G: Ground Study	**Early Start**	**6) Technology**
F: Flight Study	**Task To Be Determined After Decision Point**	**7) Countermeasure**
L: Lunar	**Major Milestone/Event/Accomplishment**	**8) Information To/From other Elements**
NSBRI	**1) Risk Characterization**	**9) Information to HSRB**
DA&M: Data Analysis & Modeling	**2) Task↓↑Task**	**10) Requirements**
FP: Flight Prep	**3) Standards - New**	**11) Study**
AO: Add on to another study	**4) Standards - Update**	**Stop**
Planned/unfunded	**5) Tools**	**Major Decision Point**

Task Name

2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

ISS and other vehicles

a b c d e f g

▲a: 6 Crew Capability; ▲b: Shuttle Retired; ▲c: EFT1; ▲d: MPCV CDR; ▲e: EM1; ▲f: EM2; ▲g: End of US Commitment to ISS

ISS as Mars analog

HHC Exercise & Performance Portfolio (E/P)

Risk of Impaired Performance Due to Reduced Muscle Mass, Strength and Endurance

SM7: Can an integrated post-flight functional task performance test be used on returning ISS crew members to obtain performance decrements?

Functional Task Test (FTT): (Bloomberg, Directed Study)

Shuttle

F: STS Data Collection DA&M Final Report & Recommendation 9

ISS

FP AO DA&M ↑2: Recommended to Flight Study; ↑9: Final Report & Recommendation

F: ISS Data Collection 2 9

FTT Factors of Influence/Muscle Strength

G DA&M

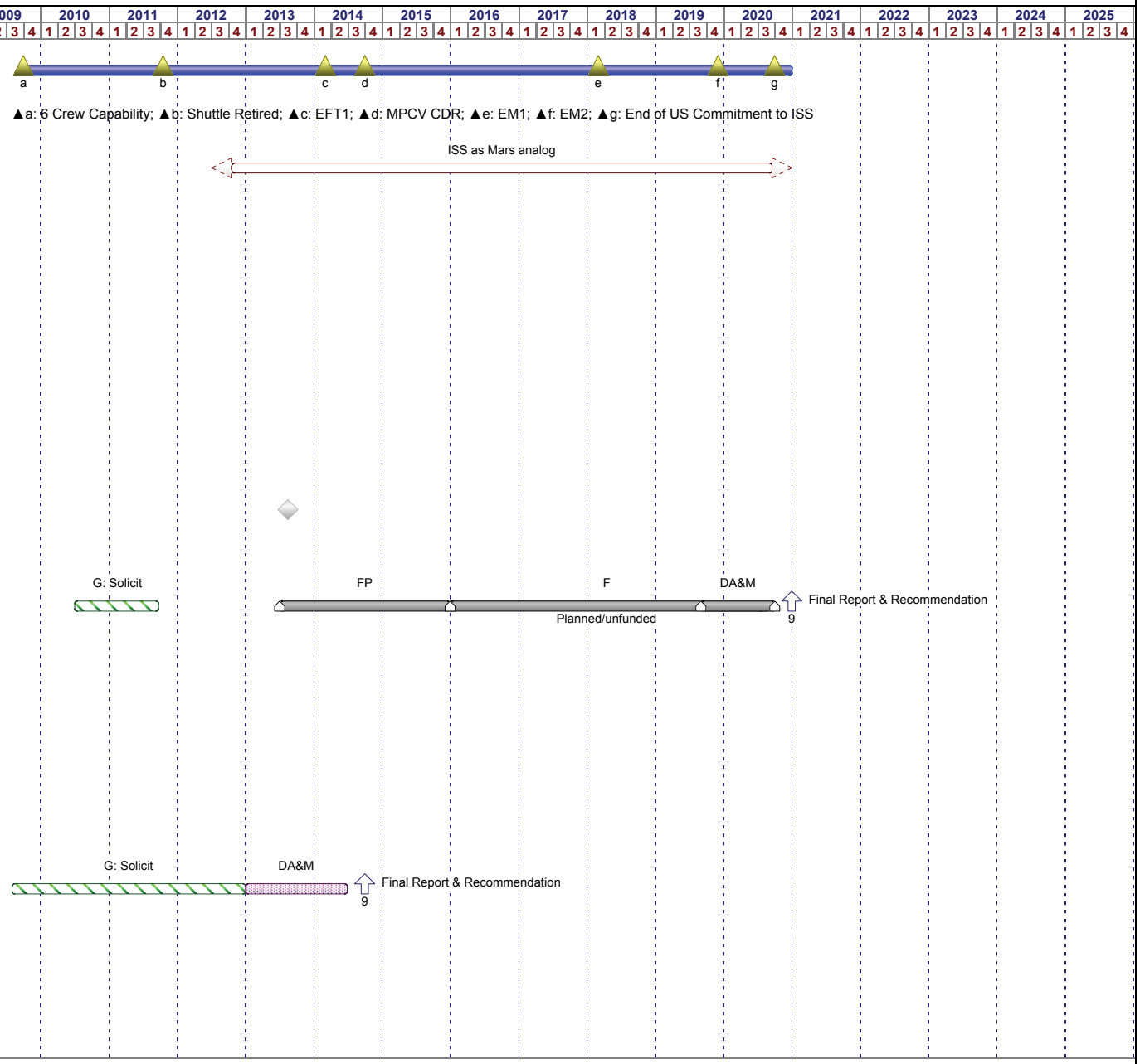
Extended Performance Tasks

Weighted Garment Final Report Available G 2

F

Task Name

ISS and other vehicles



HHC Exercise & Performance Portfolio (E/P)

Risk of Impaired Performance Due to Reduced Muscle Mass, Strength and Endurance

M2: What is the current status of in-flight and post-flight exercise performance capability?

Modulation of Muscle Function by Lower Limb Loading during Space Flight (NRA, Paloski)

Decision on implementation of re-scoped flight and new analog studies to be included in Modulation of Muscle Function by Lower Limb Loading during Space Flight NRA.

Modulation of Muscle Function by Lower Limb Loading during Space Flight - Flight Study

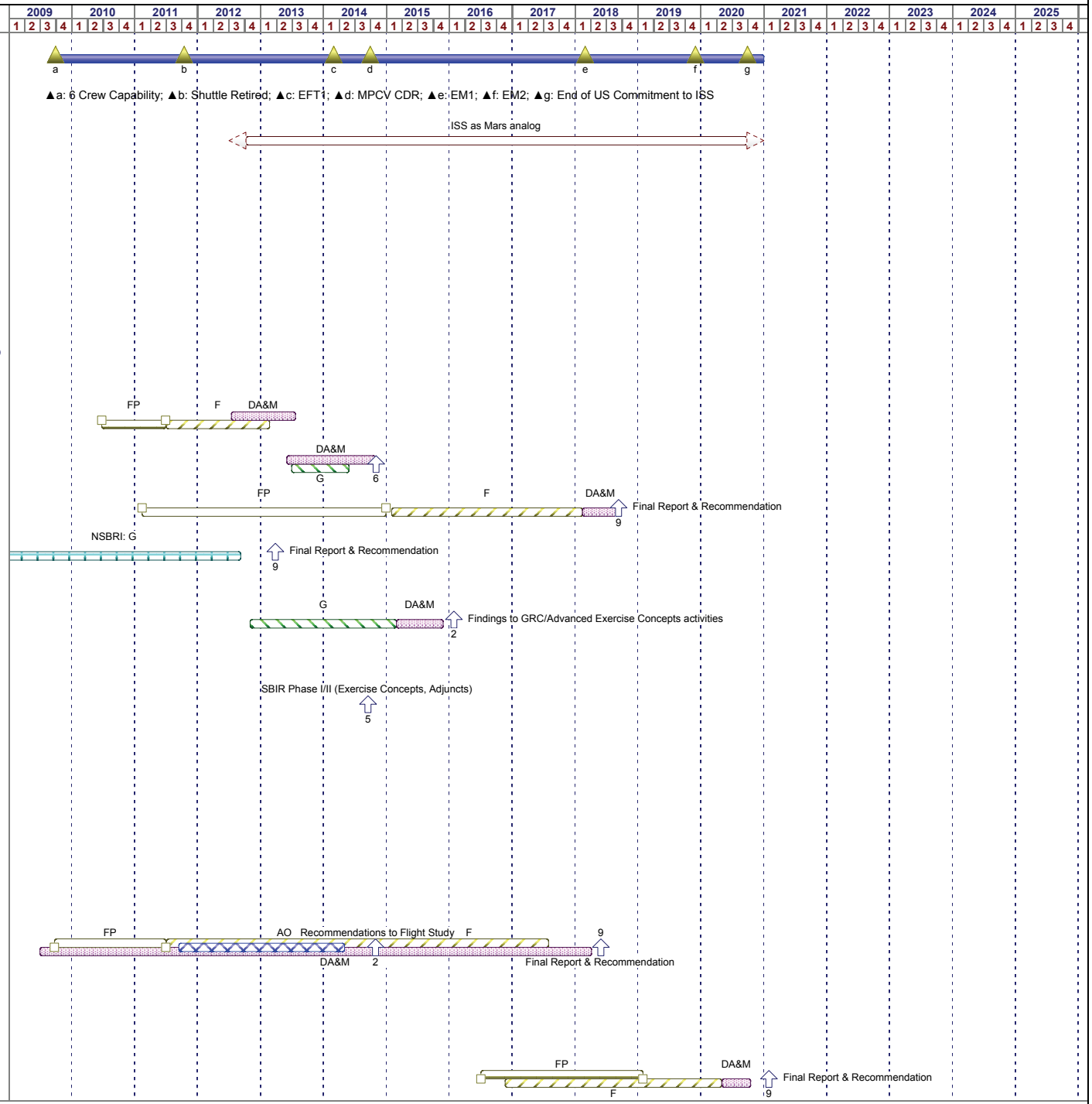
M3/M4/M6: M3: What tasks will be reqd for Expl. Missions? M4: What are the physiologic costs of Exploration mission tasks? M6: Can a std. perf. Meas. Of readiness for Expl. Tasks be dev?

Treadmill Kinematics (DeWitt, Directed) - See Muscle Risk/M7-9.

ARED Kinematics/BICE (2009 ILSRA: HRP Co-Is) - See Muscle Risk/M7-9

Standardized "Pre-flight" Exercise Tests to Predict Performance during Extravehicular Activities in a Lunar Environment" [Pre-flight Exercise Tests] (Barstow, NRA)

Extended Performance Tasks - See Muscle/SM7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ISS as Mars analog
HHC Exercise & Performance Portfolio (E/P)
Risk of Impaired Performance Due to Reduced Muscle Mass, Strength and Endurance
M7-9: Can the current in-flight performance be maintained with reduced exercise volume? What is the minimum exercise regimen needed to maintain fitness levels for tasks? What is the min. set of exercise hardware needed to maintain those tasks?
Treadmill Kinematics (DeWitt, Directed)
FP F DA&M
"Flywheel Prescription Optimization (TBD, Directed Study)
DA&M G 6
ARED Kinematics/BICE (2009 ILSRA; HRP Co-Is)
FP F DA&M Final Report & Recommendation 9
Adams NSBRI Grant - Integrated Endurance and Resistance Exercise Countermeasures Using a Gravity Independent Training Device
NSBRI: G Final Report & Recommendation 9
Integrated Resistance and Aerobic Exercise Training with Small Compact Exercise Equipment" [Exerise Training on Compact Equipment]- 2012 NSBRI/Ploutz-Snyder
G DA&M Findings to GRC/Advanced Exercise Concepts activities 2
Development of New Exercise Hardware for Exploration Missions (GRC Advanced Exercise Concepts)
SBIR Phase I/II (Exercise Concepts, Adjuncts) 5
sDTOCMS Harness Study (GRC, Directed Study) - SECONDARY
Testosterone (NRA, Urban) - See Muscle Risk/M14
Exercise Plus Nutritional Supplements 1 (NRA, TBD) - See Muscle Risk/N9
Exercise Plus Nutritional Supplements 2 (NRA, TBD) - See Muscle Risk/N9
SPRINT (Ploutz-Snyder, Directed Study)
FP AO Recommendations to Flight Study F 9
DA&M 2 Final Report & Recommendation
Hydration Effects on Muscle (NRA, TBD) - See Muscle Risk/N9
Gender Effects on Muscle (NRA, TBD) - See Muscle Risk/M23
Flight Validation Studies of Exercise+Pharm+nutrition
FP DA&M Final Report & Recommendation
F 9

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ISS and other vehicles

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ISS as Mars analog

HHC Exercise & Performance Portfolio (E/P)

Risk of Impaired Performance Due to Reduced Muscle Mass, Strength and Endurance

M14: What anabolic or anti-catabolic drugs can be used to mitigate muscle loss?

Testosterone (NRA, Urban)

G: Solicit G: Bedrest DA&M Final Report & Recommendation 9

Anabolic/Anti-Catabolic Pharmaceutical(s) with or without Exercise Studies 1 (NRA)

G:Solicit G DA&M P/U - Final Report & Recommendation Planned/unfunded 9

Anabolic/Anti-Catabolic Pharmaceutical(s) with or without Exercise Studies 2 (NRA)

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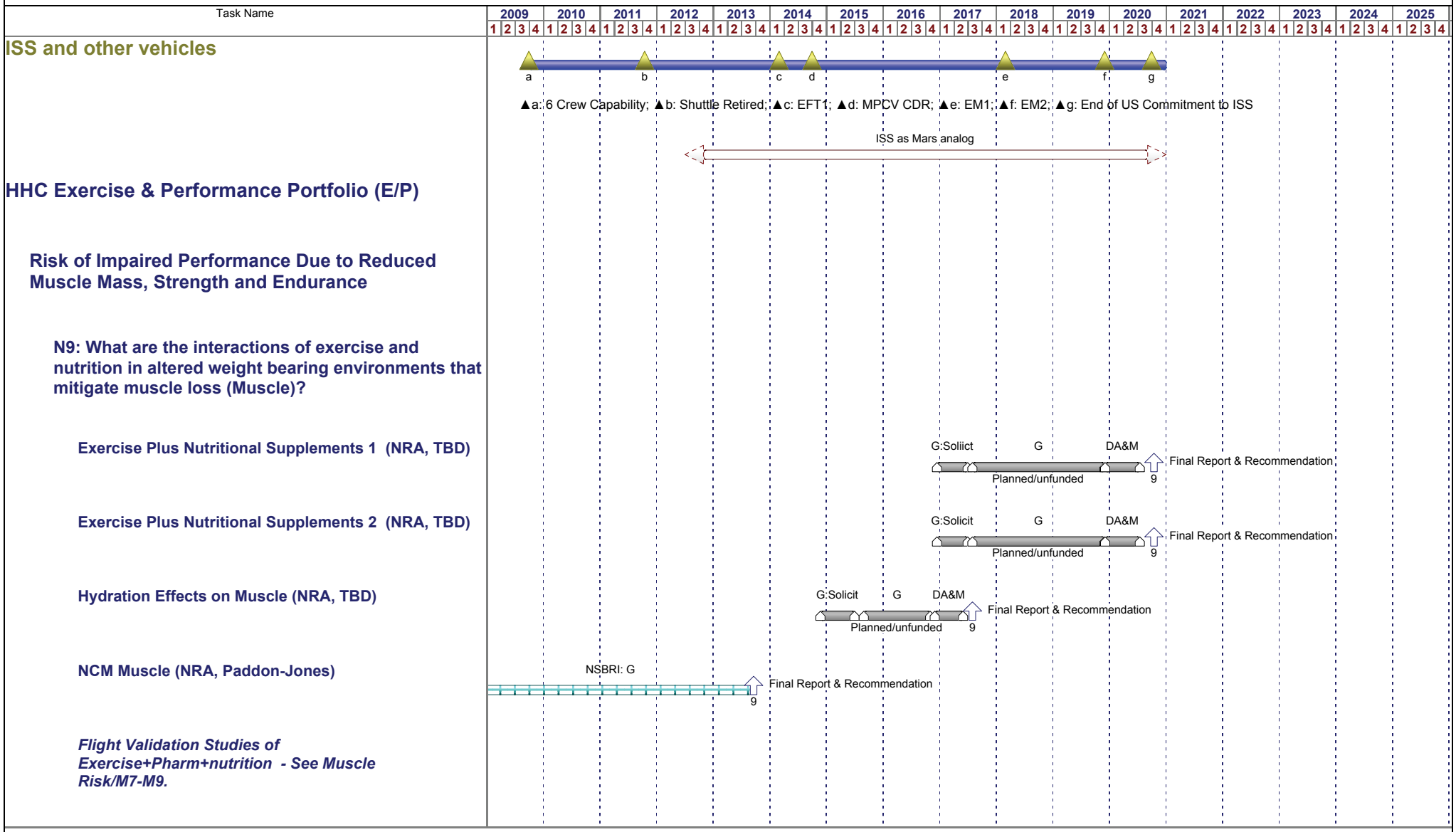
Flight Validation Studies of Exercise+Pharm+nutrition (ISS Mars Transit Simulation Study)-See Muscle Risk/M7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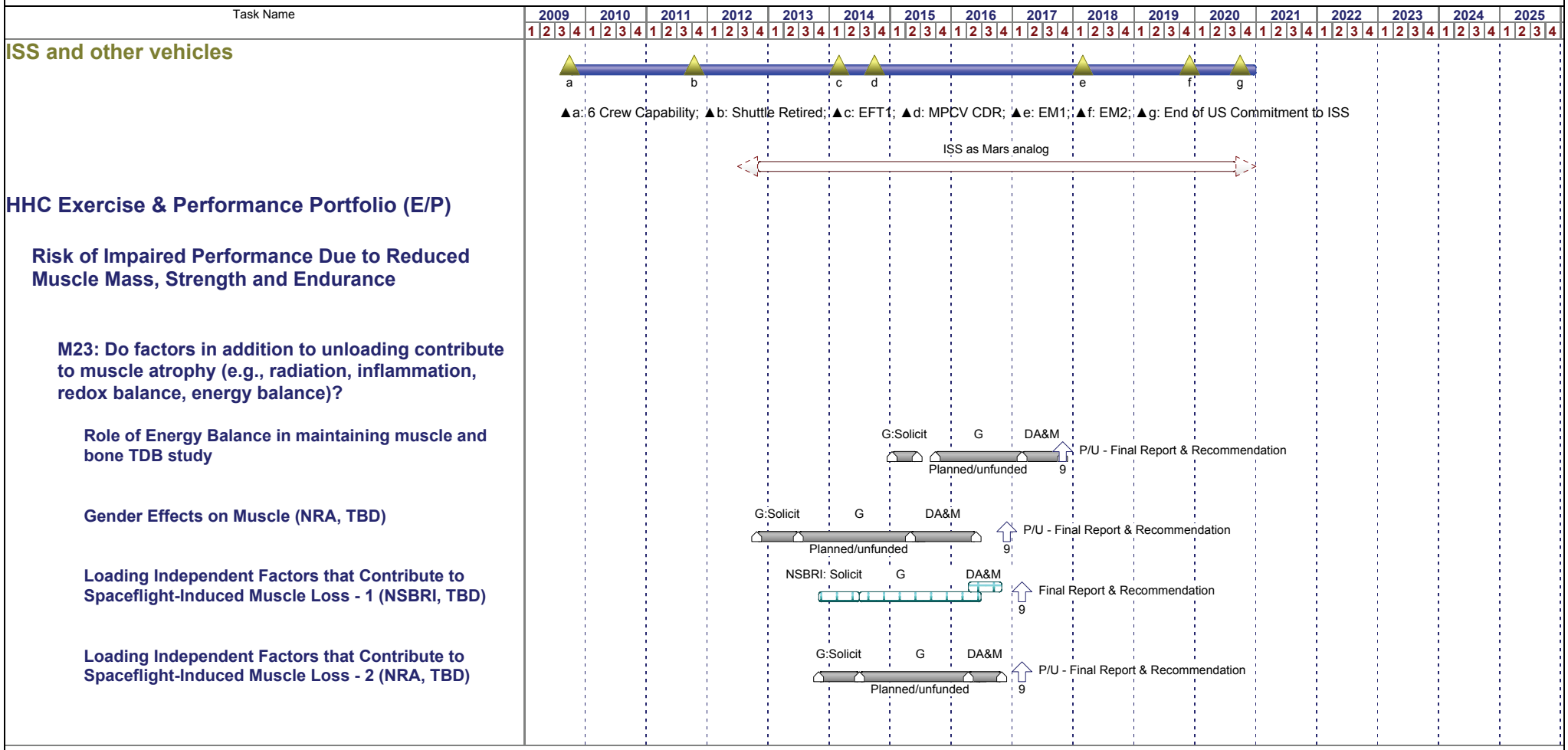
ISS as Mars analog
HHC Exercise & Performance Portfolio (E/P)
Risk of Impaired Performance Due to Reduced Muscle Mass, Strength and Endurance
N9: What are the interactions of exercise and nutrition in altered weight bearing environments that mitigate muscle loss (Muscle)?
Exercise Plus Nutritional Supplements 1 (NRA, TBD)
G:Soliict G DA&M
Final Report & Recommendation
Planned/unfunded 9
Exercise Plus Nutritional Supplements 2 (NRA, TBD)
G:Solicit G DA&M
Final Report & Recommendation
Planned/unfunded 9
Hydration Effects on Muscle (NRA, TBD)
G:Solicit G DA&M
Final Report & Recommendation
Planned/unfunded 9
NCM Muscle (NRA, Paddon-Jones)
NSBRI: G
Final Report & Recommendation
9
Flight Validation Studies of Exercise+Pharm+nutrition - See Muscle Risk/M7-M9.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ISS as Mars analog
HHC Exercise & Performance Portfolio (E/P)
Risk of Impaired Performance Due to Reduced Muscle Mass, Strength and Endurance
M23: Do factors in addition to unloading contribute to muscle atrophy (e.g., radiation, inflammation, redox balance, energy balance)?
Role of Energy Balance in maintaining muscle and bone TDB study
G:Solicit G DA&M
P/U - Final Report & Recommendation
Planned/unfunded 9
Gender Effects on Muscle (NRA, TBD)
G:Solicit G DA&M
P/U - Final Report & Recommendation
Planned/unfunded 9
Loading Independent Factors that Contribute to Spaceflight-Induced Muscle Loss - 1 (NSBRI, TBD)
NSBRI: Solicit G DA&M
Final Report & Recommendation
9
Loading Independent Factors that Contribute to Spaceflight-Induced Muscle Loss - 2 (NRA, TBD)
G:Solicit G DA&M
P/U - Final Report & Recommendation
Planned/unfunded 9

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ISS as Mars analog

HHC Exercise & Performance Portfolio (E/P)

Risk of Impaired Performance Due to Reduced Muscle Mass, Strength and Endurance

M24: What is the time course of changes in muscle protein turnover, muscle mass and function during long term space flight?

Modulation of Muscle Function by Lower Limb Loading during Space Flight - Flight (NRA, Paloski) - See Muscle Risk/M2

Determination of the Time Course of Muscle Adaptations to Long Duration Space Flight (NRA, TBD)

G: Solicit F DA&M P/U - Final Report & Recommendation
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Determination of Muscle Protein Turnover During Long Duration Space Flight (NRA, TBD)

G: Solicit F DA&M P/U - Final Report & Recommendation
Planned/unfunded 9