

# **NASA PLANETARY DATA SYSTEM NAIF NODE (PDS) PERFORMANCE REVIEW**

## **PANEL EVALUATION OF PROPOSAL SUBMITTED IN RESPONSE TO NASA CALL NOV 11, 2015**

**Proposal Number:** 16-PDSPR16-0002

**Proposal Title:** Proposal of the “NAIF Node” in response to “Call for Proposals: Planetary Data System Performance Review 2016”

**Organization Name:** CALIFORNIA INSTITUTE OF TECHNOLOGY

**Principal Investigator:** Charles Acton

### **BRIEF SUMMARY OF RESEARCH OBJECTIVES:**

This proposal discusses the performance and future plans for the Planetary Data System (PDS) Navigation and Ancillary Information Facility (NAIF) Node, and the associated SPICE (Spacecraft, Planet, Instrument, Camera, Events) software that is a crucial component of this node. The Navigation and Ancillary Information Facility, located at the Caltech/Jet Propulsion Laboratory, intends to carry out two separate but related tasks:

- 1) Further development of NASA’s SPICE ancillary information system, providing observation geometry to NASA planetary science missions;
- 2) Operate the NAIF Node of NASA’s Planetary Data System, involving peer review, archival and distribution of SPICE data, providing training materials and classes in the use of SPICE, and providing expert consultation in support of SPICE users.

### **BRIEF SUMMARY OF OVERALL EVALUATION:**

NAIF provides a unique and extremely valuable service to the planetary science and broader space communities. The NAIF Node incorporates two intertwined services, both of which are viewed as critical and vitally important for NASA to maintain and develop in the future.

The SPICE system is an integral part of many current and most future NASA and international missions. The infrastructure of NAIF software, toolsets, tutorials and training has proven to be an invaluable asset to these projects, their engineers and scientists, and to the users of their data. NAIF’s recent accomplishments – such as the adoption of SPICE by ESA, continued record of producing quality, trusted software and the release of new tools like WebGeocalc – demonstrate clear evidence of success in response to the criteria for this Performance Review.

NAIF continues to efficiently deliver data products to the PDS, which are fundamental to providing the context with which to interpret all scientific data for past and current missions. To ensure the future availability and accessibility of their archives, they have registered their PDS3

holdings within the PDS4 system, delivered their archives to the NSSDCA, and developed a backup archive at Washington University.

Most of the success of NAIF has been due to the decades of experience, technical expertise and personal dedication of the core team. A minor weakness is the need to implement “succession” plans to bring on younger engineers to learn and carry forward the NAIF work for decades to come.

**Overall Score: 5 (computed) EXCELLENT**

<b>Excellent 5.0</b>	<b>E/VG 4.5</b>	<b>Very Good 4.0</b>	<b>Good 3.0</b>	<b>Fair 2.0</b>	<b>Poor 1.0</b>
<b>4</b>	<b>5</b>	<b>1</b>			

### **TECHNICAL MERIT (70%)**

#### **Science and Technical Merit Strengths:**

The NAIF team efficiently fills a highly important niche not only for NASA but also for all major space agencies worldwide. Their recent work on the SPICE system includes the introduction of meta-kernels, sub-setting of kernels to select regions of specific interest, the migration to PDS4, and the release of WebGeocalc and Cosmographia.

The SPICE system has become a “worldwide de facto standard”. The European Space Agency (ESA) is now officially using SPICE in mission-critical science planning software, thus validating the SPICE system and attesting to its importance in both domestic and international space missions. Maintaining and further developing this valuable asset has been a critical responsibility that the NAIF team places amongst its highest priorities.

The SPICE system and NAIF tools are increasingly being used by the U.S Department of Defense and other government agencies, widening the user base and the demands on NAIF to maintain these capabilities well into the future.

The NAIF software and tutorials have made extremely complex calculations both accessible and understandable to users. To claim their software tools are the “gold standard” is not an understatement.

The recent NAIF accomplishments outlined in the proposal are significant in both breadth and added capability in light of the size of the NAIF team.

Minor – NAIF has an internal plan for maintaining and extending the software and systems, based on input solicited from both domestic and international users and their expertise regarding future mission and analysis needs. Their past performance indicates that their near term goals are achievable.

**Science and Technical Merit Weaknesses:**

Minor – Most of the success of NAIF has been due to the decades of experience of the core team. This highlights the need to implement succession plans for the P.I., Charles Acton, and other key senior personnel to maintain the same level of service in the future. Such a plan was not defined in the proposal. This is a potential risk longer term though not a specific criteria of this review.

Minor – The strategy for prioritizing software updates and new versions was not well articulated in the proposal. The NAIF team is too small to satisfy all the software change requests of the user community while also supporting the NAIF Node, providing training and answering specific user questions.

**Science and Technical Merit Score: 4.75 mean / 5 median EXCELLENT**

<b>Excellent 5.0</b>	<b>E/VG 4.5</b>	<b>Very Good 4.0</b>	<b>Good 3.0</b>	<b>Fair 2.0</b>	<b>Poor 1.0</b>
<b>6</b>	<b>3</b>	<b>1</b>			

**Realistic/Reasonable Cost (30%)**

**Cost Strengths:**

The NAIF team is very efficient and is able to accomplish extraordinary work within its limited resources to date. The proposal identified an approximately even split of budget between SPICE development and NAIF Node operations.

**Cost Weaknesses:**

Minor – The proposal did not provide information on the role and duties of each current NAIF team member and how their responsibilities will be distributed in the future should funding cuts occur.

**Rating of Cost Reasonableness: 3.7 mean / 4 median VERY GOOD**

<b>Very Good 4.0</b>	<b>VG/G 3.5</b>	<b>Good 3.0</b>	<b>Fair 2.0</b>
<b>6</b>	<b>2</b>	<b>2</b>	

## **COMMENTS AND SUGGESTIONS FOR THE PROPOSER:**

### **Additional Comments to the Proposer:**

The adoption of the SPICE system by a growing number of non-Planetary Science programs within NASA, such as missions in Heliophysics, Astrophysics, Earth Sciences and Human Exploration, is a glowing testament to the value that NAIF provides. These non-traditional users are also potential alternative avenues for funding, which should be explored further.

The ability to better collect detailed metrics and user information for internal use would enhance task prioritization and help build the case for budget justifications in the future.

There is a growing ecosystem of experienced SPICE users who are training coworkers and creating local software tools built on the core SPICE libraries. In looking to prioritize future software development work, it may be advantageous to encourage user development for some of NAIF's many outstanding projects. This has proven to be successful in many open source efforts throughout the science community and elsewhere. For example, NAIF could focus on maintaining the core software libraries and allow the user community to develop any desired wrappers, such as Python. Though this would "break" the rigorous testing and control by NAIF of *all* SPICE related tools, it could allow the NAIF team to focus on protecting and evolving the core capabilities of SPICE while still developing new capabilities for broader use.

User training is an important service provided by NAIF that will continue to grow with the expanded adoption by SPICE by non-traditional users in increasingly global locations. This becomes a bandwidth challenge for a small group such as the NAIF team. NAIF should consider alternative approaches to delivering the most training value for the least amount of resources. This could include videotaping the April 2016 training session to post online for users to watch at their leisure, and shorter, more regular online webinars on just one topic at a time to enable training to more users without having to travel or commit a large block of time.

### **Additional Comments to NASA only:**

The versatility of SPICE and the exceptional user-focused services provided by NAIF are fundamental and essential core capabilities supporting NASA planetary science program that are important to continue supporting.

The SPICE system and NAIF tools are increasingly being used by the U.S Department of Defense and other government agencies, widening the user base and the demands on NAIF to maintain these capabilities at a high level well into the future. These entities should be involved in providing financial support.

NAIF utilizes a small, core team of four people to perform multiple tasks covering multiple areas of expertise. This four-person team has accomplished extraordinary work within its limited resources as described in their recent accomplishments in the proposal. Even In-Guide funding would continue a slow decline in NAIF staffing, precipitating an erosion in future services and needed SPICE capability enhancements.