the meeting, the SRP received an in-depth briefing of the current status of the Sensorimotor Risk from Dr. Jacob Bloomberg, the Human Research Program (HRP) Sensorimotor Discipline Lead Scientist and Dr. Millard Reschke, the Chief Scientist of the Neuroscience Laboratories at the NASA Johnson Space Center (JSC). The SRP was impressed with the information that Dr. Bloomberg and Dr. Reschke presented and think that the in-person meeting (instead of WebEx/teleconference) allowed for more interactive and thoughtful conversations.

II. Critique of Gaps and Tasks for the Risk of Impaired Control of Spacecraft, Associated Systems and Immediate Vehicle Egress Due to Vestibular/Sensorimotor Alterations Associated with Space Flight

1. *Have the proper Gaps been identified to address the Risk?*
   A. *Are all the Gaps relevant?*
   B. *Are any Gaps missing?*
2. *Have the appropriate targets for closure for the Gaps been identified?*
   A. *Is the research strategy appropriate to close the Gaps?*
3. *Have the proper Tasks been identified to fill the Gaps?*
   A. *Are the Tasks relevant?*
   B. *Are there any additional research areas or approaches that should be considered?*
   C. *If a Task is completed, please comment on whether the findings contribute to addressing or closing the Gap*
4. *If a Gap has been closed, does the Rationale for Gap closure provide the appropriate evidence to support the closure?*

Gaps and Tasks:

- The SRP thinks the proper Gaps have been identified to address the Risk; as updated and restated, the Gaps are considered to be relevant, and there do not appear to be Gaps that are missing.
- The SRP thinks the appropriate targets for closure of the Gaps have been identified and the overall research strategy is deemed to be mostly appropriate.
- Overall, and with limited exception, the SRP believes that the proper tasks have been identified to fill the Gaps.

- The SRP considers the most relevant tasks for closing the Gaps that lead to Sensorimotor Risk are The Functional Task Test (FTT) and The Field Test.
- The tasks involving Space Motion Sickness (SMS) Countermeasures and the Bedrest Study are also considered by the SRP to be highly relevant for closing the various sensorimotor Gaps.
- Although intuitively one would assume consensus in the operational community as the basis for Gap closure, there does not currently appear to be any specific protocol for determining when a Gap should be closed. This lack of objective criteria and the absence of a specific protocol is a matter of concern to the SRP.

SM2.1: Determine the changes in sensorimotor function over the course of a mission and during recovery after landing.

- The SRP thinks this gap is relevant and appropriate.
- The manual control tasks including simulations of landing an aircraft and operating a Mars Rover (data collection sessions are almost complete) demonstrate increased variability only on the day of landing. It is not clear that the findings represent a meaningful change in sensorimotor performance, nor is it clear what countermeasures will (or can) be developed. The reported difference between pre-flight and post-flight scores appears to be an effect of learning, which can further confound the interpretation of the results.

Tasks:

- Straight Ahead in Microgravity (SAM-Wood, Active) – PI: Gilles Clement, Ph.D. – International Space University
- Recovery of Functional Performance Following Long Duration Space Flight (Field Test-Reschke, Active) – PI: Millard Reschke, Ph.D. – NASA Johnson Space Center
- Assessment of Operator Proficiency Following Long-Duration Spaceflight (Manual Control - Moore, Active) – PI: Steven Moore, Ph.D. – Mount Sinai School of Medicine
- Effect of Sensorimotor Adaptation Following Long-Duration Spaceflight on Perception and Control of Vehicular Motion (Manual Control - Wood, Active) – PI: Scott Wood, Ph.D. – Azusa Pacific University
- Physiological Factors Contributing to Postflight Changes in Functional Performance (FTT-Bloomberg, Active) – PI: Jacob Bloomberg, Ph.D. – NASA Johnson Space Center
- Sensorimotor Assessment and Rehabilitation Apparatus: Procedures and Equipment (SARA-Schubert, Active) – PI: Michael Schubert, Ph.D. – The Johns Hopkins University School of Medicine
- The Role of Tactile Sensation on Locomotor Adaptation in Astronauts Returning from Long Duration Space Flights (Tactile Sensation & Locomotor Adaptation-Stergiou, Active) – PI: Nicholas Stergiou, Ph.D. – University of Nebraska at Omaha
- Effects of Long-duration Microgravity on Fine Motor Control Skills – PI: Kritina Holden, Ph.D. – NASA Johnson Space Center
- Promoting Sensorimotor Response Generalizability: A Countermeasure to Mitigate Locomotor Dysfunction After Long-Duration Spaceflight (Mobility-Bloomberg, Completed) – Completed Task
- Spatial Reorientation of Sensorimotor Balance Control in Altered Gravity (Spatial-

Paloski, Completed) – Completed Task
- Data mining activities for Sensorimotor Discipline (Sensory DM-Reschke, Completed) – Completed Task

SM2.2: Determine the effects of long-duration spaceflight on sensorimotor function over a crewmember's lifetime.

- The SRP thinks this gap is relevant and appropriate.

Task:

- Expanded Longitudinal Assessment of Crew Sensorimotor Function (TBD, Unfunded) – Unfunded Task/Not within Current Budget

SM6.1: Determine if sensorimotor dysfunction during and after long-duration spaceflight affects ability to control spacecraft and associated systems.

- The SRP thinks this gap is relevant and appropriate.

Tasks:

- Effect of Sensorimotor Adaptation Following Long-Duration Spaceflight on Perception and Control of Vehicular Motion (Manual Control - Wood, Active) – PI: Scott Wood, Ph.D. – Azusa Pacific University
- Assessment of Operator Proficiency Following Long-Duration Spaceflight (Manual Control - Moore, Active) – PI: Steven Moore, Ph.D. – Mount Sinai School of Medicine
- Development of Countermeasures to Aid Functional Egress from the Crew Exploration Vehicle Following Long-Duration Spaceflight (CM Egress - Mulavara, Active) – PI: Ajitkumar Mulavara, Ph.D. – Universities Space Research Association
- Effects of Long-duration Microgravity on Fine Motor Control Skills – PI: Kritina Holden, Ph.D. – NASA Johnson Space Center
- Robust Human-System Interface Design for Spaceflight-Induced Environments (Interface Design-Stone, Completed) – Completed Task
- Sensorimotor Displays and Controls to Enhance the Safety of Human/Machine Cooperation During Lunar Landing (Lander D&C-Young, Completed) – Completed Task
- Advanced Displays for Efficient Training and Operation of Robotic Systems (Robotic Systems-Oman, Completed) – Completed Task
- (ZAG/Otolith) Ambiguous Tilt and Translation Motion Cues After Spaceflight/ Otolith Assessment During Postflight Re-adaptation (ZAG/Otolith-Wood, Completed) – Completed Task
- Sensorimotor adaptation following exposure to ambiguous inertial motion cues (Inertial cues-Wood, Completed) – Completed Task
- Galvanic Vestibular Stimulation (GVS) as an Analogue of Post-flight Sensorimotor Dysfunction (GVS-Moore, Completed) – Completed Task
- Head-Eye Coordination during Simulated Orbiter Landings (Head-eye-Moore, Completed) – Completed Task

SM7.1: Determine if there are decrements in performance on functional tasks after long-duration spaceflight. Determine how changes in physiological function, exercise activity,

and/or clinical data account for these decrements.

- The SRP thinks this gap is relevant and appropriate.
- One of these tasks under this Gap (NeuroMapping-Seidler, Active) examines changes in brain structure/function to determine if these changes contribute to the sensorimotor deficits that result from extended spaceflight. As a first step, it is necessary to determine what these changes might be. Also, it has been argued that similar investigations could be undertaken to assess long-term risks associated with exposure to microgravity, especially with advanced age. The current tasks employ imaging techniques that may lack sufficient test-retest reliability (i.e., no standardized measures of reliability are currently provided for the methodology used), resulting in significant concern for the usefulness of these tasks. To resolve this issue, the SRP recommends that the investigators perform additional analyses to quantify the reliability of their methodology. Further, the assumption that, because the brain is proximally responsible for behavior, it is of inherent interest to study it, is subject to some question, particularly for a research effort directed to resolving real-world performance problems that may interfere with operational effectiveness. The objectives of the project are: 1) to identify changes in brain structure and function that result from spaceflight and from bed rest, and 2) to correlate these changes with behavioral measures. The relevant operational issue is concerned with behavioral deficits and changes in sensorimotor behavior, irrespective of any underlying structural or functional changes in the brain. The observed changes in behavior may or may not be correlated with measurable changes in the brain. Therefore, the relevance of the brain-imaging task for closing the Gap specified in the research plan may be questioned. Further, there are other significant and more broadly relevant statistical and conceptual issues involving small "n" tasks that require resolution (and that are discussed in Section V of this report). Nevertheless, and despite the SRP's concerns, success in this endeavor would represent a significant scientific accomplishment, and a potentially useful tool for identifying and predicting sensorimotor deficits.

Tasks:

- Physiological Factors Contributing to Postflight Changes in Functional Performance (FTT-Bloomberg, Active) – PI: Jacob Bloomberg, Ph.D. – NASA Johnson Space Center
- Recovery of Functional Performance Following Long Duration Space Flight (Field Test-Reschke, Active) – PI: Millard Reschke, Ph.D. – NASA Johnson Space Center
- Bed Rest as a Spaceflight Analog to Study Neurocognitive Changes: Extent, Longevity, and Neural Bases (NeuroMapping-Bedrest-Seidler, Active) – PI: Rachael Seidler, Ph.D. – University of Michigan
- Spaceflight Effects on Neurocognitive Performance: Extent, Longevity, and Neural Bases (NeuroMapping-Flight-Seidler, Active) – PI: Rachael Seidler, Ph.D. – University of Michigan
- Recovery Data Mining: Relationship between In-Flight Exercise and Postflight Sensorimotor Performance. (Recovery Data Mining-Reschke, Completed) – Completed Task
- Data mining activities for Sensorimotor Discipline (Sensory DM-Reschke, Completed) – Completed Task
- Performance Data Mining: Correlation Between Previous Performance Data with Clinical Observations – Completed Task

SM24: Determine if the individual capacity to produce adaptive change (rate and extent) in sensorimotor function to transitions in gravitational environments can be predicted with preflight tests of sensorimotor adaptability.

- The SRP thinks this gap is relevant and appropriate.
- The SRP identified weaknesses in the tasks attempting to correlate changes in brain structure/function with changes in sensorimotor behavior and in the task to develop predictors of adaptability. Particularly vexing are the issues of uncontrolled between-subject variance due to small sample size and determining and/or developing the statistical approaches necessary to derive reliable predictors from any studies that are based on relatively small samples. The specific methodology and the conceptual basis for the brain imaging tasks were also of concern to members of the SRP.
- The task to develop personalized countermeasures to enhance sensorimotor adaptability still lists computerized dynamic posturography (CDP) test 5 as a vestibular function test, which it clearly is not.

Tasks:

- Developing Predictive Measures of Sensorimotor Adaptability to Produce Customized Countermeasure Prescriptions (Sensorimotor Predictors-Bloomberg, Active) – PI: Jacob Bloomberg, Ph.D. – NASA Johnson Space Center
- Developing Predictors of Sensorimotor Adaptability - ISS Flight Validation (Flight: SM Predictors-TBD, Planned) – Planned Task
- Developing Personalized Countermeasures for Sensorimotor Adaptability: A Bedrest Study (Sensorimotor Predictors - Retrospective - Mulavara, Active) – PI: Ajitkumar Mulavara, Ph.D. – Universities Space Research Association

SM26: Determine if exposure to long-duration spaceflight leads to neural structural alterations and if this remodeling impacts cognitive and functional performance.

- The SRP thinks this gap is relevant and appropriate.

Tasks:

- Spaceflight Effects on Neurocognitive Performance: Extent, Longevity, and Neural Bases (NeuroMapping-Flight-Seidler, Active) – PI: Rachael Seidler, Ph.D. – University of Michigan
- Bed Rest as a Spaceflight Analog to Study Neurocognitive Changes: Extent, Longevity, and Neural Bases (NeuroMapping-Bedrest-Seidler, Active) – PI: Rachael Seidler, Ph.D. – University of Michigan
- Inner Ear Otoconia Response in Mice to Micro- and Hyper-gravity (Otoconia-Boyle, Active) – PI: Richard Boyle, Ph.D. – NASA Ames Research Center

SM27: Determine the most optimal pharmacological and sensorimotor countermeasure combination that reduces Space Motion Sickness (SMS) while minimizing side effects.

- The SRP thinks this gap is relevant and appropriate.
- The SRP suggests that an additional research area be considered that involves the development of new countermeasures to SMS, which can severely interfere with

astronaut sensorimotor performance. Current approaches rely on pharmacological agents, such as promethazine, a phenothiazine that possesses antihistaminic, sedative, anti-emetic, and anticholinergic effects. Other clinical uses for promethazine include the management of allergic reactions and anaphylaxis, treatment of post-operative nausea and vomiting, and as an adjuvant for post-operative pain. This current drug of choice may have excessive and sometimes unreported side effects, and is possibly a more general agent than desirable. Other pharmacological agents should be considered.

- Also, both training and nutritional countermeasures may be efficacious for the prevention of SMS in some circumstances.
- Overall, the SRP recommends that improved SMS countermeasures be investigated.

Tasks:

- Countermeasures to Reduce Sensorimotor Impairment and Space Motion Sickness Resulting from Altered Gravity Levels (SMS CM Development-Young, Active) – PI: Laurence Young, Ph.D. – Massachusetts Institute of Technology
- Pre-flight Training of Autonomic Responses for Mitigating the Effects of Spatial Disorientation During Spaceflight (Pre-flight Training for Spatial Disorientation - Cowings, Active) – PI: Patricia Cowings, Ph.D. – NASA Ames Research Center
- SMS CM Development - Medication Optimization (TBD, Planned) – Planned Task
- Space Motion Sickness Countermeasures in Spaceflight (SMS CM Flight-TBD, Planned) – Planned Task

SM28: Develop a sensorimotor countermeasure system integrated with current exercise modalities to mitigate performance decrements during and after spaceflight.

- The SRP thinks this gap is relevant and appropriate.

Tasks:

- Straight Ahead in Microgravity (SAM-Wood, Active) – PI: Scott Wood, Ph.D. – Azusa Pacific University
- Development of Countermeasures to Aid Functional Egress from the Crew Exploration Vehicle Following Long-Duration Spaceflight (CM Egress - Mulavara, Active) – PI: Ajitkumar Mulavara, Ph.D. – Universities Space Research Association
- Sensorimotor Countermeasure Evaluation Suite (TBD, Planned) – Planned Task
- Sensorimotor In/Post-Flight Evaluation and Rehabilitation Tool (TBD, Planned) – Planned Task
- Sensorimotor Integrative Countermeasure Development - Bedrest (TBD, Planned) – Planned Task
- Development of Countermeasures to Enhance Sensorimotor Adaptation - ISS Flight Validation (Flight:Sensorimotor Adaptation CM, Planned) – Planned Task
- Development of Countermeasures to Enhance Sensorimotor Adaptation (SM Adaptation-Bloomberg, Completed) – Completed Task
- Promoting Sensorimotor Response Generalizability: A Countermeasure to Mitigate Locomotor Dysfunction After Long-Duration Spaceflight (Mobility-Bloomberg, Completed) – Completed Task
- (ZAG/Otolith) Ambiguous Tilt and Translation Motion Cues After Spaceflight/ Otolith

Assessment During Postflight Re-adaptation (ZAG/Otolith-Wood, Completed) – Completed Task

- Neurovestibular Aspects of Short-radius Artificial Gravity: Toward Comprehensive Counter Measure (Short Radius AG-Young, Completed) – Completed Task

III. Discussion on the strengths and weaknesses of the IRP and identify remedies for the weaknesses, including answering these questions:

A. Is the Risk addressed in a comprehensive manner?
   - The IRP appears to address the Risk in a comprehensive and generally effective manner; nevertheless, there may be opportunities to enhance the IRP.

B. Are there obvious areas of potential integration across disciplines that are not addressed?

   - The SRP feels the integration across HRP disciplines is being addressed adequately, although not systematically. A formalized panel that would convene regularly to discuss issues across discipline boundaries could be useful in this regard.
   - The SRP is concerned about the lack of communication across the various HRP SRPs. An example being during the *"integration discussion"* it was brought up that the current treadmill is too heavy for the Mars expedition and therefore was being redesigned, a fact that not all SRPs were aware of.

IV. Evaluation of the progress on the Sensorimotor Risk Research Plan since the 2013 SRP meeting

- The SRP thinks the development of well-designed measures to evaluate functional deficits that can affect the safety and efficiency of the crew (FTT and Field Tests) are outstanding and have shown a positive effect of in-flight exercise on post-flight functional mobility. This is a major accomplishment.

- The SRP was particularly impressed by the FTT. Mapping between ecological functional tasks and physiological measures is always a challenge, as the boundary between the two kinds of assessment can be ambiguous at times. Nevertheless, the data were impressive and seem to emphasize non-vestibular postural control as the major abnormality following space flight; it also suggests that bed rest is a good model for these effects. These findings support the credibility of conducting additional bed rest studies to evaluate potential countermeasures.

- The Field Test, which in many respects can be seen as a compressed version of the FTT, was also considered to be of great worth and interest. The main rationale for the Field Test is to obtain very early post-flight data to get a sense of the time course of post-flight abnormalities and the speed with which they recover. It was not explicitly noted whether these data would be compared with immediate testing after prolonged

bed rest, and if so, whether the bed rest model could be used to make some of this field-testing less necessary in the future, or perhaps allow investigators to concentrate on non-overlapping features, given the very limited time available.

- The distinction between vestibular and body-loading problems has helped to identify the particular physiological systems that need to be targeted with countermeasures for specific types of spaceflight-induced deficits; this effort represents another significant accomplishment.

- Bed rest appears to provide a useful model for the effects of low gravity, and behavioral, cognitive and vestibular tests, e.g., ocular vestibular-evoked myogenic potential (oVEMP) are of definite value in bed rest studies.

- Potential countermeasures for problems of post-flight functional mobility have been identified in some tasks. These countermeasures include the use of increased body loading on a treadmill and increased load in squat exercises.

- Use of personalized countermeasures for sensorimotor adaptability in pilot studies has demonstrated the ability to train subjects to a stable level of performance with respect to tilt perception, and additional work along similar lines should be pursued.

V. Additional Comments

- Although many tests of performance have considerable shared variance, there is a lack of analysis of potential correlations between tests, which might lead to a reduction in the number of tests that need to be conducted. Unfortunately, standard statistical analysis is probably not appropriate, given the small sample size of most studies; nevertheless, there may be solutions for this statistical dilemma from advances in the field of small "n" statistical analysis.

- There is a lack of analysis of potential correlations between tests and perceived or real decrements of performance as noted by astronauts (this analysis would require an astronaut log of some type and/or the collection of actual in-flight performance data).

- There is also a lack of correlation between computerized dynamic CDP and real decrements in performance by the astronauts (or, for that matter, even between posturography and real decrements in performance by non-astronauts). Although CDP has become a standard test in the space program, this lack of correlation to real-world performance brings into question the value of the test. The relationship between performance on certain tests and real life activities are often undocumented and unknown. We do know that certain clinical tests can be used to predict the risk of falling, or that they are related to lower extremity strength, and are supported by tasks that have good reliability and validity; it is unclear why these validated clinical tests were not used by the NASA investigators.

- There is insufficient evidence to document the reliability of many measures used.

Even those measures that are based on documented and reliable methods have been modified over their use so that their reliability must be re-evaluated, e.g., sit to stand time; Dynamic Visual Acuity (DVA), etc.

- There is a paucity of known countermeasures for the problems identified in some tasks, and information regarding how quickly fine motor and force control deficits develop in the International Space Station (ISS) is generally lacking; collection of specific in-flight data could be useful.

- The SRP was concerned that some tests do not provide appropriate challenges to sensorimotor performance, e.g., the DVA test using an oscillating chair approximates the vertical displacement and frequency of walking in earth gravity, but not on Mars.

- The investigators should take greater advantage of newly developed methodologies, e.g., infrared eye movement systems, Sensorimotor Assessment and Rehabilitation Apparatus (SARA), etc., and incorporate them across multiple experiments.

- Stochastic vestibular stimulation may result in impaired performance; a comprehensive documentation of the effects of stochastic vestibular stimulation is needed.

- There is a growing awareness in the neuroscience community of the dangers of small "n" studies. One big danger is that even positive results in underpowered studies are questionable because they often cannot be reproduced. This is much more serious when the goal is to apply findings in a true practical sense. These same concerns arose with both the neuroimaging and the predictor studies. The error here is to conflate correlation (problematic in itself) with true prediction. For any study of inter-individual differences to be reliable and of practical use, the study generally needs to be based on a large number of individuals with a priori planned comparisons, and with measures that have been validated. Unfortunately, this is often not the case, and this issue needs to be addressed.

- A repeatedly identified shortcoming of the entire HRP involves the potential life or death consequences of decisions that are based on the results of studies involving small numbers of subjects. What is desperately needed here is an explicit reference on how to perform small "n" scientific studies with measurement techniques that are often new and frequently un-validated. There is a profound need for a statistics core that can address these critical methodological concerns before large amounts of unusable and unreliable data are collected and analyzed.

- The SRP was presented with little evidence for either an overarching logic of experimental design or a commonality of purpose, except for the need to overcome sensorimotor problems resulting from spaceflight. Instead, the impression was one of earnest ingenuity, repeated use and modification of existing tools, and novel frameworks and approaches in somewhat isolated groups of investigators. It is not just individual projects that need to be "integrated," but the methodological, statistical

and scientific principles underlying them as well.

- Because there are trade-offs between the number of observations per subject and the number of subjects used in a given study, it is strongly recommended that HRP should encourage and support the development and use of small sample statistical analyses that are specifically applicable to studies involving small numbers of human subjects with limited time available for testing.

VI. 2014 Sensorimotor Risk SRP Research Plan Reviews: Statement of Task for the Risk of Impaired Control of Spacecraft, Associated Systems and Immediate Vehicle Egress Due to Vestibular/Sensorimotor Alterations Associated with Space Flight

The 2014 Sensorimotor Risk Standing Review Panel (SRP) is chartered by the Human Research Program (HRP) Chief Scientist. The purpose of the SRP is to review the Risk of Impaired Control of Spacecraft, Associated Systems and Immediate Vehicle Egress Due to Vestibular/Sensorimotor Alterations Associated with Space Flight section of the current version of the HRP's Integrated Research Plan (IRP) which is located on the Human Research Roadmap (HRR) website (http://humanresearchroadmap.nasa.gov/). Your report, addressing each of the questions in the charge below and any addendum questions, will be provided to the HRP Chief Scientist and will also be made available on the HRR website.

The 2014 Sensorimotor Risk SRP is charged (to the fullest extent practicable) to:

1. Based on the information provided in the current version of the HRP's IRP, evaluate the ability of the IRP to satisfactorily address the Risk by answering the following questions:

    A. Have the proper Gaps been identified to address the Risk?
        i) Are all the Gaps relevant?
        ii) Are any Gaps missing?

    B. Have the appropriate targets for closure for the Gaps been identified?
        i) Is the research strategy appropriate to close the Gaps?

    C. Have the proper Tasks been identified to fill the Gaps?
        i) Are the Tasks relevant?
        ii) Are there any additional research areas or approaches that should be considered?
        iii) If a Task is completed, please comment on whether the findings contribute to addressing or closing the Gap.

    D. If a Gap has been closed, does the rationale for Gap closure provide the appropriate evidence to support the closure?

2. Identify the strengths and weaknesses of the IRP, *and* identify remedies for the weaknesses, including, but not limited to, answering these questions:
    A. Is the Risk addressed in a comprehensive manner?
    B. Are there areas of integration across HRP disciplines that are not addressed that would better address the Risk?
    C. Other

3. Based on the updates provided by the Element, please evaluate the progress in the research plan since the last SRP meeting.

4. Please comment on any important issues that are not covered in #1, #2, or #3 above, that the SRP would like to bring to the attention of the HRP Chief Scientist and/or the Element.

Additional Information Regarding This Review:

1. Expect to receive review materials at least four weeks prior to the meeting.

2. Attend the 2014 Sensorimotor Risk SRP meeting in Houston, TX on December 17 - 18, 2014.
   A. Attend Element or Project presentations, question and answer session, and briefing.
   B. Prepare a draft report that addresses each of the evaluation criteria listed in the panel charge. Debrief the HRP Chief Scientist and a representative from the Human Health Countermeasures (HHC) Element on the salient points that will be included in the report and specifically the items in the panel charge.

3. Prepare a draft final report (approximately one month after the meeting) that contains a detailed evaluation of the current IRP specifically addressing items #1, #2, #3, and #4 of the SRP charge. The draft final report will be sent to the HRP Chief Scientist and he will forward it to the appropriate Element for their review. The HHC Element and the HRP Chief Scientist will review the draft final report and identify any misunderstandings or errors of fact and then provide official feedback to the SRP within two weeks of receipt of the draft report. If any misunderstandings or errors of fact are identified, the SRP will be requested to address them and finalize the 2014 SRP Final Report as quickly as possible. The 2014 SRP Final Report will be submitted to the HRP Chief Scientist and copies will be provided to the HHC Element that sponsors the sensorimotor discipline and also made available to the other HRP Elements. The 2014 SRP Final Report will be made available on the HRR website (http://humanresearchroadmap.nasa.gov/).

VII. 2014 Sensorimotor Risk Standing Review Panel Roster

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