

2006-710: A MODEL FOR PREPARING THE NSF CAREER PROPOSAL

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A Model for Preparing the NSF Career Proposal

Introduction

A CAREER award from the National Science Foundation can help to advance the careers of Assistant Professors in Engineering.¹ The CAREER program is the descendent of several earlier NSF programs to enable junior faculty to perform quality research and education. These programs began in 1983 with the Presidential Young Investigators (PYI) award, which was replaced by the NSF New Young Investigators (NYI) award in 1992. In 1992, NSF instituted the Presidential Faculty Fellows (PFF) award as a more selective program that awarded young faculty up to \$100,000 per year for five years with no matching-fund option.

Among the results of a 1992 report on the Presidential Young Investigator program, was the finding that awardees believed that educational activities were not valued by their institutions. Partly in response to this concern, the Faculty Early Career Development (CAREER) program was approved by NSF's National Science Board in 1994, and the first awards were made in fiscal year (FY) 1995. While the focus of earlier programs was primarily on research, the focus of the CAREER program is on integrating teaching and research in accordance with NSF's core strategies of; developing intellectual capital, integrating research and education, and promoting partnerships. In 1996 the Presidential Faculty Fellows award was replaced by the Presidential Early Career Awards for Scientists and Engineers (PECASE) program. Beginning in FY 1997, applicants to the CAREER program could also apply for consideration for a PECASE.

To be eligible for a CAREER grant applicants must meet the following criteria: "By the Directorate's July deadline for submission of CAREER proposals, they must hold a doctoral degree in a field of science or engineering supported by NSF, be untenured, and have not previously received an NSF PECASE or CAREER award. Additionally, by October 1st following the July deadline for submission of CAREER proposals, they must be employed in a tenure-track position (or tenure-track-equivalent position) as an assistant professor (or equivalent title) at an institution in the U.S., its territories, or possessions, or the Commonwealth of Puerto Rico, that awards degrees in a field supported by NSF; or be employed in a tenure-track position (or tenure-track-equivalent position) as an assistant professor (or equivalent title) at an organization in the U.S., its territories, or possessions, or the Commonwealth of Puerto Rico, that is a non-profit, non-degree-granting organization such as a museum, observatory, or research lab. Proposers may submit only one CAREER proposal per annual competition, and may not participate in more than three CAREER competitions. Proposals that are not reviewed (i.e., are withdrawn or are returned without review) do not count toward the three-competition limit. For a position to be considered a tenure-track-equivalent position, it must meet all of the following requirements: (1) the employing department or organization does not offer tenure; (2) the employee is engaged in research in an area of science or engineering supported by NSF; (3) the appointment is a continuing appointment; (4) the appointment has substantial educational responsibilities; and (5) the proposed project relates to the employee's career goals and job responsibilities as well as to the goals of the department/organization."²

Rather than nominations from institutions with a brief research abstract, as was the case with PYI, NYI, and PFF, CAREER applicants prepare and submit a 15-page Project Description with a departmental endorsement.³

The goals of the CAREER program are:

- i) To provide stable support at a level and duration that are sufficient for the early career development activities of outstanding teacher-scholars in the context of the mission of their organization.
- ii) To build a foundation for a lifetime of contributions to integrated teaching and research by awardees.
- iii) To increase the participation of those traditionally underrepresented in science and engineering, and
- iv) To create NSF's most prestigious award for young faculty, as reflected by the size and duration of the CAREER award, and the selection of nominees for the Presidential Early Career Award for Scientists and Engineers (PECASE) award from the ranks of CAREER awardees.

The CAREER program is supported by all the directorates at NSF. Indeed 7.5% of all proposal actions at NSF are CAREER. More than 3700 CAREER awards have been made from 1995 – 2004, from which 160 PECASE awardees have been chosen. The duration of the CAREER award is 5 years with a minimum amount of \$400,000 (\$500,000 for the biological sciences) over that period. However the CAREER program has become increasingly competitive, and given its potential value to the career of junior faculty, many Assistant Professors agonize over writing and submitting their CAREER proposal.

The goal of this paper is to present a systematic model for preparing the NSF CAREER proposal. Its objectives are to provide; a historical context for the CAREER program, a pedagogical guide to preparing the proposal and supporting documents, and a template for writing the CAREER proposal. In the words of an experienced NSF program officer, *“if you don't submit a proposal, your chances of receiving an award are zero.”*

The CAREER Proposal Sections and Format

There are 13 distinct sections required in an NSF CAREER proposal. The core of these requirements are the Project Summary, Project Description, Budget with justification, and the Departmental Endorsement from the applicant's department head. These sections of the proposal will be discussed in this paper. A detailed checklist of requirements for the complete proposal is available from the NSF website.⁴ The requirements are summarized in Table 1.

In addition to the items on the checklist, NSF provides general guidelines for the preparation of proposals⁵ and more specific for the preparation of CAREER proposals.¹

Table 1. Faculty Early Career Development (CAREER) Proposal Checklist

#	Item	Description
1	PI Information	<ul style="list-style-type: none"> • Required in SFF
2	Cover Sheet	<ul style="list-style-type: none"> • Announcement #

#	Item	Description
		<ul style="list-style-type: none"> • Organization/Unit – Program applying to • Co-PIs – not allowed • CAREER Eligibility – check boxes • PECASE Eligibility – Check box to select
3	Project Summary – 1 page	<ul style="list-style-type: none"> • Summary of proposed integrated education and research activities Must separately address both merit review criteria (intellectual merit and broader impacts)
4	Table of Contents	•
5	Project Description – 15 pages	<ul style="list-style-type: none"> • The heart of the proposal
6	References Cited	•
7	Biographical Sketch – 2 pages	•
8	Budget – 3 pages	<ul style="list-style-type: none"> • In SFF • Include budget justification
9	Current and Pending Support	<ul style="list-style-type: none"> • In SFF • Current grants and grants applied for
10	Facilities, Equipment and Other Resources	• In SFF
11	Supplementary Documents	<ul style="list-style-type: none"> • Departmental Endorsement from department head or equivalent • Includes mandatory declaration • Letters of commitment from collaborators
12	List of Suggested Reviewers	•
13	Deviation Authorization	<ul style="list-style-type: none"> • With approval of cognizant NSF Assistant Director. • No eligibility exemptions
14	Collaborative Proposals	• Not Applicable
15	Co-PI Senior Personnel	• Not Applicable

SFF - Standard Fastlane Form

The Project Summary

The project summary has a 1-page limit. It gives the first impression of your proposal to reviewers. Reviewers read this very important section of the proposal to get an overview your idea, rationale, major activities, expected results, and achievement of the NSF merit review criteria of intellectual merit, and broader impacts. Thus, at minimum, the project summary should state the issue or problem you propose to study, establish its relevance and importance to your field of study, state your research hypothesis, and define the long term goal(s), short term objectives, and associated activities. This is a good point to define your proposed activities in the areas of research, education, and service or outreach if appropriate. **It is mandatory to state the intellectual merit and broader impacts of your proposed work in the project summary**, as these address NSF’s merit review criteria that are required of all proposals submitted to NSF. Reviewers will check specifically for the intellectual merit and broader impact statements in your project summary and project description. Thus, it is recommended that you highlight these words in your summary. For example you might write, “the **intellectual merit** of my proposal is...,” and “the **broader impacts** of my proposal are...” A good idea is to write the project summary after the project description and budget have been completed, so that it represents an informed summary of the content of the proposal.

Merit Review Criteria

NSF announced new criteria for the review of proposals on July 10, 1997⁶. These criteria are described in detail in a subsequent notice to the academic community by then NSF director, Rita Colwell⁷. The criteria are copied below directly from that second notice:

Intellectual Merit:

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

Broader Impacts

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

The intellectual merit review criterion elicits the contribution of the proposed work to the direct field of study and other related fields. They also probe for innovative thinking and the capacity of the researcher and her institution to complete the work successfully. The broader impacts criterion looks for the integration of research and education, the capacity to leverage existing research and education facilities and infrastructure, and the key aspect of broadening the participation of students from groups that are underrepresented in the disciplines of higher education that are relevant to the proposal.

The Project Description

The project description has a 15-page limit. It is the most important section of the proposal. In the early years of the CAREER program it was called the Career Development Plan. To a certain extent, the project description is a detailed version of the project summary. It must follow a logical sequence from the problem statement to expected results. The narrative should be directed to a reviewer who is likely to be trained in your discipline, but may not be an expert in your specialization within that discipline.

The following outline, and the template in Figure 1 are meant as guidelines for writing the project description. They contain specific sections, and a brief description of each. The idea is for you as a proposer to write systematically each section in this outline that is appropriate to your proposal, thereby ensuring the logical sequence from problem description to expected results, and the inclusion of the intellectual merit and broader impacts discussion.

Problem statement

This should begin with a paragraph that states the problem or topic you are planning to study. You should say why the problem is important, and how it is relevant to your field of study. You may introduce your literature review at this point to state previous work that has been done on the problem, highlight the areas of the literature in need of additional work, and position your proposal to address one or more of these areas of additional need.

Project goal(s)

This should state the long term vision for the work of which your proposal is a part. For example, your goal(s) may be to improve the safety of the public water supply and to improve the quality of information available to consumers about their water supply. Later, your objectives will state short term measures you will take to achieve these goal(s).

Research hypothesis

The research hypothesis is a testable prediction about expected outcomes of the study, given the problem statement. Though ideally suited to empirical projects, the hypothesis serves as a good example for stating the expected results of the study in the context of its long term goals, and previous work reviewed in the literature. The hypothesis should be stated in such a way that the project objectives may serve as steps in the process of testing the hypothesis. An example of a research hypothesis for our goal of improving the safety of the public water supply is, “the use of accurate residual chlorine detectors at point of use in homes will increase the safety of the public water supply.”

Project Objectives

The project objectives in a CAREER proposal may be of three types; **research objectives** (which specify the steps required to test the research hypothesis), **education objectives** (that integrate the research and education aspects of the project), and if relevant, **outreach or service objectives**, which address the broader impacts of the proposed work. You should give careful consideration to the objectives because they establish the deliverables for your project. In empirical work the research objectives may be replaced by the research methodology. It is suggested that you state no more than four of each type of objective (research, education, and outreach) or no more than ten total objectives for the project (whichever is less). Each objective should be associated with at least one evaluation criterion that enables you to measure and report the extent to which the objective was achieved over the course of the project. A research objective for the hypothesis of using residual chlorine detectors in the home could be, “to document the incidence of reported deviations from the standard for residual chlorine in homes equipped with residual chlorine detectors.” Evaluation criteria for this objective could be i) a validated system for recording residential complaints about residual chlorine readings, and ii) a monthly summary of the number of reported deviations from the standard by households in the study area.

Project Activities

Each research, education and service/outreach objective should have an associated set of activities by which the objective is to be accomplished. Activities should be limited to those necessary to complete the objective within the time limit of the proposed project. An example of activities for the objective of documenting the incidence of reported deviations in residual chlorine levels in drinking water might be; i) development of affordable residual chlorine detectors, ii) distribution of detectors to households in the study area, iii) developing of system for households to report deviations in measured residual chlorine, and iv) publication of a monthly report of the number of cases of deviations from the residual chlorine standard in households in the study area.

Project Deliverables

Each objective should be associated with at least one measurable deliverable that is related to the expected results of the project, and to the evaluation criteria by which the performance of the project may be evaluated. . For example, i) a validated system for recording residential complaints about residual chlorine readings, and ii) a monthly summary of the number of reported deviations from the standard by households in the study area, would be deliverables for the objective of documenting the reported deviations from the standard for residual chlorine, related directly to the expected result of improved safety of the public water supply and identical to the stated evaluation criteria for this objective.

Project Schedule

Each project activity should have an associated start and end date. For multi-year projects units of months are a reasonable measure for the duration of an activity. All activities should be completed within the period covered by the proposed project, and the schedule should describe the sequence of activities leading from project start to completion.

Integrating Research and Education

The integration of research and education is a key goal of the CAREER program. NSF considers it important that the excitement of discovery in research is translated effectively into inspired teaching and learning. It is important to present a clear and sound strategy for integrating your research and education plans. This may include plans to use experiments or case studies from your research in your lesson plans, as well as the use of interested students from your courses as undergraduate research assistants. NSF encourages the use of undergraduates in research, and offers supplemental funding to the CAREER grant to support this activity through the Research Experiences for Undergraduates (REU) program.⁸ NSF also encourages visits to foreign research facilities, and collaboration with foreign institutions in research and educational activities. In addition, partnerships with industry, national laboratories, and K-12 schools are considered good examples of activities that can integrate research and education. As you think about integrating research and education, it can be very valuable to have advice from the cognizant NSF program officer for your proposed project. The NSF website offers a list of suggested contacts for the CAREER program by NSF division.⁹

Figure 1. A Template for Writing the CAREER Proposal Project Description

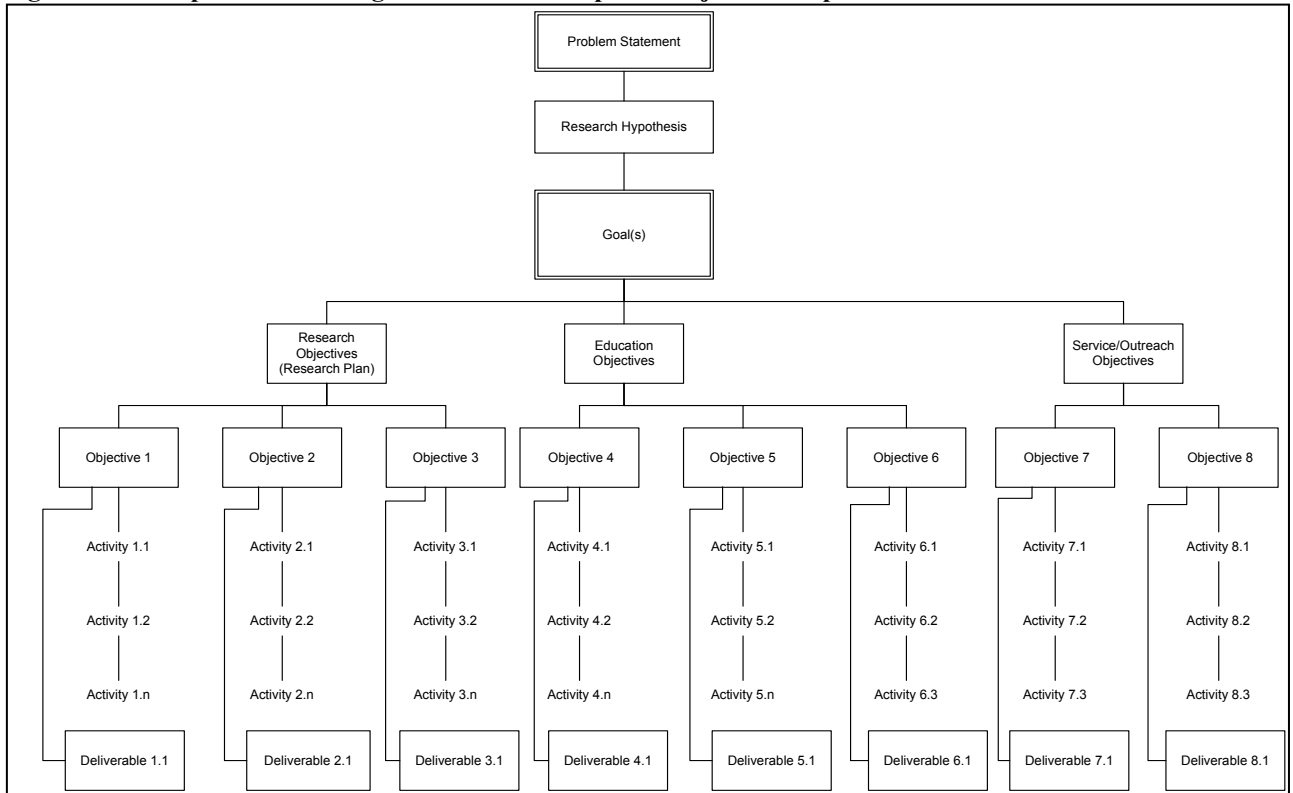


Table 2 illustrates the schedule for a two-year project with eight activities (2 activities for each of four objectives). In this case the unit of activity is 3 months from the start of the first month to the end of the last month in each column.

Table 2. Schedule for a 2-year project with 8 activities

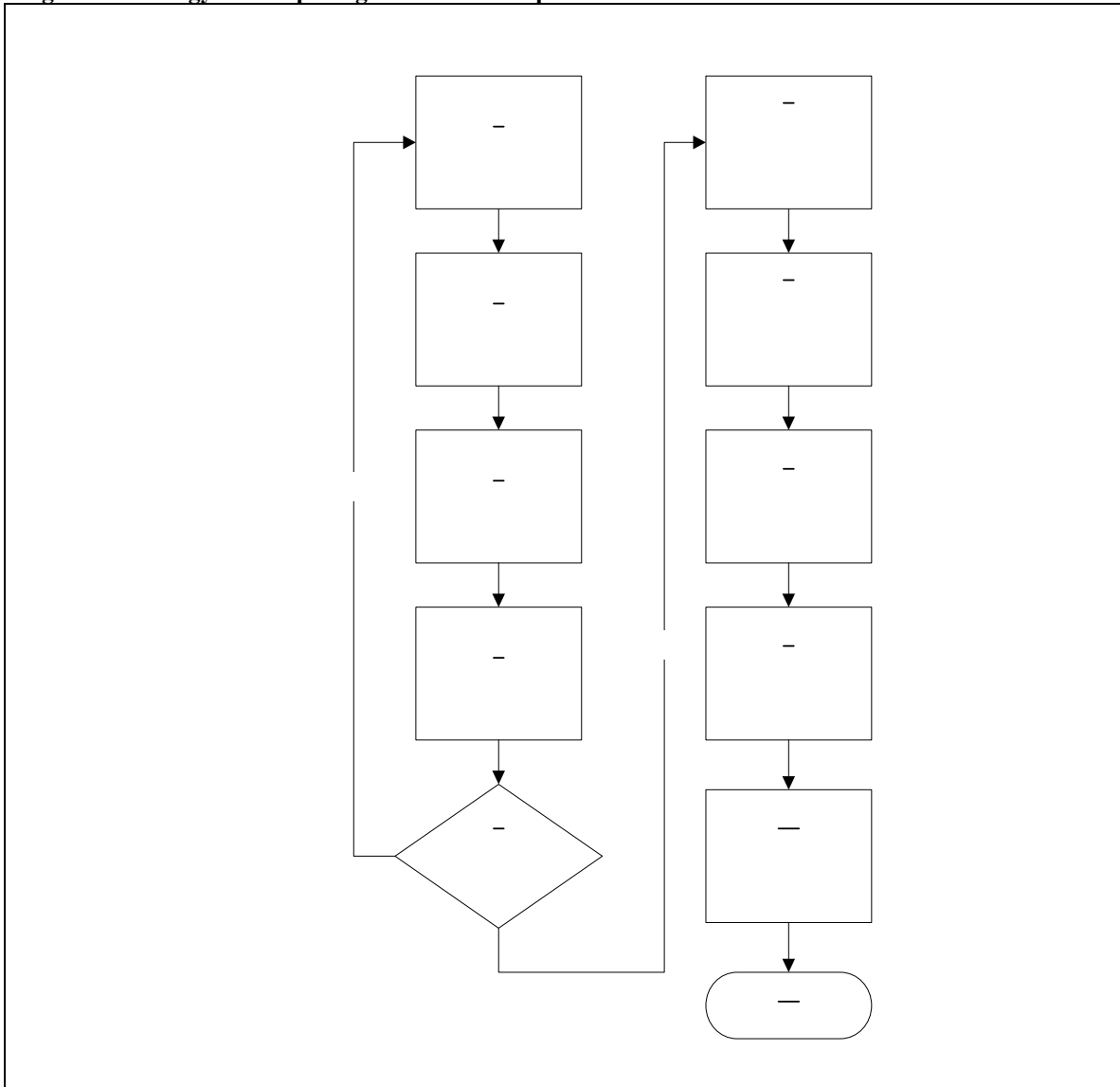
Activity #	Description	9/06 - 11/06	12/06 - 2/07	3/07 - 5/07	6/07 - 8/07	9/07 - 11/07	12/07 - 2/08	3/08 - 5/08	6/08 - 8/08
1.1	Develop reporting system	X	X						
1.2	Distribute detectors		X	X					
2.1	Document results		X	X	X	X			
2.2	Students analyze results		X	X	X	X	X		
3.1	Teach course on community water	X				X			
3.2	Host community water website	X	X	X	X	X	X	X	X
4.1	Students present results at AWWA conference							X	
4.2	Publish results in ASCE journal								X

CAREER Strategy and Rationale

A complete CAREER proposal requires documents you prepare yourself, and documents that must be prepared by other entities at your university. Thus, it is important to have a

strategy for preparing the proposal that allows sufficient time for these other entities to prepare the necessary documents for you, while you are writing your project description, project summary and drafting your budget. Figure 2 provides a flowchart for preparing the complete CAREER proposal.

Figure 2. Strategy for Preparing the Career Proposal



It begins with the genesis of the idea for your project. This may come from a continuation of your PhD thesis work, from the literature, or just simply your own original bright idea. Write these down in a concept paper. It should contain a thorough review of the literature so that you can become an expert on the subject of your proposal. Because most CAREER proposers are in the early stages of their career, they will not have an extensive list of publications to demonstrate their expertise on the subject, thus it is important to demonstrate this grasp in the discussion of the literature review and relevant project methodology. Be sure to highlight what is creative and innovative about the idea. Note

the importance and significance of your proposed work and how it plays to your strengths. Discuss options for sustaining the work beyond the period of your CAREER grant, identifying possible sources of funding to continue the work. This preliminary work should be done six to nine months before the due date of the CAREER proposal. It is recommended that you subtract ten working days from the due date of the proposal to allow time for your proposal to be processed by your university's Office of Sponsored Programs (OSP) and submitted in time via Fastlane.

The next step in your strategy is to vet and validate your concept paper through a network of peers and mentors who serve as your internal review mechanism. Revise your concept paper to reflect their critique. At this point you should be confident about the feasibility of your idea, and your intention to submit a CAREER proposal. This should be at least 6 months before the CAREER due date (in July) allowing for your two week buffer.

At this point you should notify your OSP. They can help you to establish a Fastlane account. Fastlane is the name of the website by which NSF manages its proposals. With rare exceptions, you must submit your proposal via Fastlane. OSP can help greatly with this, and will actually be responsible for hitting the final "Submit" button, when your proposal is completed. The procedure will be different if there is not an OSP at your institution. NSF can help you with this.¹⁰

You are now ready to draft a budget in Excel, and send it to OSP for their input. They will have to modify it to reflect fringe benefits, university overhead, and a host of other administrative requirements for the budget. You can be writing your project description while this is going on. At the same time you should notify your Department head and/or Dean of your intent to submit the proposal. Let her and her secretary know that you will need the letter of endorsement and give them a date for this letter that is at least two weeks in advance of your two-week buffer. This is important because the CAREER proposal is usually due in July, when people may be traveling or on vacation. If you will be collaborating with other individuals or organizations on your project, you should ask them for letters of support at this time with the same due date as the departmental letter.

You have the option of applying for a PECASE award at the time you submit your CAREER proposal. This is a simple check box on the CAREER proposal cover sheet. There is nothing to be lost and much to be gained from this application, so it is suggested that you check the "I wish to be considered" box on the PECASE application at this time.

Your next step (at least four months before the due date) is to contact the NSF program officer in the division that seems the best match for your proposal. It may not always be obvious which program is the best fit for your proposal, so you may have to communicate with several program officers. Contact information for the program officers is available on the NSF website.⁹ A good procedure is to send an email first, then a phone call. You may then send them a short set of PowerPoint slides outlining your idea, and/or visit them in person if possible. The program officers are invaluable sources of guidance and information in shaping your concept into a competitive proposal. They can help you find

the best program fit for your proposal, and give you useful tips on preparing your proposal. Most importantly, they want to help you and see you succeed!

After you get advice from your NSF program officer it is time to revise your concept paper. Submit it once more to your internal review network, returning to the literature for additional reinforcement of your hypothesis and methodology. At this point it should be two to three months before the due date. You can update your budget with OSP, and provide them with other information they need (current and pending support etc.) to complete the administrative portions of the proposal. This is also a good time to start collecting your departmental endorsement and letters of support. File them in a safe place where they will be easy to retrieve. Your departmental secretary may be a good place.

At this point your task is to write the project description in final draft form from the concept paper. Use the template/outline in figure 2 as a guide. It is suggested that you write consistently in short sessions each day¹¹ Your draft should be finished no less than a month before the due date. Send it around for internal review one last time. Finalize your budget and other supporting documents during the review period, and begin uploading completed documents to Fastlane. Draft the project summary, and prepare the budget justification statement with the help of OSP during this time.

At your two-week buffer you should be finished revising your proposal after the review of your draft. Also complete the project summary. Remember, it should follow the same sequence of topics as your project description. When you are done, provide all the documents to OSP since they take care of the final submission. Check on Fastlane during this two-week period to ensure that the proposal is uploaded and complete. If there are last-minute details needed, you should have time to take care of them during this buffer period. When the proposal is submitted you will receive an email notification to that effect from NSF (it may go to your OSP). Take time to recover from the final stressful two weeks of the CAREER proposal, then resume your work. You will usually be notified of the results around September.

Conclusion

Specific guidance on appropriate activities that integrate research and education, and satisfy NSF's merit review criteria, are best provided by the cognizant program officer within the directorate and division that are closest to your discipline. However, the spirit of the CAREER program suggests that it is not generally intended to support three types of activities; major purchases of equipment for the setup of laboratories, the support of postdoctoral fellows and/or administrative staff, and hosting of workshops or conferences. NSF provides other programs that may be used to fund these purposes. If these activities are significant components of the proposed activity, it is advisable to confer with the program officer on how these activities should be presented or what alternatives may be available to support them.

The author offers these additional points of advice as a PECASE and CAREER awardee. Firstly, the award is a beginning. After you receive it you have to deliver on all that you

promised in the proposal! NSF requires annual reports of your progress via Fastlane. Thus, certainly celebrate after receiving the award, but be prepared to stick to your proposed plan and accomplish the work.

Secondly, while it is a prestigious award, the CAREER award alone probably will not get you tenure. Thus, you must remain committed to publishing the results of your work, applying for additional grants to sustain your research, and recruiting and graduating Masters and PhD students. In other words, treat the CAREER award as a catalyst for your career, not as a crowning achievement.

Thirdly, no matter how “rich” you may feel after you receive your CAREER award, do not take on more graduate student advisees than you can manage effectively. The author suggests that three full time graduate students is a full load for an assistant professor. If another grant allows you to hire a postdoctoral fellow who is capable of advising graduate students, or you have senior graduate students, who are capable of advising junior students, you may be able to support more than three students. If neither of these conditions apply, it is advisable to work with a small number of students with whom you can interact regularly, and work together in advancing your research.

Fourthly, and finally, if you do not receive a CAREER award, it is not the end of your career. You may apply three times for the CAREER award. In addition, there are many other funded programs at NSF to which you may apply, whether or not you receive or are planning to apply for the CAREER award. Thus, it is important to “try and try again,” remembering, “*if you do not apply your chances of being funded are zero.*”

As with most things, the keys to a successful CAREER proposal are preparation and organization. This paper provides a guideline to help you with both. The other keys to success are inspiration and innovation. The fact that you are preparing a CAREER proposal means that you already have an abundance of those. Good luck!

1.0 References

¹ Faculty Early Career Development (CAREER) Program External Evaluation Summary Report, NSF #REC-9912174. 1999

² National Science Foundation, Faculty Early Career Development (CAREER) Program, Program Solicitation. NSF 05-579. (<http://www.nsf.gov/pubs/2005/nsf05579/nsf05579.htm>)

³ National Science Foundation (1997). Faculty Early Career Development (CAREER) Program, Guidelines for Submission of Proposals. NSF 97-87, p.4.

⁴ http://www.nsf.gov/crssprgm/career/career_submission_checklist.pdf.

⁵ *Grant Proposal Guide*, NSF 04-23, Effective September 1, 2004. http://www.nsf.gov/pubs/gpg/nsf04_23/

⁶ NSF, Important Notice No. 121, *New Criteria for NSF Proposals*. July 10, 1997.

⁷ NSF, Important Notice No. 125, *Merit Review Criteria*. September 20, 1999.
(<http://www.nsf.gov/pubs/1999/iin125/iin125.html>).

⁸ National Science Foundation, Research Experiences for Undergraduates (REU) Program, Program Solicitation. NSF 05-592. (<http://www.nsf.gov/pubs/2005/nsf05592/nsf05592.htm>)

⁹ <http://www.nsf.gov/crssprgm/career/contacts.jsp>

¹⁰ Frequently Asked Questions about the Faculty Early Career Development (CAREER) Program For Fiscal Years 2006, 2007, and 2008, (NSF 05-027) <http://www.nsf.gov/pubs/2005/nsf05027/nsf05027.jsp>

¹¹ Boise , R., *Advice for New Faculty Members: Nihil Nimus*, Pearson, Needham Heights, MA. 2000.137-143.