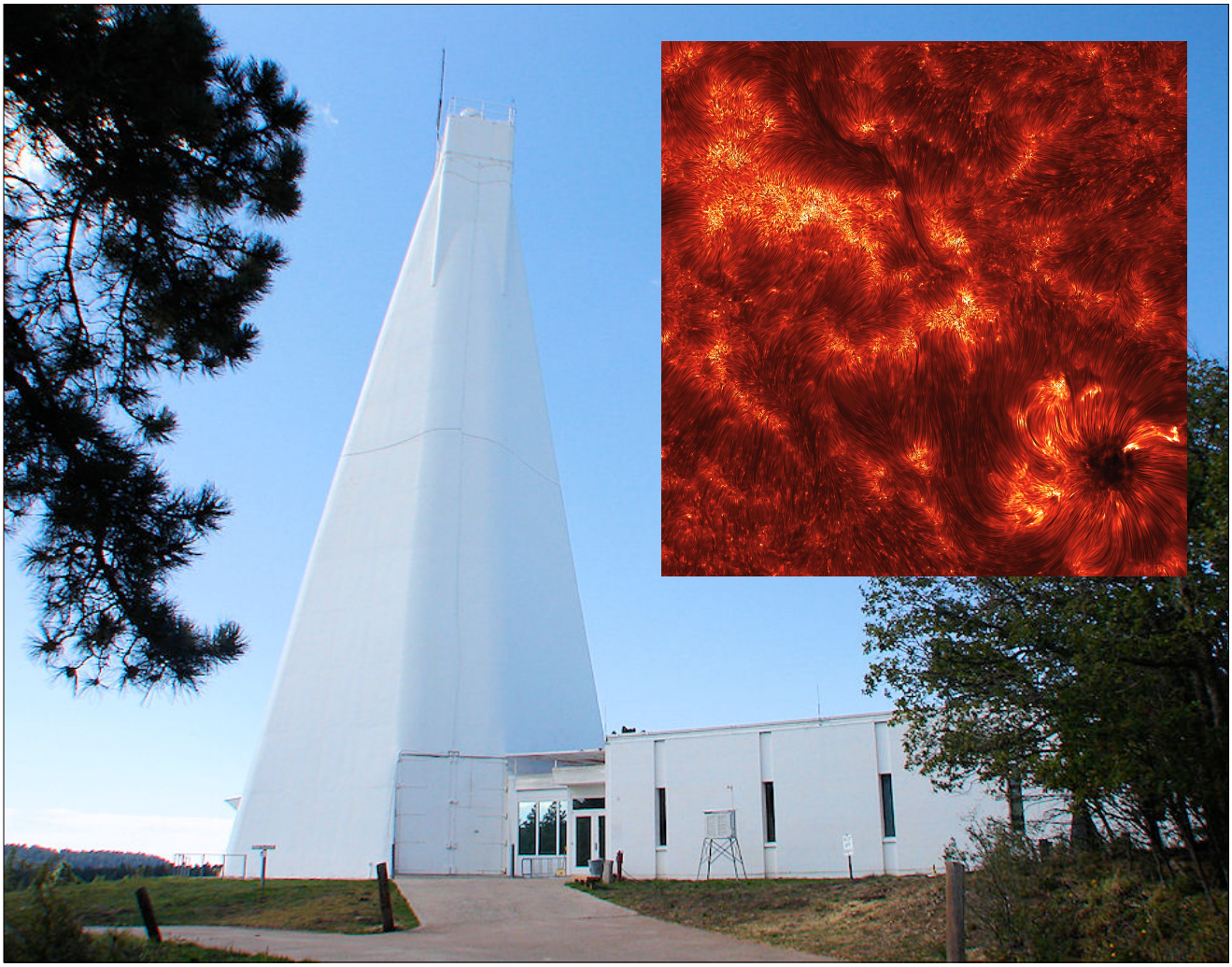

A transition plan to operations of the Dunn Solar Telescope by the Sunspot Solar Observing Consortium

Prepared upon request for The National Science Foundation

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EXECUTIVE SUMMARY

The New Mexico State University have been awarded a $1.2M, 2-year, proposal to complete several tasks necessary to provide for a transition of the Dunn Solar Telescope and Sunspot site to a Sunspot Solar Observatory Consortium (SSOC). The award of proposal NSF AST 1649052 entitled "*The transition of operations of the NSF's Dunn Solar Telescope from the National Solar Observatory to the Sunspot Solar Observatory Consortium,*" was contingent upon the completion of a detailed transition plan within 60 days of the start of the award. This document serves as that detailed transition plan and contains a detailed description of each task, a breakdown of the anticipated transition costs, a breakdown of costs and implementation of proposed upgrades and updates, a description of the roles and responsibilities of NMSU, NSO, and the SSOC, and a long range plan for consortium development. It also presents some important changes with respect to the original proposal.

Intellectual Merit

In order to be ready to operate the DST, the SSOC should consists of multiple partners interested in the science, student training, instrumentation, and public outreach potential of the telescope and the Sunspot site. To achieve this, the SSOC requires a working, simplified telescope and site that can operate at minimum costs and low risk, for maximum benefit to the entire solar community. The route to this operations model entails a 2 year transition consisting of 5 tasks.

- Provide for telescope observations, using the full suite of instrumentation.
- Maintain and upgrade IT equipment at the telescope, and site.
- Maintain and upgrade the telescope control system.
- Simplify, and provide a back-up for, the telescope adaptive optics.
- Maintain and simplify site operations.

Broader Impact

This transition plan facilitates the potential formation of the SSOC, and thereby provides an increased user-base for the new DKI solar telescope in USA, and an enhanced understanding of our Sun. The development of these scientific advances in ground-based solar physics will enhance our understanding of the Sun as our nearest star, and will deliver essential space-weather data in a synoptic manner. It provides an ideal location for next generation instrumentation. It provides for the retention of the DST as an operational telescope and location for student training, while postponing the necessity of immediate decommissioning of the site. It increases the viability of the successful visitors center at Sunspot.

1.0 THE SUNSPOT SOLAR OBSERVATORY CONSORTIUM

As part of the restructuring connected to the Daniel K. Inouye Solar Telescope (DKI), the National Solar Observatory (NSO) will leave the Sunspot site in October 2017. However NSF, NSO, and the larger solar physics community in USA see extended scientific, educational, instrumentation and public outreach advantages in maintaining, simplifying, and upgrading, certain aspects of the telescope and the site of Sunspot. As such, the New Mexico State University (NMSU) are leading a national effort to form and lead a Sunspot Solar Observatory Consortium (SSOC) to maintain the operations of the Dunn Solar Telescope (DST) and Sunspot site for a minimum 5 year span beyond Oct 2017.

The success of a transition to these SSOC operations depends critically on the completion of several tasks. These tasks were laid out in some detail in the unsolicited proposal NSF AST 1649052 entitled "*The transition of operations of the NSF's Dunn Solar Telescope from the National Solar Observatory to the Sunspot Solar Observatory Consortium,*" awarded by the NSF to NMSU. With a start date of Oct 1, 2016, this 2-year proposal overlaps the final year of NSO operations and first year of the SSOC operations. As part of the resulting award of this proposal to NMSU, NSF requested a detailed transition plan within 60 days of the start of the award. This document serves as that detailed transition plan. In addition to a description of each task, this transition plan includes a breakdown of the anticipated transition costs, a breakdown of costs and implementation of proposed upgrades and updates, the roles and responsibilities of NMSU, NSO, and the SSOC, and a long range plan for consortium development. This document also presents some important changes with respect to the original proposal.

Simplification of the DST operations

In order to be ready to operate the DST, the SSOC must be able to attract partners interested in the science, educational, instrumentation and public outreach potential of the telescope and the Sunspot site. This requires a working, simplified, telescope that can operate at minimum costs for maximum benefit to the entire solar community. Recently the site has been operated by NSO on 14.25 FTE annually. The current operations includes a 5-day week of observations, with observers, telescope engineers and science support staff. The long term vision of the SSOC is to move to a streamlined and simplified operations model encompassing an annual 8.5 FTE of personnel, moving to a 7-day week, only requiring one observer at any time, and building a large synoptic observing component. By operating on these reduced personnel requirements and efficient cost of operations, and reducing long term risk, we increase the likelihood of obtaining a successful consortium to operate the site.

Personnel	NSO FTE (current)	Funded Proposal FTE		SSOC FTE	
	Fy17		Fy18		Fy19+
Science Staff / Admin	4	-	-	0.50	0.5
Observers	2	0.75	1	1	2
Telescope Software Engineer (IT)	1	0.75	1		1
Telescope Control Engineer (TCS)	2	0.75	1	-	1
Telescope Instrument Engineer (A0)	-	0.66	1	-	1
Facilities (Site Engineer)	4.50	0.58	0.50	1.50	2
Visitors Center	1	-	-	1	1
Total	**14.25**	**3.5**	**4.5**	**4.0**	**8.50**

Table 1: Summary of FTE for current and proposed operations model of the Dunn Solar Telescope and Sunspot site. The SSOC operations, starting October 2018, will consist of 8.5 total FTE. The partial FTE for the 5 positions as funded in Fy17 originate from the start dates for each position (See Section 2). All positions are funded for all Fy18 and Fy19+. The changes in this table, as compared to Table 1 of the proposal are explained in Sections 2 and 3 below. The proposal will still fund for a total of 8 FTE over the 2 year duration. In Fy18, the SSOC provide funds for 4 FTES to bring the operations up to a full long term allocation of 8.5 FTE. The details on SSOC funding are described in Section 5 below.

The minimum transition to eventual SSOC operations at this low annual level of 8.5 FTE requires the completion of five main tasks during the transition period funded by proposal 1649052 . First, one observer will be trained and documentation of the telescope observations will be completed. Second, one telescope software engineer will be trained, documentation of telescope IT and site IT maintenance will be completed, and an IT upgrade plan will be designed, reviewed, and implemented. Third, a telescope control engineer will be trained, the telescope control system maintenance will be documented, and an upgrade plan will be designed, reviewed, and implemented. Fourth, a telescope instrument engineer will be trained, and a new telescope adaptive optic systems will be designed, reviewed, and implemented. Fifth, one site engineer will be trained, documentation of the site and facilities will be completed, and site simplifications will be designed, reviewed, and implemented. All 5 tasks will occur via close interaction of new personnel with current NSO and Astrophysics Research Consortium (ARC) personnel resident in Sunspot, NMSU personnel in Las Cruces, and current personnel from other SSOC members.

2.0 DETAILED BREAKDOWN OF ANTICIPATED TRANSITION COSTS

The anticipated transition costs are provided in Table 2 below. These estimates are based on detailed discussions with NSO and ARC about appropriate payscales, and non payroll costs, at Sunspot.

	Fy17 (Dollars in Thousands)			Fy18 (Dollars in Thousands)		
Personnel	**FTES**	**Payroll**	**Non-Payroll**	**FTES**	**Payroll**	**Non-Payroll**
Director / Admin	-		3	0.50	68	3
Observers	0.75	63	3	2	174	3
Telescope Software Engineer (IT)	0.75	89	12	1	122	12
Telescope Control Engineer (TCS)	0.75	101	20	1	139	20
Telescope Instrument Engineer (A0)	0.66	78	20	1	121	20
Facilities (Site Engineer)	0.58	44		2	156	300
Visitors Center	-			1	60	
Total	**3.5**	**375**	**58**	**8.5**	**840**	**358**
NSF Proposal		**434**	**58**		**442 (+59)**	**258**
Required SSOC contribution					**339**	**100**
Difference		**59**	**0**		**0**	**0**

Table 2: Summary of anticipated costs for the FY17-18 transition period. The total FTEs are the same as in Table 1. All payroll costs include both benefits (35%) and associated indirect costs (25%). Non-payroll costs include travel, equipment purchase, utilities, and associated indirect costs (25%). The proposal budget awarded by NSF to NMSU is for $492 in FY17 and $700 in Fy18. Some funds from Fy17 are carried into Fy18.

In Fy17, non payroll costs provided for by proposal 1649052 include $50,000 for equipment upgrades and $8000 for travel. All payroll costs in Fy17 are entirely provided for by the award of proposal 1649052. In the proposal we originally requested for 4 FTES in Fy17. However delays in the proposal budget award, and delays in hiring of personnel, have forced us to alter our Fy17 plan. In this altered scenario a total of 3.5FTEs are allocated to Fy17.

The changes in this new breakdown for Fy17 costs, as compared to the original proposal are

- we will delay the hires for an observer, a telescope software engineer a telescope control engineer, to Jan 1st, 2017, hence each of these three hires will only require 9 months (0.75FTE) in Fy17 instead of 1.0 FTE as originally proposed.
- we will move up the hire for a telescope instrument engineer (AO) to Feb, 2017, hence this hire will require 8 months (0.66FTE) in Fy17, instead of 0.5FTE as originally proposed.
- we will move up the hire for a site engineer to March, 2017, hence this hire will require 7 months (0.58FTE) in Fy17, instead of 0.5FTE as originally proposed.

In total this altered scenario adds up to 3.5FTE, compared to original proposal for 4.0FTEs, at an underspend of $59,000 in Fy17. We ask for this underspend to be carried forward to Fy18.

In Fy18 the proposal covers non payroll costs of $50,000 for equipment upgrades, $8000 for travel, and $200,000 for utilities. The non-payroll portion of the budget covered by the proposal include 2/3 of all utilities costs. The SSOC will provide the remainder of the non-payroll costs. The payroll costs in Fy18 are partially covered by the proposal. In the proposal we requested for 4 FTEs in Fy18. The altered scenario presented in Table 2 allocates 4.5 FTEs to the proposal in Fy18. The full FTEs for the observer, a telescope software engineer and a telescope control engineer are the same as in the proposal. The 0.5 FTE for the site engineer is the same as in the proposal. Hence the only change in this new breakdown for Fy18 is

- we will extend the hire for the telescope instrument engineer (AO) to one full FTE in Fy18, instead of 0.5FTE as originally proposed.

In total these changes add up to 4.5FTE, compared to original proposal for 4.0FTES.
In FY18, the SSOC should provide for an additional 4FTES and all additional utilities costs.

Over the two years of the transition, the total FTEs and total cost to NSF, remains the same as in the original proposal.

Each year, the proposal budget allows for $8000 of travel, budgeted as $3000 for the director for consortium development and travel to Sunspot and Boulder, $3000 for observer training travel, and $2000 for software engineer training travel. The remaining non-payroll costs are for equipment purchase and utilities costs. These are detailed in each of the tasks described in Section 3 below.

3.0 IMPLEMENTATION OF TRANSITION TASKS

The transition to a simplified and streamlined operations model requires the completion of five tasks related to telescope observations, telescope maintenance and upgrades, and site maintenance. Each task requires knowledge transfer via completion of documentation, knowledge transfer from current NSO staff to new SSOC personnel over a two year transition, and the generation, review, and implementation of plans for updates and upgrades to simplify the telescope and site.

Task 1: Train one telescope observer and document telescope observations.

There is currently one fully-trained NSO observer (Doug Gilliam) at Sunspot with 3 new DKIST observers undergoing training. Most of the observations carried out 5 days per week at the DST are PI-driven, with two observers. The need for two observers on most occasions (one on the telescope, one on the bridge) is driven by the fact that DST has a large suite of instrumentation, and PI-driven optical set ups have multiple, complex, configurations. However as we plan to simplify the observing set-up, and implement a synoptic program for 50% of the observing time we reduce our long term requirement to only one observer at the telescope on most occasions. Hence the transition period only requires for the training of one new observer, ready to assume full control of the telescope in October 2018.

The advertisement for this new hire was opened on November 1, 2016. Applications closed on Dec 1, 2016. It is anticipated that this observer will start their post on Jan 1, 2017, allowing for a 9 month period of overlap with NSO observers. Although Doug Gilliam may work some of this time in Maui, it is expected he will spend the majority of 2017 and even some of 2018 in Sunspot. The new observer will be initially responsible for competing a written telescope operations document, deliverable after 6 months. The new observer will work closely with the SSOC scientists to provide feedback on proposed synoptic observing plans for the consortium. The new observer will work closely with the telescope engineers and NSO personnel to design telescope upgrades and updates in Fy17, and then implement approved telescope upgrades and updates in Year Fy18.

We note that a second observer to assist consortium partners with PI-led observations is budgeted to be funded by SSOC partners by October 2017, separate from the proposal. Our new observer will also assist in training this second observer in Fy18.

Task 2: Train one telescope software engineer, document telescope and site IT, and design and implement upgrades and updates to telescope and site IT.

The DST contains over 50 computers, of different ages, hardware, operating systems, and software versions. The Sunspot site runs its own servers and intranet, and provides a series of internet wireless routers on site. The maintenance of this site IT is currently covered by one IT personnel in Sunspot. By consolidating and updating these systems, and through transfer of all IT to NMSU, risk of unsolvable IT failure is greatly reduced. At minimum, the SSOC will require one telescope software engineer ready to assume full control of all IT at the telescope and the site in October 2018.

The advertisement for the new telescope software engineer hire was opened on November 1, 2016. Applications closed on Dec 1, 2016. It is anticipated that this hire will start their post on Jan 1, 2017. The current NSO person in charge of the servers and wireless at Sunspot, Jon Doherty, will move to Boulder, CO in Jan 2017. However he will temporarily return to Sunspot for a 1-2 week spell to provide for knowledge transfer of site IT to this new hire. The current NSO person in charge of the telescope IT, Craig Gullixson, will remain in Sunspot until at least Oct 2017 (and possibly beyond this), and will work closely with this new telescope software engineer to provide knowledge transfer.

This new telescope software engineer will be initially responsible for completing a written site IT and telescope IT document, deliverable after 3 months. This will be followed by a telescope and site IT inventory and risk management assessment, deliverable after 6 months. This inventory and risk management assessment will be delivered to the SSOC in parallel with the equivalent documents in Tasks 3, 4, and 5. Upon approval of these documents by the SSOC, the telescope software engineer will design risk-reduction software upgrades and updates, in close collaboration with the other telescope engineers, observers, and NSO personnel. An IT upgrade and update document will be provided to the SSOC by the end of Fy17. These IT upgrade and update plans will be passed through a critical design review by personnel from NMSU, ARC, and NSO before approved upgrades and updates are then implemented by the telescope software engineer in Fy18. Each 6 months thereafter the telescope software engineer will be required to provide an updated combined inventory, risk assessment, and future upgrades plan to the SSOC.

We estimate new equipment and software costs at ~$20,000 over the 2 years transition. This estimate is based on 3 new computers for the DST ($12000), 3 new long range wireless routers for the site ($2000), server upgrades ($3000), and software ($3000). Any additional costs will be evaluated by the SSOC and provided for by the SSOC if deemed essential.

Task 3: Train one telescope control engineer, document maintenance of telescope TCS and design and implement upgrades to telescope TCS.

The complexity of the current telescope control system (TCS) is one of the main reasons that necessitates a requirement for 2 observers at the DST at most times - one on the telescope light table with the adaptive optics system, and one on the bridge. Further, the TCS contains significant risk in its older server motors, mercury float bearings, and control software. Regular inspection and maintenance is key to the longevity of the TCS. Fully documenting maintenance and risk, and implementing upgrades greatly reduces the risk associated with the TCS. As such, the telescope will be less expensive to operate, and much less liable to catastrophic failure. At minimum, the SSOC will require one telescope control engineer ready to assume full control and maintenance of the TCS in Oct 2018.

The advertisement for the new telescope control engineer hire was opened on November 1, 2016. Applications closed on Dec 1, 2016. It is anticipated that this hire will start their post on Jan 1, 2017. The current NSO personnel (Craig Gullixson) with most knowledge of the TCS will remain in Sunspot until at least Oct 2017 (and possibly beyond this). Observer Doug Gilliam is a second source of vital knowledge transfer for this task.

This hire has been advertised and funded as a senior telescope engineer post, as it has been recognized that this person will act as the lead in the difficult task of designing the TCS maintenance and any TCS upgrades, and play a significant role in both Task 2 and Task 4. This new telescope control engineer will be initially responsible for completing a written telescope TCS operations and maintenance document, deliverable after 3 months. This will be followed by a telescope control system inventory and risk management assessment, deliverable after 6 months. This includes the key, high risk, maintenance of the mercury float bearing. This second inventory and risk management assessment will be delivered to the SSOC in parallel with the equivalent documents in Tasks 2, 4, and 5. Upon approval, the telescope control engineer will use this inventory and risk management document in order to design any risk reduction updates to the TCS, in close collaboration with the other telescope engineers, observers, and NSO personnel. A proposed TCS upgrade and update document will be provided to the SSOC by the end of Fy17. These TCS upgrade and update plans will be passed through a critical design review by personnel from NMSU, ARC, and NSO before approved upgrades and updates are then implemented by the telescope control engineer in Fy18. Each 6 months thereafter the telescope control engineer will be required to provide an updated combined inventory, risk assessment, and future upgrades plan to the SSOC.

We estimate new equipment and software costs for this task at $40,000 over the 2 years transition. This includes $20,000 for upgrades / new server motors, $10,000 in maintenance of the mercury bearing, and $10,000 for other combined costs (including wiring and software). Additional costs will be evaluated by the SSOC and provided for by the SSOC if deemed essential.

Task 4: Train one telescope instrument engineer (AO), document telescope AO and design and implement new DST AO system.

The current Adaptive Optics (AO) system at the DST is of a unique design, based on parts that were previously on a back-up port. The expertise that built this system is not guaranteed to be available to the SSOC, and many of these AO parts are no longer available to purchase. As such the AO remains a high-risk point of catastrophic failure. In order to mitigate this high risk, we had originally planned for the current AO to be replaced with modern, simple, off-the-shelf components. In addition, we originally envisioned that an identical back up system should be built and placed on a 2nd port. Furthermore it was proposed that this task could then be completed within 1 year.

However, in extensive discussions with personnel at NSO, it is now clear that the cost of this original plan is both too expensive and unjustifiable. New deformable mirrors (DMs) alone could cost upwards of $100,000. As such NSO personnel Rich Radick and Doug Gilliam completed a comprehensive optics inventory, upon which it became clear that a preferred option will be to design and implement a new AO based on parts already available at the DST. This change to our plan has made the AO hire into a position that we should begin as soon as possible and retain on SSOC staff for the duration of the project (a total of 1.66FTE over 2 years of the proposal see Table 1).

The advertisement for the new telescope instrument engineer (AO) hire will be opened by January 1, 2017. It is anticipated that this observer will start their post in Feb, 2017. The current NSO personnel with most knowledge of the AO is Dr Rich Radick, emeritus in resident at Sunspot. Dr Radick has already initiated the inventory and risk assessment of this task, and will work on the design of the new AO system in partnership with this new hire. A conceptual design will be presented to AO expertise in NSO-Boulder for review by April 2017. This design will most likely consist of building a dual wave front sensor AO system on a currently unoccupied port, using the existing DMs and DM electronics, but replacing the specialized, custom-built, data-processing system with a modern, off-the-shelf computer running either a modified version of KAOS (currently under license from Kiepenheurer-Institut für Sonnenphysik to NSO) or a similar system.

Upon approval of the design, implementation of the new AO will begin by May 2017. As this will be built on an unoccupied port, this can and will occur in parallel with current NSO operations. The new AO will then become the standard telescope AO in October 2017 and the current existing AO will be moved to a back-up port to then play the dual role of a reserve system and an instrument development portal. Each 6 months thereafter the telescope instrument engineer will be required to provide an updated combined inventory, risk assessment, and future upgrades plan to the SSOC.

We estimate new equipment and software costs for this task at $40,000 over the 2 years transition. This includes $15,000 for a wavefront sensor high-speed camera and frame-grabber, 3 high speed computer-based processors ($10,000), software ($5000), and $10,000 for other combined costs (including some optics).

Additional costs will be evaluated by the SSOC and provided for by the SSOC if deemed essential. However as AO is our first priority, we retain the flexibility to spend more of the proposal equipment funds on this task if required, even at the expense of only partial completion of Tasks 2 and 3. If the current AO fails, the DST loses its unique capabilities required for a world-class observing site. Our partners at NSO and California State University Northridge also wish to work with us on other AO development projects for students. This priority for Task 4 is reflected in the urgency to move to a longer hire, to both start and complete this task earlier than Task 2 and 3, and to retain this hire into operations beyond Fy18.

Task 5: Train one site engineer, document site maintenance, and design and implement site simplifications.

The Sunspot site currently provides for housing (11 redwood houses, 23 relocatable houses, 8 apartments), a visitor's center, a small dining facility, a main lab, community buildings, water, sewage, electricity and an extensive vehicle pool. The maintenance of all these facilities are covered by 4.5 FTE in Sunspot. We had originally envisaged requiring at minimum 1 site engineer, only beginning in Fy18. However, it close discussion with personnel at NSO, it is now clear that this person will play a significant role in providing a full inventory of Sunspot, estimating the condition and potential maintenance costs of the site, assisting with transfer of site facilities from NSF to the SSOC, and designing and implementing any site reductions. As such, we request to hire the site engineer as soon as possible and retain them on SSOC staff for the duration of the project (a total of 1.58 FTE over 2 years, see Table 1).

The advertisement for the new site engineer hire will be opened by January 1, 2017. It is anticipated that this observer will start their post on March 1, 2017. The current NSO personnel with most knowledge of the site (Rex Hunter) will reman in Sunspot until October 2017. Initially the new hire will be responsible for completing a written site operations and inventory document, deliverable within 2 months. Based on this document, and in close collaboration with both NSO and ARC, the site engineer will propose a site transfer and simplification plan (including additional proposed budget) to the SSOC by July 2017. Upon approval of these documents by the SSOC, a site transfer and simplification plan and budget will be presented to NSF by the end of Fy17. Although the formation of SSOC operations postpones the immediate necessity of decommissioning the site, ultimately the site remains under the ownership of the NSF and the costs of decommissioning will return to NSF a some stage. The design and implementation of a site transfer and simplification plan allows for any such decommissioning to be carried out piece-meal and selectively over the next few years.

A second site engineer will be hired by SSOC funds, depending on the agreed outcome of the site transfer and simplification plan. At this stage we envisage that if we can retain, and charge appropriate rent, for the redwood houses and apartments, this site income will pay for the second site engineer.

The utilities costs in Fy18 of the proposal (note NSO are still on site and paying utilities in Fy17) are based off the actual 5 years costs as supplied by NSO. Between Fy11 and Fy15, the NSO operated a main lab and substantial housing on-site. In Fy16, closing extra facilities and moving to a shorter observer week led to substantial cost savings at Sunspot. The Fy18 estimate is based on taking the Fy16 6-month figures as provided by NSO, multiplying by 2 to make this a 12 month price, and

multiplying by annual 2% inflation to Fy18. Further we assume we operate on 85% of the electricity and gas due to our reduced staffing on site. The total estimated Fy18 utilities cost (including indirect costs) is about $300,000. In the requested budget for the proposal we estimated that carrying out the proposed tasks will occupy about 2/3 of the time in Yr2, thereby arriving at our estimated utilities costs for this proposal of $200,000. The SSOC is responsible for the remaining 1/3 utilities ($100,000).

4.0 ROLES AND RESPONSIBILITIES

The transition to a simplified and streamlined SSOC operations model is only possible by a close collaboration between NMSU, the SSOC, and the NSO. Indeed we note that without the interests, expertise, and assistance from NSO and ARC (a key SSOC partner), the operations of Sunspot and DST is absolutely not possible. As such, NMSU, the NSO, and ARC have developed a close working relationship over the past 3 years and have worked as a trio to promote the viability of SSOC operations. Below we delineate individual roles and responsibilities during this transition period.

Roles and responsibilities of NMSU.

The New Mexico State University is the sole recipient of the transition grant award 1649052. As such all new hires will be employed by NMSU, including appropriate pay and benefits. NMSU will administer all funds and provide financial and legal reporting to NSF. The New Mexico State University will be the operating entity of the operations budget for the SSOC in Fy18 and beyond.

Key Personnel:
As PI of the proposal, Dr. McAteer (NMSU) will act as director of this project, assuming all responsibility for scientific and financial management. He will continue to act as the single point-of-contact with NSF regarding scientific reporting. He will assume the responsibilities of ensuring that key outcomes are delivered in a timely fashion. Dr. McAteer will host meetings in New Mexico, and lead the efforts to build the SSOC. NMSU will provide for Dr McAteer to dedicate his time as Science Director of this project,

As Co-PI of this proposal, Dr. Holtzman (NMSU) will play a key role in communications with both the NMSU administration and ARC. He will assist on legal formation of the SSOC. He will act at the lead NMSU person on the AO design.

As Co-PI of this proposal, Dr. Jackiewicz will guide science outcomes of the synoptic program, ensuring community involvement and data availability. He will act as the connection between the SSOC and the Hale Collage online graduate program.

All three key NMSU personnel will act on all interview panels and in gathering data for the NSF mid term review of the proposal.

Roles and responsibilities of NSO.

As a key collaborator on this project, NSO-Sunspot will assist with training for the new hires and in the design of the updates and upgrades for the site and telescope.

Key Personnel:
NSO Director Valentin Pillet is coordinating the close collaboration with Dr McAteer at NMSU. He will continue to visit Sunspot as part of his regular duties and will meet with Dr McAteer on each occasion. Dr Pillet and Dr McAteer have already developed a close working partnership, including hosting a SHINE session, hosting a DKI Science Working Group at NMSU, submitting a separate joint proposal to NSF, and coordinating Dr McAteer's sabbatical on spectropolarimetry. As chair of the NSO Users Committee and NMSU Member Rep for AURA, Dr McAteer is fully aware of the NSO commitments and limitations in regards to Sunspot.

Doug Gilliam is the main NSO-Sunspot observer. He will remain in Sunspot for most of Fy17 and Fy18. He will act as the main source of knowledge transfer for the new observer in Task 1. He will provide input on a synoptic program observing set up, and assist with the telescope control system (Task 3) and AO project (Task 4).

Craig Gullixson is the main NSO-Sunspot control systems engineer and telescope IT engineer in Sunspot. He will remain in Sunspot for all of Fy17. He will act as the main source of knowledge transfer for the telescope control engineer (Task 3) and for the telescope IT component for the telescope software engineer (Task 2). He will assist with the design of the new AO system (Task 4).

Jon Doherty is the main NSO IT site engineer in Sunspot. Although he will move to Boulder in January 2016 he will return to Sunspot for short trips as required to provide knowledge transfer for the site IT component for the telescope software engineer (Task 2). He will be available by phone for any immediate site IT problems that may occur.

Rich Radick is NSO emeritus in Sunspot. He will remain in Sunspot. He will be the main source of knowledge transfer for the telescope instrument engineer (Task 4). He will assist with training the observer and completing the inventory for Tasks 2 and 3.

Rex Hunter provides all oversight for NSO-Sunspot site issues. He will remain in Sunspot for all of Fy17. He will be the main source of knowledge transfer for the site engineer (Task 5). He will assist with completing the site transfer and provide input to the site transfer and simplification plan.

NSO is considering supplying a remote worker to Sunspot until October 2018 and beyond. The details of this remote worker are not yet confirmed and are dependent on NSF approval, but may result in a reduced cost for the SSOC operations. Personnel from NSO-Boulder and NSO-Sunspot will together provide critical design reviews for Tasks 2, 3 and 4. In return for this partnership, the SSOC and NSO will develop a MOU stating the future availability of the DST and Sunspot site to NSO.

Roles and responsibilities of the SSOC.

As collaborators on this project, all SSOC partners will provide scientific input towards the design of the synoptic program, and run their own PI-led projects at the telescope, in Fy18. Each partner will join in bi-weekly telecons and meetings as we form the legal and financial aspects of the SSOC, assist with training for the new hires, and in all design reviews of the updates and upgrades for the telescope.

As a local collaborator on this project, the ARC will assist with training for the new hires and in the design reviews of the updates and upgrades for the telescope. ARC will provide key input into the site transfer and simplification plan. ARC have committed to provide time for APO Director Klaene to contribute local administration and supervision for this project and will work closely with the rest of the SSOC on an expansion of the Visitor's Center.

5.0 LONG RANGE PLAN

Development of SSOC Governance

A complete and thorough investigation into the legal structure, operating agreement with partners, and liabilities of the SSOC will be performed by NMSU in Fy17. This is a vital step in ensuring the long term stability of the SSOC. A SSOC Governance document will be delivered to the NSF as part of the mid term review of proposal 1649052.

At this stage we envisage that an SSOC Board of Governors, formed by Oct 2017, will consist of voting members from each partner institute. The voting weight of each partner will be in proportion to their contribution to the consortium. The Board will be assigned with the initial task to form founding documents. The long term vision of the SSOC is to reinvent and reinvigorate the DST and Sunspot by focusing on the four aspects of science, education, instrumentation and public outreach. The founding documents will focus on these 4 components. Each component will be led by 1 consortium partner. These documents, and any changes made to them thereafter, will be brought for an approval vote before an annual Board of Governors meeting in Sunspot.

Long term prospects of the SSOC:

The long term financial prospects of the SSOC is provided in Table 3. After the transition years of Fy17 and Fy18, the vision of the SSOC is to operate the DST with 8.5FTE at an annual estimate of ~$1.2M.

	(Dollars in Thousands)				
Partner	**FY18**	**FY19**	**FY20**	**FY21**	**FY22**
NMSU - Internal	**88**	**130**			
NMSU - State of New Mexico	63	250	250	250	250
CU - Boulder	**50**	**50**	50	50	50
California State University Northridge	**50**	**50**	**50**	50	50
ARC	**25** + 75	100	100	100	100
Other	50	50	50	50	50
Site Income	70	71	73	74	76
Carry over	59	32	146	144	156
Total SSOC Contribution	530	733	719	719	732
NSF Contribution	**700**	611	623	636	648
Total Contribution	1,230	1,344	1,342	1,354	1,381
(Payroll + NonPayroll)	1,198	1,222	1,246	1,271	1,297
Balance	32	146	144	156	183

Table 3: Current and potential financial commitments to the SSOC. Current commitments are in **bold.** Potential commitments are in normal font. The NSF contribution in FY18 is the year 2 of the funded proposal and depends on year 1 success and the mid term review. In Fy18, the required SSOC contribution to fund all payroll and non-payroll costs identified in Table 2 is $439,000. In outlying years, we recognize NSF funding will depend on a separate operations proposal to NSF and is estimated at 50% of operations costs.

We have obtained financial commitments from 4 institutes to date.

NMSU have committed $218,000 over 2 years. In the longer term, NMSU is continuing to approach the state of New Mexico for our contribution. We note that NMSU efforts to lead this project hinge on these state funds in the long term.

CU Boulder have committed to $50,000 annually for at least 2 years, with an emphasis on hosting student workshops, and the study of solar flares.

CSUN have committed to $50,000 annually for at least 3 years, with an emphasis on observing opportunities for their Master students and research into quiet Sun dynamics and spectropolarimetry of active regions.

The University of Hawaii and High Altitude Observatory are interested in both leaving and developing their DST instruments at no cost to the project. We have additional international instrument commitment from UK and Italy.

In November 2016, ARC committed to $25,000 to the final quarter of 2017. The ARC board of governors commit to their own budget on a calendar year basis, so the remaining $75,000 of their annual $100,000 contribution cannot be committed until November 2017. ARC emphasis is focused on site and facility access, and an enhancement of the visitor's center. However, ARC also contains the University of Washington and Georgia State University and we continue to pursue their interest in developing their observing program at the DST.

We are in discussions with 2 other groups in USA (including Southwest Research Institute).
We have potential financial interest from the Chinese Academy of Sciences, however we have nor included this in Table 3 as we must evaluate this Chinese investment further with NSF before we adopt an agreement with them.

Site income is derived from housing, apartments, and the visitors center, based off the actual income as supplied by NSO.

We have estimated a continuing NSF contribution of 50% of total operating costs each year.

Descope options

For the first two years (and possible beyond) NSO may retain an off-site hire at Sunspot, thereby reducing the overall costs to the SSOC. However, there remains a distinct possibility that we would need to consider reducing costs.We propose 3 descope options.
Descope A: Remove non self-sufficient financial components.

There are two financially self-sufficient components to our long range plan. These are the visitor's center FTE, which can be funded from income from an expanded visitor's center and the second site engineer FTE, which can be funded from income from the rental of houses and accommodation. If either, or both, of these are a drain on the finances, they can be gradually reduced to part-time positions and / or eliminated. However we note that these components are important to our SSOC partners (in particular ARC) and so this is not our preferred option.

Descope B: Reduce 1 telescope engineer.

The long term plan as presented includes 3 telescope engineers, to accommodate risk management of the aging components of the telescope. Assuming there are no major problems with the telescope, we could drop this by reducing to part-time, or removing, one telescope engineer. However we note that this option comes with enhanced risk of telescope down time, should any part malfunction.

Descope C; Reduced operations.

The summer months of June - August correspond to monsoon season in the Sacramento Peak mountains. During this time the Apache Point Observatory runs somewhat reduced operations. We could adopt a similar procedure. We note that although the DST cannot simply be shut down for three months, there are substantial savings in utilities by running shorter observing windows during these months, or by running in pure synoptic mode. This is currently the preferred option of descope.

6.0 SUMMARY

In this document we have presented the detailed transition plan for proposal NSF AST 1649052 entitled "*The transition of operations of the NSF's Dunn Solar Telescope from the National Solar Observatory to the Sunspot Solar Observatory Consortium.*" In summary

- As a result of some changes to the implementation of this transition, the anticipated costs differ from the original proposal by -$59,000 in Fy17 and +$59,000 in Fy18. We request that NSF permit this carry over of some funds. One the 2 years of the proposal, the new implementation still delivers on 8FTE spread across 5 tasks.
- 3 key documents are deliverable to the SSOC by March 2017: a written telescope and site IT document, a written telescope TCS operations and maintenance document; a written site operations and inventory document.
- An AO conceptual design will be completed by April 2017 and reviewed at NSO-Boulder.
- A written telescope operations document is deliverable to the SSOC by June 2017.
- 3 key risk assessment documents are deliverable to the SSOC by June 2017: a telescope and site IT inventory and risk management assessment; a telescope control system inventory and risk management assessment; a site transfer and simplification plan. Each document will be reviewed at NSO-Sunspot, by a team from NSO, ARC and NMSU.
- A new AO system will be in place by Oct 2017.
- A legal consortium will be in place by Oct 2017.
- All documents will be submitted to NSF as they are completed, and in bulk at the proposal mid term review at the end of Fy17.
- After review, all upgrades and updates to the telescope IT, TCS, and site will begin in Fy18.
- In Fy18, the SSOC will design founding documents, focusing on the 4 aspects of research, education, instrumentation and public outreach. The consortium will design and implement the synoptic program in parallel with their own PI-led observations.

This transition plan provides for sufficient time for knowledge transfer to new hires, in parallel with creating inventory and risk management plans. Upon review of these plans, the new hires will then perform the upgrade and updates to provide the required simplification and risk reduction. With the completion of all 5 tasks by Oct 2018, the SSOC will be ready to assume management of the DST and Sunspot site.