JEO Project interactions with Instrument Concept Teams - Pre-Final Selection

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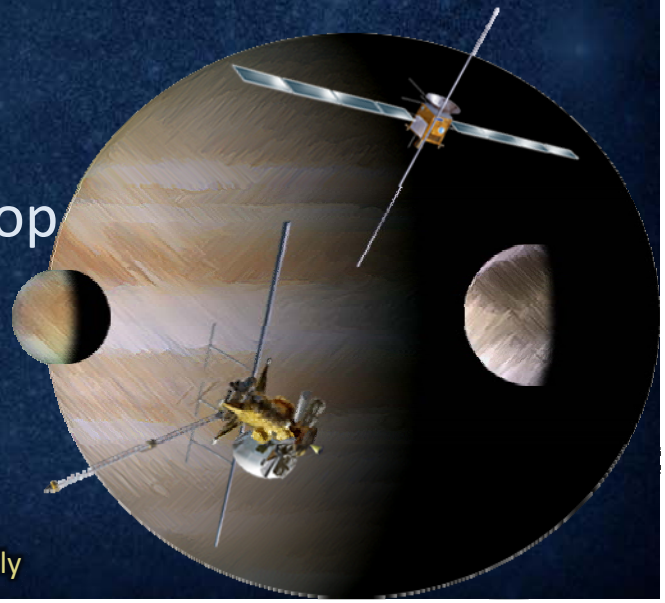

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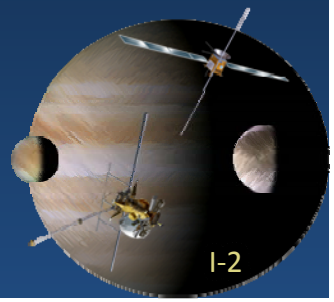
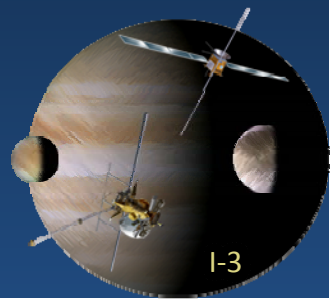
Pre-Decisional - For Planning & Discussion Only

The AO is currently in DRAFT form and its contents, including the Step 2 process presented here, are under discussion. Proposers are responsible for reading the final AO, which will fully describe the Step 2 process that will be used.



Technical Support to the Instrument Proposers: Purpose

- The two step AO process is predicated on a belief that significant technical and cost risk mitigation can be achieved by clarifying the mission context and disseminating technical information *during* instrument concept development
- There are some fundamental objectives that form the basis for how that process should develop:
  - Successful Implementation: Process leads to selection of a payload that has highest probability meeting science goals within resources
  - Legitimate selection: Process ensures an open and fair selection process
  - "Family values": Process reflects and promotes cooperation and collaboration



Technical Support to the Instrument Proposers: Goals and Constraints (1)

- The Project will uniformly offer adequate and competent support to all instrument teams
  - The process must be consistent with rules, regulations and procedures established by NASA
  - The process must be consistent with the Organizational Conflict of Interest Avoidance Plan and firewall
  - The process must provide assurance that competition sensitive information will be protected (Non-disclosure Agreements, training, documentation)
- An ombudsperson and oversight process may be included (by NASA) to provide recourse outside of the Project

Technical Support to the Instrument Proposers: Goals and Constraints (2)

- The Project will provide firewalled technical points of contact and information exchange who:
  - Maintain division of knowledge and support between personnel supporting proposers and those potentially assessing proposals
  - Control and document information provided to proposers
  - Provide technical information for risk mitigation
  - Assure proposers that competition sensitive information will not be shared outside of the firewall or with other proposers
- Programmatic Q&A pertaining to the AO process will be handled by the HQ Program Scientist using a separate process

Potential Interaction Types

Interaction types under consideration

- Objective release of information to everyone at once (tools, documents, classes/seminars etc)
- Providing parts and sensor test facilities and setup support

Likely to fit with process objectives *(assumed for the remainder of this presentation)*

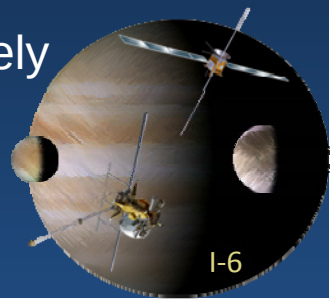
- Provision of website for access to shielding design tools and documentation
- More involved discussion with tailoring of information based on need, may require one-on-one discussions with experts via written back and forth Q&A

Unlikely to fit with process objectives

- Provide "bull pen" of shielding design experts available for discussion at instrument team request

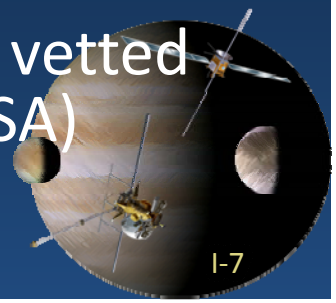
Very Unlikely

- Providing "design team" members for each instrument team to help identify issues and resolution paths



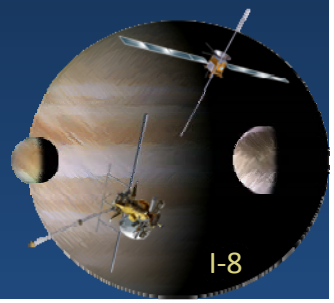
Notional Interaction Process

- Overview
  - Each proposal team will be provided a single point of contact (POC) within the project
  - The project will form a support team of the POCs and subject matter experts (SME) for radiation, planetary protection, and other issues
  - All POCs and SMEs will be firewalled and governed by NDAs
  - Communication and information transfer will be in writing and archived
- Interaction will be governed by strict processes and procedures that will be documented
  - The governing processes and procedures will be vetted with an independent resource (agreed to by NASA)



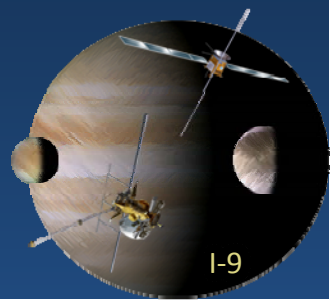
Instrument Support Team

- Each single point of contact (POC) in the Instrument Support Team will be
  - Assigned at start of Step-2 for the duration of the remaining AO process
  - An experienced payload system engineer
  - Dedicated to the role (only job)
  - Tasked with supporting ~3-4 proposal teams
- Subject matter experts (SME) will be added to the support team for areas that are important to risk reduction
  - E.g., Radiation environment, radiation circuit design, shielding, planetary protection
  - Will communicate through the POCs and not interact independently with proposal teams
- The Instrument Support Team will be kept as small as practical to facilitate rapid workflow
  - Would be comprised of APL and JPL project
- The whole Instrument Support Team acts as a committee to review questions, determine their scope, and review answers



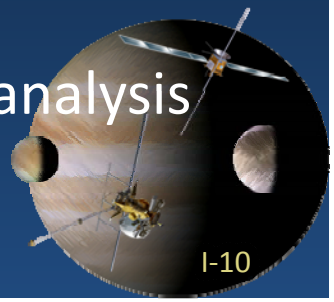
POC and SME Roles and Responsibilities

- POC
  - Interacts with instrument teams to understand needs and receive questions
  - Defines initial plan to determine answers
  - Coordinates final answers and documentation
  - Communicates answers and supporting information to instrument teams
  - Derives FAQs for general release to all teams (if applicable)
  - Performs general instrument support available to all teams (e.g., interface and accommodation studies)
- SME
  - Provides answers to instrument team questions
  - Performs broad instrument support available to all teams (e.g., parts program, other developments)
- Both
  - Must be behind the AO Firewall
  - Must attend Instrument Support Team meetings
  - Must keep connected to project technical work



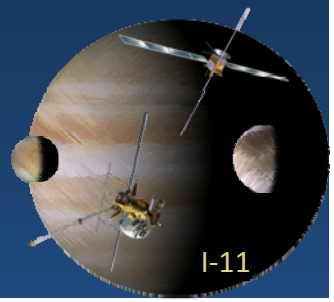
Communication Methods

- All communications between POCs and instrument teams are written and logged
- Casual conversations or information exchanges between POCs and instrument teams are not allowed
- All questions and answers are captured in writing
- All answers are reviewed by the entire Instrument Support Team for process consistency and compliance
- Initial responses should be available within a few work days after a question is logged
  - Some questions could be out of scope and cannot be answered
  - Not all answers will be speedy, as some research or analysis may be needed



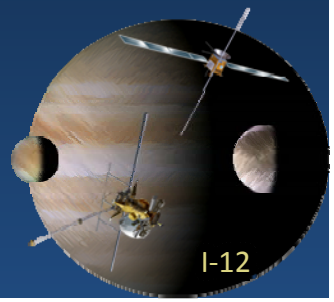
Potential Information to be Exchanged

- Proposer questions and Instrument Support Team answers concerning:
  - The mission and system, its flexibility, and interpretations of architectural intent
  - Radiation circuit design, shielding, tools, & models
  - Radiation testing of parts and materials
  - Planetary protection approaches, DHMR effects on parts and assemblies, re-contamination in I&T
  - S/C accommodation (data and power interfaces, thermal design, grounding, location and configuration, orientation)
- Questions that are free of proprietary material will be posted to a FAQ for all teams
- Note: General guidance, advice, and review of work will not be provided



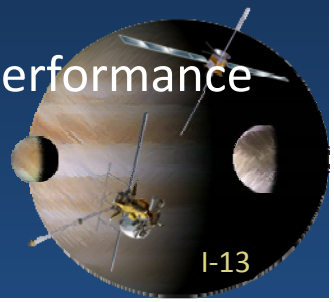
Reserved Beam-Time

- The project will reserve test facilities for instruments to use for testing critical parts, materials or sensors
  - Co60 facilities for tbd [2] months (TID)
    - Minor logistical support of testing
    - No ELDRS testing
    - TID
  - Proton/Electron facility for Displacement Damage testing
  - SEE Testing facility
  - Linear accelerator for sensor testing for tbd [2] months
    - More significant support of testing
- Instrument team develops test plans and procedures
- Project may facilitate the communication between the instrument team and the facility
- Instrument teams run their own tests
- Specifically for sensors and front end electronics (ROICs) or other specialized parts (RF circuits)
  - APML parts would be tested by the Project

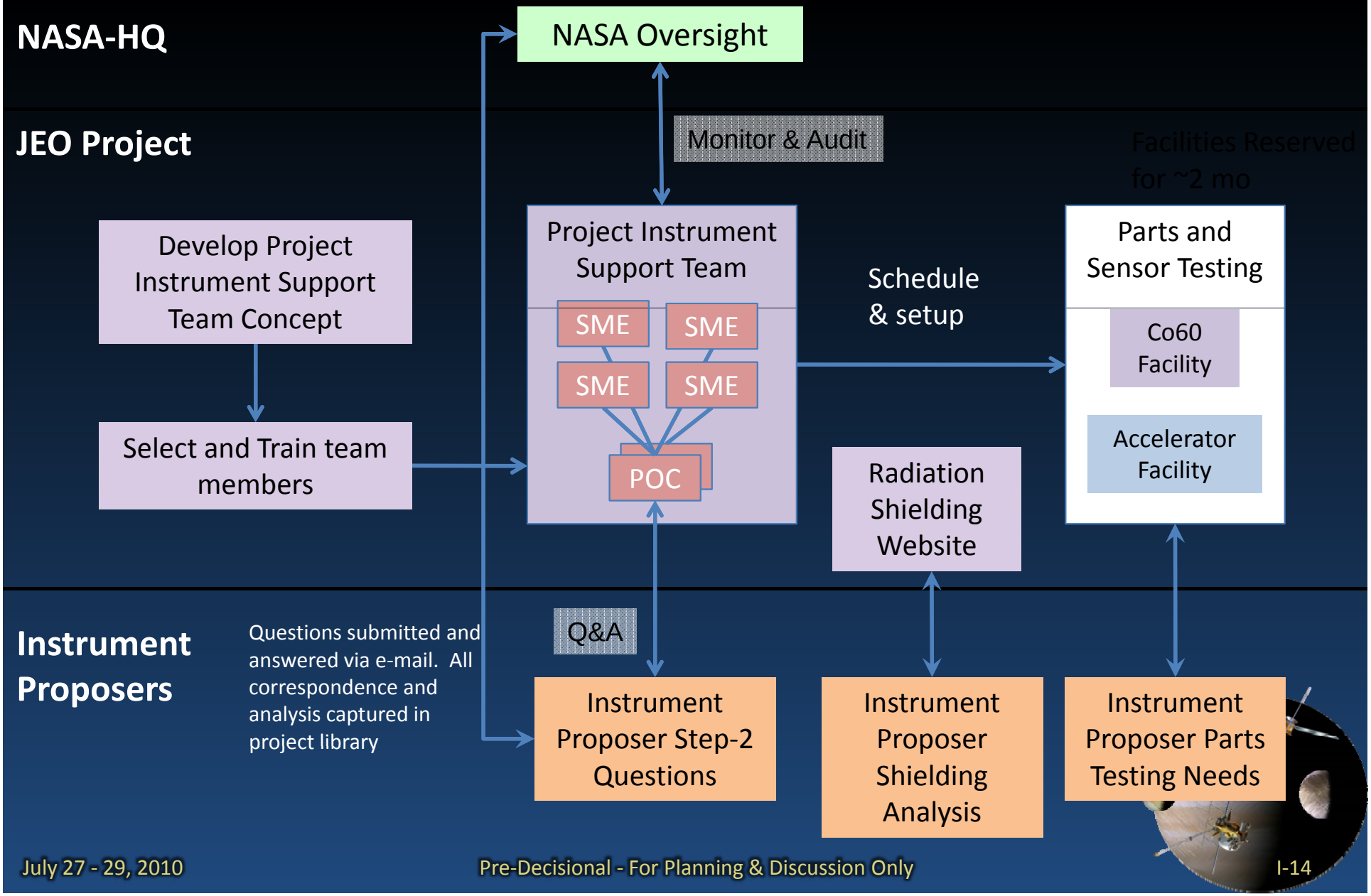


Web-site of Shielding Expertise

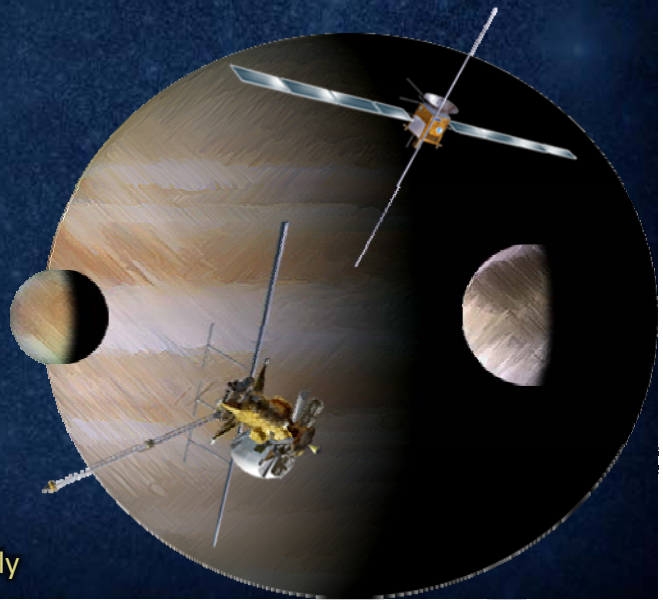
- Maintain website for dissemination of as is shielding information including:
  - Provide link to public tools and user guides, and potentially an example problem
    - For example; FASTRAD, Geant4, MCNPX
    - The website could also provide a simple ray tracing tool for those who do not have that capability
    - Provide benchmarking data
  - Provide environmental Inputs to shielding analysis:
    - Radiation Environment Data:
      - External flux spectra
      - Mission fluence spectra
    - 1D Radiation Data:
      - Mission dose-depth data for TID and DDD in Al, Ti, and WCu
      - Peak flux dose-depth curve for TID and DDD in Al, Ti, and WCu
  - Provide Equivalent Spacecraft Geometry (a.k.a., shielding mass model)
    - Description of baseline spacecraft that allows manual modeling (simple shapes, building block format)
      - material, thickness, shape, and location within the spacecraft coordinate system
    - A corresponding STEP file of the spacecraft model that allows users to download the model for their transport analysis
- Use of the website information is at discretion of instrument team and would not be required
- Instrument team responsible for all results including design and performance calculations to show it meets requirement specifications



Step-2 Interactions Flow Chart



Step-2 Technical Resource Management



Resource Allocation Approach For Instrument Selection Process

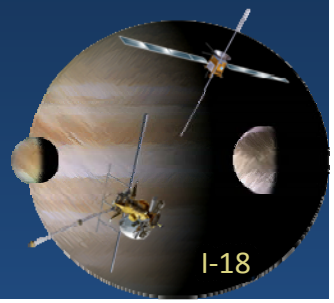
- No allocations are given or intended for individual instruments
- Aggregate resources for Mass, Power, Data volume, and mounting accommodation will be provided
- Instrument proposal teams will be asked to estimate resource usage (and appropriate reserves)
- After final selection, proposed resources and reserves will be controlled and changes will be negotiated
- Project intra-instrument resource trading board is expected to be used after project PDR

Aggregate Resource Allocations

- Resources for use by the aggregate payload were developed for the 2008 Study Report based on analysis by the SDT and the study team considering:
  - Science objectives
  - Model payload measurement characteristics and assumed operating modes
  - Observation and data return scenarios
  - System design opportunities and constraints
- The Proposal Information Package (PIP) will provide the resources available for the aggregate payload in the current mission concept
  - Discusses the sensitivity of the system to changes in the total
  - Provide guidelines and suggestions for use by the instrument proposers to minimize resource needs
- Significant trade studies are planned in phases A and B to address key issues (e.g., radiation dose, planetary protection, shielding mass, thermal, distribution, interface descriptions, and type of enclosures)
  - Prior to final selection, these trades will continue to use model payload information
  - After final selection, instrument teams will be fully involved with these trades

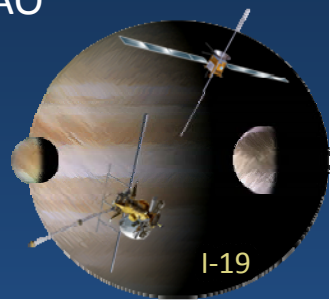
Resources Provided

- Mass
  - Aggregate mass for the total payload including reserves
  - Includes instrument components internal and external to the spacecraft, shielding, thermal control, and cabling
- Power
  - Average power for aggregate payload in driving scenario (e.g. 2 orbit scenario in Europa orbit) including reserves
  - Includes power for operating and non-operating modes, actuators, and thermal control, including electric makeup heat
- Data volume available for science data downlink
  - Daily average data volumes including reserves
  - Based on S/C telecom rates, downlink timing scenarios, and DSN tracking scenarios
- Accommodation Fields of View
  - Location opportunities, pointing assumptions
  - Provides a “cold side” for radiator placement



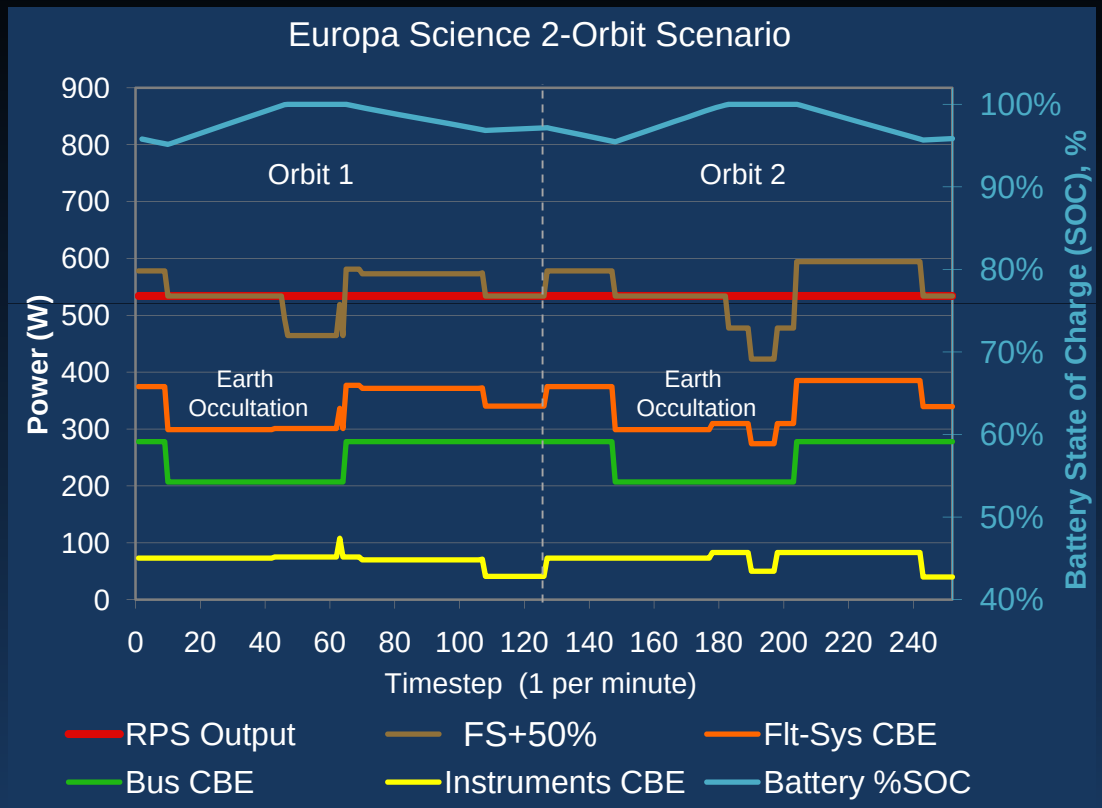
Mass Issues

- Assumptions from the current mission concept
  - For shielding mass efficiency, Instruments are divided into exposed and internally sheltered components
  - The exposed components mass would include shielding needed to protect the instrument and enable sufficient observation quality
  - The baseline S/C would provide enclosure(s) for internally sheltered instrument electronics
  - Components required to be radiation tolerant to 300 kRad
- Instrument mass estimates to include:
  - All instrument components
  - Packaging, mounting, and radiation shielding of exposed items, and spot shielding of electronics inside enclosures
  - Prorated mass fraction for S/C provided enclosures
    - Excludes end-plates, thermal management and mounting mass (allocated to S/C)
    - Algorithm for estimating electronic enclosures to be provided in the AO
  - Cabling
    - From S/C to enclosures and from enclosures to external components
    - Algorithm for cable estimating will be provided in the AO



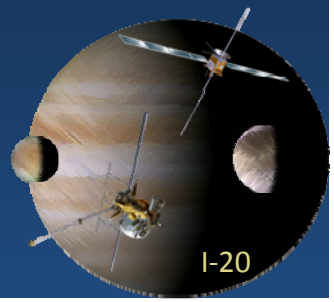
Power Issues

Driving power scenario is the Europa orbital science scenario



- Power is highly constrained
  - Limits instrument modes and downlink data rates
- Science observation scenario is data storage limited
  - Data is transferred real-time to the ground
- 2-orbit operations scenario permits power/data rate balance

Updates to science scenarios will always be limited by power and data storage



Power Issues

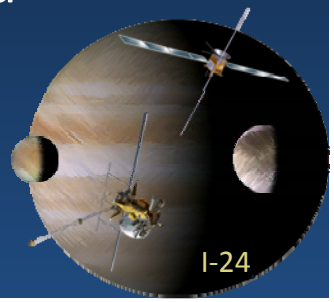
- The current mission concept assumes average values for the payload in the most driving operations scenarios
  - Scenario averages are for the aggregate payload
  - Scenarios include data volumes which drive telecom power modes
- Analysis of the model payload suggests that for many instrument types, non-operating power modes are the most significant drivers for the payload
- Suggestions to reduce power consumption include:
  - Use louvers, RHUs and variable RHUs to control non-operating temperatures
  - Include short duration transitional modes (e.g. warm-up) and low power standby or ready modes
  - Include additional operational modes if power consumption varies significantly
  - Reduction of data volume has beneficial effect on telecom power

Data Volume Issues

- Constraints
  - The mass memory is likely to be small (1 Gb) for Europa science
    - ~7 Gb would be returned each day from Europa orbit
    - Retransmission would not be practical
    - Data reduction through compression or other means must be done on the fly before storage (for low to moderate rates, could be done by non-instrument computers)
  - For Jovian Tour, a larger (16 Gb) non-Radhard mass memory could be possible
    - 2-4 Gb daily data return (fewer DSN passes)
    - Retransmission and limited on-board data processing could be practical
  - Data rates could vary daily by more than a factor of 2
- Suggestions
  - Observation modes with varying data rates will provide science and operational flexibility for more robust scenarios and mission data return
    - Data reduction techniques, Channel selections, and Variable extent
    - Diverse Tour phase opportunities may need this most

Accommodation Fields of View

- The current mission concept shows considerable area on the instrument mounting deck for instruments FOV and radiator accommodation
  - The shape and design may be determined after selection
  - A “cold side” of the spacecraft is envisioned for radiator placement
  - Remote sensing instruments for Europa would be co-boresighted on the nadir facing deck
  - In-situ instruments would be mounted on or near the nadir deck for best FOV and least interference from appendages and noise sources
- Instruments with deployed appendages should keep the nadir and ram directions relatively clear of obstructions for other’s FOVs

Summary

- NASA is developing a technical support process for Step-2 development in the Instrument AO
  - Balances many competing concerns
  - Reduces mission risks for the key areas of radiation and planetary protection
  - Respects and protects the independence, intellectual property, and competitiveness of the instrument proposers
- Resources given by the AO are based on the current mission concept and are for the aggregate payload
  - Instruments do not have a pre-allocated budget
  - Significant resource growth by the selected payload seriously compromises mission feasibility