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ASAC Report to the Board

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Charge 1: With the first three Proposal review cycles (Cycles 0, 1 and 2) now behind us, the ASAC should list and comment on lessons learned and make suggestions for improving the proposal submission and review processes for future cycles. In particular:

1) **ASAC should suggest ways to optimize the duplication checking and the technical assessment procedures in order to reduce the workload on both JAO staff and the APRC/ARP members.**

2) **Since the terms of many of the current ARP and APRC members have now ended with the Cycle 2 PRP, ASAC should make an assessment of the scientific expertise and diversity of the membership needed for future cycles. They should suggest names for potential panel members, including those who may have theoretical/numerical backgrounds, as well as those from other observational wavelengths.**

3) **Assuming that the request for ALMA time will remain at or increase from the 1300+ proposals per cycle, it is important to ensure a realistic and manageable workload on panel members. ASAC should debate and comment on the scientific pros and cons of different means of managing this workload, such as increasing the fraction of proposals that are triaged out before the panel meeting, enlarging the numbers of panels and/or panel members to discuss a larger fraction of the proposals, enlisting non-traveling assessors, or suggesting other alternative scenarios.**

4) **Comment on the current JAO policy for change requests during the Phase 2 submission process.**

Executive Summary

- The formation of the JAO PRP working group is an excellent initiative. It needs to be coordinated with the ASAC.
- We wholeheartedly support the JAO plans to run technical and science assessments in parallel, structure the consensus reports and increase time available to write them, improve the match between assessors and proposals, and increasing panel size for cycle 3, as well as the ideas presented for addressing even higher proposal loads.
- The large dispersion in triage scores needs to be understood.

- The delays for implementing a duplication-checking tool continue to be a disappointment. There is urgent need for a PI duplication check tool for cycle 3.
- The recent examples of mismatch between PI intent and observatory execution should be addressed.
- We strongly recommend that the documents, guidelines, and statistics concerning change requests be made public, and that maximizing science return and archival value be made an explicit consideration.

ASAC was informed about the formation of an ALMA working group to review strengths and weaknesses of the current proposal reviewing process (PRP). JAO director Pierre Cox established such group to specifically review the organization of the ARPs/APRC meetings, the timeline of the proposal review process, and the policies and procedures in place. The members of the working group, Andrew Baker, Jacqueline Bergeron, Neal Evans, Andres Jordan, Satoki Marushita, and Roberto Neri, plus the ex-officio members Pierre Cox (chair), Gautier Mathys and Lars-Ake Nyman, held a telecon on Sep 16, 2014 to initiate discussion about the PRP. The working group was very appreciative and supportive of JAO's initiative to improve the PRP along three axes: the quality of the consensus reports, the handling of the science goals duplication checks, and the workload management of the PRP. ASAC expressed support for JAO's efforts to streamline the organization and improve the quality of the cycle 3 proposal reviewing process with the help of the working group, although coordination is necessary to reduce the risk of unnecessarily duplicating efforts.

Gautier Mathys presented to the ASAC a summary of the lessons learned, open issues, and JAO ideas to improve the PRP. The problems identified include too long a time between triage and ARP meetings, too little time to write consensus reports, poor handling of duplications, and poor quality of the feedback to the PI. As a result of lessons learned from previous ALMA cycles and in response to discussions and feedback received from various parties, JAO presented ASAC a list of corrective PRP actions for cycle 3: the time between triage and ARP meetings reduced to 2 weeks by running technical and science assessments in parallel, improve and homogenize the quality of the consensus reports by structuring them and increasing the turnaround time for science and technical assessors, improving the ARP and APRC duplication tools and the discrimination of duplications, and adjust the match between areas of competencies of science assessors and fields of research of proposals to which assessors are assigned. **ASAC endorses these plans.**

ASAC was pleased to see that JAO examined a number of possibilities for managing the load of the panels, such as adjusting the triage thresholds, increasing the number of science assessors, and instituting traveling and non-traveling assessors for the ALMA proposal reviewing panels. While these suggestions need to be explored further and evaluated jointly with the PRP working group, **ASAC supports JAO's view that increasing the number of science assessors plus (if necessary) raising the triage threshold would be the preferred method** to address an

increase in the number of proposals in a future cycle. Specifically, **we support the plan to recruit one additional assessor for each panel to prepare for cycle 3**. ASAC also supports JAO's preference for "traveling assessors" (assessors who attend the PRP meetings) rather than "write-in assessors" (who would provide only written reviews), but remarks that physical presence is not absolutely necessary and telecommuting could be an option open to assessors (as is usually open for NSF panelists, for example). The committee also supports the view that the thresholds by which proposals are triaged should be set according to the oversubscription of observing time for each cycle. **ASAC shares the JAO concern about the large dispersions observed in the scores of cycle 2 triaged proposals**, and urges JAO to explore the reasons for that.

ASAC is pleased to see that efforts are planned to improve the duplication checking of science goals, but is very disappointed about the fact that no automatic duplication check will be likely implemented in the Observing Tool before ALMA cycle 4. **Surprisingly, the plans for implementing duplication checking by PIs in Cycle 3 are still not fleshed out.** The committee was made aware of difficulties but continues to remark that JAO must explore and consider all possible options and actions that can be taken in the near-term to develop and implement a simple proposal duplication-checking tool already for cycle 3.

The committee is also concerned about the fact that science data are sometimes not complying with the user intent. As an example, the ALMA observatory has completed projects with up to a factor of 5 higher spatial resolution than requested by the user. It seems that the culprit is a selection in the OT characterizing the source as a "point source", which the observatory interpreted as meaning that observations can be obtained in more extended arrays than originally specified. It is very clear that proposers are not aware of the precise consequences of clicking on that button, and the observatory needs to make them abundantly clear before taking actions such as observing a source in an array very different from the resolution originally requested. Contacting the PI is always an option.

ASAC received the report about the change request process and statistics by Lars Nyman. Currently, the Change Request Standing Committee (4 JAO members + 1 ARC manager) makes a recommendation for each change request to the Director, based on an internal document and internal guidelines. According to these, change requests that incorporate new relevant information, are optimizations, or are intended to repair honest mistakes are generally granted, unless they result in duplications, an increase in observing time, produce extra work for the staff, or are due to "sloppy" proposal preparation (as in, PI ignored information available a the time of proposal writing). Based on this information, **the ASAC strongly recommends** that: 1) **the process for change requests be made transparent to the community**, including the relevant documents and guidelines, 2) **"maximizing the scientific return of ALMA and the archival value of the data" be made an explicit consideration**, and 3) that the CRSC **compile and make public their own statistics** for approval/denial of change requests, which will help to decrease the

work load of the committee by clarifying for the community the limits of what is an acceptable request. We also recommend that feedback from the CRSC to the PI be constructive and explanatory.

Charge 2: Pursuant to standing Charge 2, continue to assess the status of Cycle 1 and Cycle 2 observations. Are the data meeting user expectations? Are the data products released of satisfactory quality? Are the data being released to the PIs in a timely fashion, and are adequate progress updates being communicated to the PIs and the community at large? ASAC should comment on and suggest ways to improve data release policies, in particular policies for special cases, where release of partial data sets (not yet passed QA2) might be desirable for maximum scientific benefit.

Executive Summary

- The low observing efficiency is a concern that needs immediate attention. ALMA should strive to reach a high completion rate for Cycle 2.
- We strongly recommend that partial OUSs are delivered to PIs upon request when no new data are expected for 3 months or more due to change of configurations or other circumstances.
- We have some concerns about the long-term maintainability of the archive in the current model of data delivery.
- The scientific productivity measured in number of publications, time to publication, publication rate, citations, and high-impact publications is excellent.
- We need to make the Project Tracker more user-friendly.

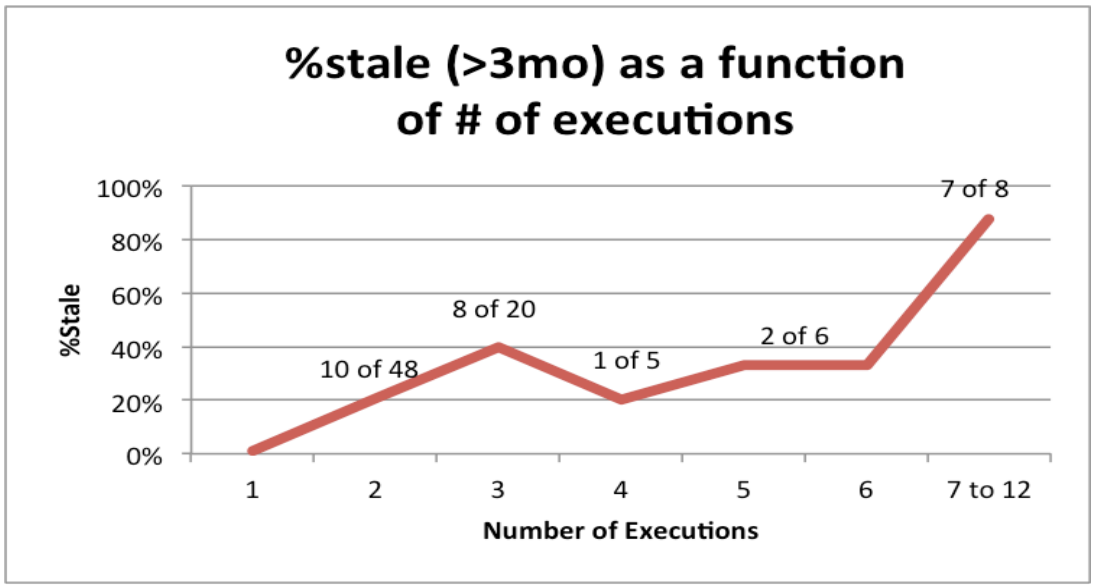
The ASAC received the JAO report by Lars Nyman. The progress in the completion fraction for Cycle 1 projects is reasonable, with 112 projects completed so far out of 196, compared to 14 in the report at the last ASAC f2f in February. Unfortunately, some of the projects still incomplete require the more extended arrays that will not be available again for several months. This is a particular example of the "stale data" phenomenon, with recommendations that will be discussed below. Note that more hours of Cycle 1 observations had to be transferred into Cycle 2 than were originally anticipated. This was due to the delay in completing pads for the more extended configurations.

The situation for Cycle 2, however, is worrisome and merits immediate attention. We are 9 observing sessions into the cycle (>1,100 hours). The fraction of completed Cycle 2 projects is low (8/397), but more importantly the average execution efficiency is only 36%. The main reason for the low efficiency appears to be software instability at least in part due to system design. The time required to complete the A+B projects is 1,670 hours at 50% efficiency, while the science observing time remaining till the end of cycle 2 is ~1,500 hours. A 50% efficiency is yet to be obtained; the peak execution efficiency during the 9 observing blocks done

for Cycle 2 so far was 45%. **So it already appears extremely likely that even in an optimistic scenario ALMA will not complete all the high-priority (A+B) Cycle 2 projects.** Note that this is a simple calculation that does not include considerations about scheduling inefficiencies due to cycling through configurations, or the scarcity of high-frequency observing time now that we will be entering in the austral summer.

The ASAC strongly recommends that improving the science execution efficiency of the array receive high priority. The observatory should not accept this low an efficiency and proceed with "business as usual". We risk having a very low completion rate at the end of Cycle 2, and although this is still early science and there is no expectation of 100% completion, **ALMA should strive to reach a high completion rate among the high priority projects**. There is still time to execute a corrective action (increasing efficiency and/or science time to attain a high completion rate) and avert this problem. That time will rapidly disappear as the scheduled end of the cycle comes closer.

The median delay between completion of a science goal and delivery of data to PIs in Cycle 2 is approximately 40 days, of which ~15 are spent in the QA2 phase. This is down from 85 days for Cycle 0. Hopefully the widespread use of the pipeline will reduce the time to PI even further. The outstanding problem is that the distribution of the "time to PI" has a very long tail when more than one execution of an observing block is required to complete the science goal. Between 20% and 40% of all the projects that require more than one execution become "stale" (wait in the queue for 3 months or more since the last execution). That percentage rises to 90% for projects that require 7 or more executions of an observing block to be complete and pass onto QA2.



The time lag between the first and last observation of an OUS (a science goal deliverable to the PI) was greater than 3 months for 35% of the NA cycle 1 OUSs, as an example. This delay while the project waits for more data to proceed into QA2 is a consequence of the model adopted, where all the data has to be acquired before the project undergoes QA2 processing and is delivered to the PI (or is returned to the observing queue). This problem will only get worse in the future, when we anticipate a larger fraction of the projects will require more than one execution to complete. This is an undesirable situation from the standpoint of the science productivity of the instrument. We also recognize, however, that repeating the full QA2 assessment on partial datasets is burdensome for the project, in part because the pipeline and archive are designed to run and store full datasets rather than individual executions (a decision that perhaps that merits revisiting).

In view of this, **we very strongly recommend that a PI should be allowed to request delivery of partial data**, without waiving the remainder of his/her observations, **if it will not be possible to obtain additional data for at least 3 months** owing to the array configuration schedule or other circumstances. These data will be pipeline processed (including basic imaging) and sent to the PI with reasonable checking by the ALMA staff. The 1-year proprietary period for that fraction of the data will begin when they are delivered to the PI. The PI should be made aware of the partial data release possibility.

The format of the data delivery to the PIs was discussed by the ASAC. Currently, PIs are delivered raw data, scripts to calibrate the data and produce reference images, and calibration tables. We are concerned about the long-term viability of this model, particularly for observations that cannot be processed by the pipeline, and of the resulting archive. The pipeline is in principle designed to be backwards compatible, but with new versions of CASA every six months, other scripts will rapidly become obsolete and incompatible. Maintaining the long-term compatibility of the scripts and the pipeline, or coming up with a mechanism to guarantee that old scripts can still be run, appears as an important goal for a viable archive. **ALMA needs to develop and implement a policy to ensure all ALMA archival data taken from Cycle 1 onwards can be readily processed by users.**

Surveys show ALMA users are very happy with the data quality received so far. The scientific productivity of ALMA has been high. The Project Scientists report presented by Al Wootten indicates an even distribution of science productivity among executives. The publication rate is not uniform across categories and it has a wide distribution (out of 151 publications so far: ISM+SF 52%, Galaxies 18%, High-z 26%, Disks+Planets 5%). Approximately 7% are Science/Nature publications. The impact in terms of citations is led by cosmology as well as star and planet formation. The delay between data acquisition and publication is of 10 to 20 months, which is satisfactorily short and comparable to other instruments (e.g., HST). One way to motivate PIs further is to require a report on the previous use of ALMA projects during proposal submission, probably within the OT framework.

The same user survey reveals that the lowest level of user satisfaction occurs for the Project Tracker and its usability. **The ASAC has recommended in the past a simplification and clarification of the PI interface, and would like to see that implemented.** In the limited experience of the members of the ASAC as users there was some concern expressed about whether the automatic emails contacting the PI when changes of state occur to OUS in the project were working.

Charge 3: JAO will provide ASAC with input regarding capabilities and observing modes planned for Cycle 3. ASAC should review and comment on these modes well in advance of the next Call for Proposals. Are the modes on offer those sufficient to address the highest impact science themes? Are there other capabilities that should be given higher scientific priority?

Executive Summary

- The EOC for Cycle 3 is progressing nicely. We endorse the plan for offering non-standard observing modes.
- We recommend that the highest EOC priority be given to developments that will improve the observing efficiency.
- We enthusiastically endorse the idea of stand-alone ACA/TP proposals.

The ASAC received an extensive report by Tony Remijan on the EOC progress. **The EOC team has made commendable progress** in testing and demonstrating new capabilities for Cycle 3 and beyond. The long baseline commissioning effort has made excellent progress and is ahead of schedule: the combination of planning and concerted effort has paid off nicely, and the demonstrated long baseline capabilities are already impressive. **The ASAC is pleased to hear that there are plans to allow some observations to be made in "non-standard" modes**; this provides a mechanism for bringing new capabilities online without waiting for their full implementation in the pipeline.

Stuartt Corder presented a list of capabilities that will be introduced in Cycle 4 or later, and discussed some of the tradeoffs involved in prioritizing them. Since the EOC group will shrink with time, there is an incentive to test new capabilities as soon as possible; on the other hand, some of the new modes have a high likelihood of destabilizing the system, hence could negatively impact ongoing Cycle 2 observations. **In general, the ASAC agrees with the prioritization proposed by the JAO.**

Because Cycle 2 observations are lagging and because the efficiency of ALMA continues to be low, **we recommend that highest priority be given to developments that will improve the observing efficiency**. Foremost among these are subarrays, which will allow antennas to be brought back into action after they are moved or serviced without interrupting activities in the main array. Reusing a single flux or passband calibration for several execution blocks in a

"session" also will improve efficiency, particularly for polarization observations. Other straightforward enhancements that would improve efficiency include "multiple intents" (e.g., using the same calibrator for both flux and passband calibration) and dynamic adjustments to timing (tweaking the observing time within an execution block to match the sensitivity requirement). Improvements to focus or pointing algorithms that would allow daytime observing of higher frequency bands (up to band 7) also would be valuable. Enhancements that will enable ALMA to meet its original specifications should also be given high priority. For example, 2 x Nyquist sampling is needed to achieve the spectral resolution promised in the baseline correlator plan.

High-risk changes with more limited science application should be postponed if possible. In particular, multi-resolution correlator modes, while valuable in the long term, were thought by Stuartt to have a high risk of destablizing the system, and will require a great deal of test time to verify correct operation.

The JAO presented the idea of stand-alone ACA/TP proposals, which met with the enthusiastic endorsement of the ASAC. **The ASAC urges that future observing cycles (ideally, beginning with Cycle 3) allow stand-alone ACA/TP proposals**. Currently the ACA does not appear to be fully utilized, and it will do excellent science by itself.

The ALMA phasing project appears to be on schedule and final tests may be completed in a few months. If the worldwide mm-VLBI community comes forward with an observing proposal that would make use of the APP, the Board may wish to reconsider the restrictions that it has placed on tests of the APP (no observations of SgrA*) and authorize use of a limited amount of Director's Discretionary Time to demonstrate this new capability.

Charge 4: ALMA Development Plan Standing Charge 4: The regional project scientists and the JAO will provide timely input to ASAC such as summaries, status updates, and other information about the completed and ongoing Development studies and projects. ASAC should assess the scientific merit of these studies (e.g. discuss the uniqueness for ALMA, the advantages and drawbacks of each capability, etc.), and comment on the scientific priority of the approved development studies. ASAC should continue their work on the ALMA2030 document and report progress to the Board and to JAO.

Executive Summary

- The ALMA2030 process is well along: the Pathways document is almost finalized, and the Facilities and Science Themes documents are well under way and to be finalized by end of November
- We aim to finish this in time to provide input for the call for studies that will take place in NA in early 2015

Session 7 of the ASAC face-to-face meeting discussed the development program and the ALMA2030 report. Project scientists from each executive provided summaries of the progress of their development programs. The main discussion was on the three reports (Facilities, Science Themes, and Pathways for ALMA Development), and the timeline for the near future. The status of the first two documents was reviewed. It was noted that the science themes document needed to have more ASAC members reviewing and commenting to ensure completeness. Input from the East Asian executive on high level, long-term astrophysics science goals was also sought for completeness. The Pathways for ALMA Development document describes collections of possible development possibilities, but is not prioritized. The science priorities need to be defined, based on the Science Themes and Facilities.

During the discussion, it was noted that Japan could propose for a large amount of funding in the next several years for future astrophysics development, which would potentially enable a large ALMA development project. The timescales for development in each of the three executives runs differently, with annual workshops in the East Asia executive, triennial calls for studies in the European executive (with no new projects until 2018), and the North American executive anticipating a call for proposals in January for development studies, and call for projects in mid-2017 (the fourth quarter of fiscal year 2016).

While there was discussion on some specific development topics, there was no consensus (this was not the purpose of the discussion). A transient response capability was discussed as a potentially transformative capability, which would require improved calibration for better study of time variability. The unique science niche of a thermal VLBI enabled by longer baselines was also discussed. Multi-beam receivers to increase the field of view were also discussed explicitly, and the disruptive nature of putting these on all antennas was noted.

The near term timeline for wrapping up this exercise, given the timelines for development in the different executives, is early 2015, so that the documents can be used in shaping development priorities. We identified Nov. 24 as the finishing date for the individual documents. The Pathways for ALMA Development document is considered almost completely final, while the other two need some additions.

The persons responsible for ensuring completion of these documents are J. Martin-Pintado for the Facilities Document and R. Osten for the Science Themes Document. The ASAC telecon scheduled for Dec. 3rd will be devoted to a discussion of ALMA's contribution to science themes and development prioritization. **We anticipate the three documents will be published as ALMA memos** after they are considered finished. In order to include as large a cross-section of the community as possible in the planning and prioritization process, the topic of ALMA Development will be folded into a panel discussion planned at the upcoming Tokyo ALMA meeting on Dec. 9 and chaired by P. Cox. NRAO is holding a workshop at the upcoming American

Astronomical Society meeting, on January 4, and discussion of ALMA Development will be included in this workshop. The documents will be made available before these meetings.

Charge 5: After 3 proposal cycles, discussion should start about the best time to allow proposals for Large Programs in the ALMA Call for Proposals. ASAC is invited to debate and report on:

1) **The optimum cycle to introduce Large Programs**

2) **The minimum and maximum time request and for Large Programs; in particular, should the threshold for a Large Program be lowered from the current level of 100 hours. If so, what would the ASAC recommend for this threshold? Or, would it be better to allow an adjustable threshold, set by the JAO, as a function of Cycle number?**

3) **The total duration of a Large Program: should Large Programs be run over multiple cycles or be restricted to only one cycle? Should there be a separate category for monitoring programs, or should those also be included with Large Programs?**

4) **Proprietary periods for Large Programs**

Executive Summary

- We recommend revising the current definition of Large Programs contained in the Board documents.
- Full metadata for LPs should be public immediately after their approval.
- Partial early look data should be made available to the team for observation and data product tuning.
- Start to offer Large Programs in Cycle 4, unless the execution efficiency of the instrument remains low.

The ASAC, prompted by the Board Science Committee, initiated a series of discussions in June to address this charge. During this process it became abundantly clear that a major source of confusion and barrier was the specifics of the definition of ALMA Large Programs (LPs). As a consequence, and starting with questions asked by the regional SACs as well as this charges we started working on sharpening the definition of LPs. A starting proposal was put together by the Chair and the regional Project Scientists and discussed in great detail at the face-to-face meeting together with the JAO representation (Director, Deputy Director, and Head of Operations) and the Regional Scientists. The resulting document, containing the details of the definition agreed as well as the rationale for its different points accompanies this report.

The ASAC recommends that the current definition of LPs be revised as follows.
ALMA LPs are projects that enable a wide range of timely science and:

1) require over 50 hours (a threshold to be revisited[1] as ALMA evolves),
2) are reviewed together with the normal proposals but only accepted if they receive "A" ranking, and after undergoing a step of reconciliation and down-selection between panels at the level of the ALMA Proposals Review Committee (APRC),
3) where time is split among participating regions in proportion to the number of designated "co-PIs"[2] ,
4) for which the proposals have: a) one additional science justification page, b) an additional separate section with the details of the science exploitation plan and the team resource and management plan, and c) an additional optional separate section describing "value-added" public data products that the team promises to make available to the community (including the methods for their generation), which is to be particularly considered when ranking the proposal,
5) for which the proprietary period is the same as in normal proposals, and
6) which are allowed to use only "mature" ALMA capabilities defined by the JAO.

Furthermore, we recommend that the total fraction of time devoted to LPs in a given cycle be capped at 15% (to be revisited as ALMA evolves[3]).

We recommend that the metadata for approved LPs be immediately published, including abstract, proposal team (including identifying co-PIs), target list, the precise definition of the observations, and the promised data products. **We also strongly recommend that the PI/co-PIs receive "early release" partial data** to provide them with an early look, which will allow them to tune the observations appropriately, and to commence early work on the data products.

The broad agreement reached during the discussions is that ALMA should start offering LPs in Cycle 4. It was noted that the opinion of the JAO is that this is a important component of ALMA, and offering it sooner rather than later will better allow the project to work out the details. A major concern expressed by several members of the ASAC is related to the low execution efficiency of the instrument, and how that would impact LPs (as well as normal proposals). Thus if, in the preparation for Cycle 4, the execution efficiency continues to be low, we may wish to revise our recommendation. We discussed the motivation for multi-cycle LPs, but at this point we failed to identify a strong rationale for offering them, and we prefer to wait to have a better-defined need.

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[1] By the JAO Director in consultation with the ASAC.
[2] Co-PIs are a subset of co-Is designated as such in the proposal cover page.
[3] By the JAO Director in consultation with the ASAC.