



General Programmatic Terms and Conditions (PTC) for the Gen-3 Engineering Research Center (ERC) (NSF 07-521) Cooperative Agreements

The terms and conditions stated herein are the minimum but not sufficient requirements to fulfill the responsibilities to achieve the goals expected under ERC solicitation NSF 07-521. All referenced documents including websites are made a part of this Cooperative Agreement.

1. Program Description:

The goal of the Generation Three (Gen-3) Engineering Research Centers Program is to create a culture of innovation in engineering research and education that links scientific discovery to technological innovation through transformational-engineered systems research and education to advance technology and produce engineering graduates who will be creative innovators in a global economy. Because ERCs play critical roles in academe by integrating research, education, diversity, outreach, and industrial collaboration/innovation, NSF views ERCs as change agents for academic engineering programs and the engineering community at large. A full description of Gen-3 ERCs is included in solicitation NSF - 07-521 and is made a part of this document. The absence of a compelling strategy for achieving demonstrable impact in and of the key features of a Gen-3 ERC incorporated in this agreement and described in full details in NSF 07-521 is sufficient reason to deny continued funding.

2. Project Governance and Governing Responsibilities:

The Awardee will ensure that an efficient and effective project governing structure is in place throughout the award period to support all project activities and shall be responsible for fulfilling the terms of this Cooperative Agreement in accordance with its proposal, annotated response to site visit report, briefing before the ERC Award Recommendation Panel (07-521), and any post-review correspondence with the NSF program officer.

The lead and core partner universities shall function as an integrated whole, with shared research and education goals, shared elements of the curricula, and a shared program of industrial collaboration. The effort of the lead and partner universities will include small firms engaged in the research program to carry out translational research, pre-college education partners, and partner organizations devoted to speeding innovation and entrepreneurship. This team may be augmented by universities contributing

affiliated faculty. The lead university is responsible for the overall management and financial responsibility of the Center. The Center Director is empowered and responsible for efficient and effective functioning of the ERC. The Center Director may make any necessary changes in the structure of the Center including addition/deletion of its core and other partners to ensure the effective functioning of the Center. These changes will be made in consultation with NSF. The Awardee will receive the funds for the Center from NSF and other sources - including industrial partners - and disburse them to the domestic partner universities, universities contributing affiliated, and any other funded partners, based on their level of effort determined by the ERC's strategic planning process, and their performance.

3. Key Features of a Gen-3 ERC:

The ERC will have the following key features:

- a. Long-term, guiding strategic vision for transforming engineered systems with the potential to spawn whole new industries and/or radically transform the product lines, processing technologies, or service delivery methodologies of current industries and /or professional practices;
- b. Long-term strategic vision to develop an innovative, globally competitive and diverse engineering workforce;
- c. Strategic plans to realize the research, education, and diversity goals;
- d. Strategic, discovery & systems motivated interdisciplinary research program conducted by a cross-disciplinary team that includes small firms engaged in transformational research;
- e. Research focused on the advancement of technology through test beds designed to test theory and functionality in proof-of-concept systems;
- f. Innovative partnerships with member firms and organizations dedicated to stimulating entrepreneurship and speeding technological innovation for technology transfer;
- g. Education program strategically designed to produce creative, innovative engineers by engaging students in all phases of the innovation process;
- h. Cross-cultural, global research experiences through partnerships with foreign universities or other means to provide global framework;
- i. Long-term partnerships with a few middle schools and high schools to bring engineering concepts to classroom & increase enrollment in engineering;

All ERCs will have the following infrastructure:

- a. A multi-university configuration comprised of : (1) a lead U.S. university, (2) a manageable number of partner universities, which includes the lead or at least one partner university that serves students predominantly underrepresented in engineering, (3) foreign university partner(s) as proposed, (4) small firms engaged in the research program to carry out translational research, (5) pre-college education partners, and (6) partner organizations devoted to speeding innovation and

- entrepreneurship. This infrastructure is augmented by member firms and may be augmented by non-partner universities contributing affiliated faculty.
- b. A leadership team comprised of:
 - i. Center Director (tenured faculty) who is responsible for leading the ERC and administering the award in accordance with the terms and conditions of the Cooperative Agreement and reports to the Dean of Engineering;
 - ii. Deputy or Associate Director(s) (faculty) who share the leadership and management responsibilities;
 - iii. Thrust leaders (faculty) who are responsible for leading and managing major research thrusts;
 - iv. Education Program Director (faculty) who is responsible for the development and execution of the ERC's strategic education plan;
 - v. Pre-College Education Program Director (faculty or staff member) who is responsible for the pre-college education programs;
 - vi. Industrial Collaboration and Innovation Director (staff member at the lead university) who is responsible for marketing the ERC to industry/practitioners, developing and coordinating industrial/practitioner involvement, managing the role of small firms in research and innovation, and managing the partnerships for innovation;
 - vii. Administrative Director (a staff member at the lead university) who is responsible for administration, financial management, data collection, publicity, reporting, and other administrative functions;
 - viii. Chair of Student Leadership Council (SLC), comprised of undergraduate and graduate students, responsible for coordinating student activities to strengthen the ERC;
 - c. Cross-Disciplinary leadership, faculty, and student team that is diverse in gender, ethnicity and race (Cross-disciplinary refers to the inclusion of personnel from different disciplines of engineering and science not just from the subfields of a discipline.)
 - d. Council of Deans, comprised of the Deans from the lead and partner universities led by the Dean of Engineering from the lead university, which collectively as a board, coordinates the ERC's research and education efforts across the lead and partner campuses;
 - e. Scientific Advisory Board (SAB) comprised of outside experts who serve collectively as a board to advise the leadership team;
 - f. Industrial/Practitioner Advisory Board (IAB) comprised of representatives of member companies/agencies who collectively as a board, advise the leadership team and meet with the NSF site visit review team;
 - g. Internal Academic Policy Board comprised of administrators from the lead university who collectively as board, coordinates ERC plans and policies with departmental and university leaders and committees;
 - h. Adequate equipment and facilities to achieve the goals of ERC;
 - i. Headquarters office of sufficient space and resources to support the leadership, management and collaboration functions of the ERC as committed by university officials in the proposal and in any subsequent documentation;

- j. Cyberinfrastructure with appropriate software and staff to enable effective cross-campus collaboration and data collection;
- k. Policies in place to reward faculty in the tenure and promotion process for cross-disciplinary research, research on education, research and other activity focused on advancing technology and innovation, and mentoring of faculty and students plus credit or official recognition for university students engaged in mentoring other university students and in pre-college outreach.

4. Requirements for the Implementation of the Key Features:

- a. Strategic Research Planning and the Research Program:
 - i. The ERC's Research Program will be developed and structured through the ERC Program's 3-plane strategic plan. The research program will be motivated by the transformational engineered systems vision, will include fundamental inquiries, enabling technology research, and engineered systems research, proof-of-concept testbeds at the enabling and systems levels, and will operate in an integrated fashion to achieve the goals and deliverables of the ERC .
 - ii. Small firms carrying out translational research within the research program will be supported by the ERC's budget and will work in teams with the ERCs' faculty and students to speed the translation of the ERC's research to the market place.
 - iii. The ERC will include a Research Experiences for Undergraduates Program in its research program where students from outside the ERC's partner universities will participate in research during the summer term. This program will be focused on diversity. These undergraduates are in addition to the undergraduates from the ERC's partner universities that are engaged in ERC research. Support for these students will be provided using ERC base budget funds.
- b. Involvement of Foreign University Partners:

The foreign university partners of the ERC will collaborate in research and education that adds value to the ERC and to the foreign partners. Funding for activities carried out by the faculty and students from these universities on their foreign campuses will be supported by their universities or governments; however, the effort of foreign faculty and students carried out in the U.S. at the ERC partner universities may be supported by the ERC using its NSF or other funds.
- c. Involvement of Organizations Devoted to Entrepreneurship and Innovation:

The ERC's partner organization devoted to entrepreneurship and innovation will serve a dual role of speeding the innovation process and providing educational experiences for students so they better understand entrepreneurship and the innovation process.
- d. University Education:

The ERC's will develop a strategic plan for a university education program designed to develop creative, innovative, and globally competitive engineers; carry

out the program, and assess the impact of the program in achieving the desired characteristics in the impacted students.

e. Pre-college Education Program:

The ERC will develop a strategic plan for a pre-college education program that will form long-term partnerships with a small number of pre-college institutions (middle through high school). This program will (1) expose pre-college students to engineering concepts through class-room and other experiences, (2) include a Young Scholars research opportunity program for advanced students to carry out research in the ERC's laboratories, (3) involve ERC faculty and students in these activities with recognition and reward for these efforts by their home institutions; (4) include a Research Experience for Teachers (RET) program using the ERC's base budget to support teachers from the ERC's pre-college partner schools; and (5) will carry out an assessment of these efforts informed by best practices in program implementation and assessment already developed by ongoing NSF-funded and other pre-college education programs.

f. Industrial/Practitioner Partnership and Innovation:

- i. The ERC's industrial/practitioner partnership program will serve the ERC as a whole, and be strategically designed to optimize innovation and speed commercialization/utilization of ERC advances. The members constitute a mix of sizes of firms; and, as appropriate for the field, will include practitioner organizations, such as public sector service delivery agencies or medical practitioners. Foreign firms may be members of the ERC as long as they participate in accordance with the same membership agreement as U.S. firms do. The industry/practitioners will contribute to the ERC's research and education program by providing knowledge of manufacturing, product design, or the practices involved in service delivery and help establish the culture of innovation and a global experience required for its students and faculty
- ii. The ERC will also develop other innovative ways to speed the translation of knowledge into innovation, such as: (1) small firms engaged in translational research within the ERC's research program, (2) partnerships with federal, state, or local government programs designed to develop entrepreneurs, support start-up firms, and otherwise speed the translation of ERC-generated knowledge and technology into practice and products, and (3) opportunities offered by the federal Small Business Innovation Research (SBIR)/Small Business Technology Transfer Research (STTR) programs. The ERC will include analyses to determine the most effective methodologies to use to achieve these innovation goals through these types of partnerships.
- iii. ERC's industrial/practitioner partnership program will be governed by an ERC-wide membership agreement that defines the scope and function of the ERC's partnership with industry/practitioners, the types of membership such as full, affiliate, contributing, etc, the respective membership fees, and the ERC's Intellectual Property (IP) policy. The ERC will develop an IP policy that facilitates the roles of industrial partners in Gen-3 ERCs and be flexible in recognizing IP jointly developed by faculty in different universities or that developed by joint

- industry and university research. Industrial members may provide additional support for activities such as sponsored research projects, equipment donations, intellectual property donations, or educational grants.
- iv. The ERC is required to hold a meeting with its industrial members who have committed to or are interested in supporting the Center no later than three months after the effective date of the first year's award. The purpose of the meeting is to gain industrial end-user insights, guidance, and support in strategic planning, to help assure that the activities of the ERC are relevant to industry's long-term interests and needs, to enhance technology transfer and innovation. At the meeting, those firms committed to membership also will provide input for finalizing the terms of the Center's membership agreement and any refinements of its Intellectual Property policy.
 - v. The ERC will function with an Industrial Advisory Board (IAB) involving all of its Industry/practitioner members. The IAB will meet at least twice a year, carry out an annual analysis of the ERC's strengths, weaknesses, and threats to survival (a SWOT analysis), and participate in the annual NSF review of the ERC's performance and plans. During the meeting with the NSF site visit team, the Chair of the IAB will present the IAB's SWOT analysis to the review team and discuss the findings. The SWOT will be updated annually and progress of the ERC in addressing the SWOT will be discussed with the NSF site visit team as well. The Chair and the IAB members also will discuss the annual SWOT analysis with the ERC Director and the ERC Leadership team to determine appropriate future strategies to deal with the weaknesses and threats.
 - vi. Throughout the course of the ERC's funding by NSF, the Center shall continue to develop and refine its technology transfer and innovation strategy and its Intellectual Property policy, the latter in accordance with NSF's Intellectual Property guidelines (Grant Policy Manual, Section 730, "Intellectual Property") and the Awardee's policies.
 - vii. Industrial membership fees must be allocated for use for Center purposes. Industrial membership fees that are not expended in the year in which they are received must be placed in a Center account and reported to NSF and industry as 'unexpended funds' that are held in reserve for future use. Progress reports on the expenditure of these funds should be included in the Center's annual report and reported to IAB during the IAB meetings.
 - viii. Costs for organizing meetings with industry members will be borne by the ERC or the participants through a registration fee, as deemed appropriate. Costs for attending these meetings by industry members will be borne by their organizations.
- g. Student Leadership Council
- The SLC is responsible for organizing student activities to achieve the ERC's goals for research and education. The SLC will be comprised of undergraduate and graduate students and will have a Chair and a Co-Chair. The Chair will serve as a member of the ERC's Leadership Team. The SLC also is responsible for carrying out a SWOT analysis of the ERC and communicating the results to the ERC Director, the ERC's leadership team, and the NSF site visit team

5. Programmatic Activity Requirements:

- a. Joint NSF-Awardee Activities:
 - i. NSF requires the Center Director, Deputy Director, Administrative Director, Education Program Director, Industrial Liaison Officer, other key leadership or staff personnel, and representatives of the Student Leadership Council (at least one graduate and one undergraduate student) to attend the annual ERC meetings organized by NSF. Costs for attending these meetings will be borne by the ERCs
 - ii. The ERC will participate in evaluation and other types of studies of the ERC Program initiated by NSF. Such studies include but are not limited to the outcomes and impacts of the ERC Program. The ERC will also participate in workshops organized by NSF to study various issues common to the system of centers. Costs for attending these meetings will be borne by the ERC.
- b. Electronic Access:

The Awardee shall establish and maintain an electronic access capability via the Internet to transfer the quantitative and qualitative data to an NSF database. The access to this electronic information will be protected and only NSF will have and grant access. The Center will establish a WWW "Home Page" containing some elements with public access to make available any information about the Center's goals, activities, and accomplishments. The Center will develop and use an identifying logo that is consistent with the Awardee's policies and procedures and approved by the Awardee as a graphic identity to be used on brochures, newsletters, on the Center's WWW "Home Page," etc.

6. Management and Oversight:

The Awardee will ensure full commitment and cooperation among the governing structure elements and all project staff during ongoing NSF project management and oversight activities. At the site visit or during an audit, the Awardee will ensure availability of and timely access to all project documentation. As a minimum requirement, the Center Director will meet annually at NSF with the NSF ERC Program Officer assigned to the ERC for oversight to discuss progress and other issues. The timing of the visit is to be determined by mutual agreement between the Center Director and ERC Program Officer.

- a. Annual Review:

NSF will carry out annual site visits to review the progress and plans of the Center. Renewal reviews will be carried out in years three and six. Based on the performance of the ERC, and in consultation with the ERC Director, the NSF Program Officer may determine that an annual site review is not necessary. In that case, the Center Director and a team of key individuals will visit NSF to update the

NSF Program Officer and other NSF staff on progress and plans of the Center. For the purpose of the annual review, site visits will be conducted a minimum of six weeks prior to the anniversary date of the award to review performance and to provide advice to the ERC. The level of continued NSF support will be negotiated with the Awardee annually and will depend upon a review of progress through the annual site review or other means, the performance metrics, the industrial support level, and the Program Officer's assessment of progress, and the availability of funds for the program.

b. Renewal Proposal Review:

- i. If a renewal proposal is submitted during the third year of the Center's operation, NSF will conduct a site evaluation/review to determine whether to continue to support full ERC operations or provide decreased funding to phase out NSF support of the ERC over years 4 and 5. If NSF decides to continue full ERC operations, a new level of funding support will be negotiated for years 4 through 8 and three years will be added to the agreement to extend it through year 8. If the Awardee chooses not to submit a renewal proposal, NSF support to the ERC will be phased down over the two-year period covering Years 4 and 5 of the Center's operation.
- ii. If a renewal proposal is submitted during the sixth year of the Center's operation, the ERC will be evaluated in the manner described above to determine whether NSF will continue to support full ERC operations or provide decreased funding to phase out NSF support of the ERC over Years 7 and 8 of the Center's operation. If NSF decides to continue full ERC operations, a new level of funding support will be negotiated for years 7 and 8 and two years will be added to the agreement to extend it through year 10. If the Awardee chooses not to submit a renewal proposal, NSF support to the ERC will be phased down over the two-year period covering Years 7 and 8 of the Center's operation.

c. NSF will specify the format of the progress report/renewal proposal, the review process, and review criteria approximately six months before the date agreed upon for submission.

d. Termination of the Cooperative Agreement:

NSF's agreement with a Center might be terminated as a result of an annual review indicating insufficient progress in organizing the ERC to achieve its vision, or not addressing one or more key features of the Center. In the case of termination, NSF support to the Center will be phased down over the next one or two years.

e. NSF may carry out a summative site visit at the end of the 10th year of support to determine the long-term value added by the ERC.

f. After the end of the Cooperative Agreement with NSF, NSF expects the ERC to continue in a self-sufficient mode, maintaining the ERC culture with support from funds outside the ERC Program. Under no circumstances will the ERC receive ERC Program support to continue its full center operations after the Cooperative

Agreement expires, although it may receive ERC Program support through subawards from other ERCs or through special purpose awards designed to capitalize on past ERC Program investments.

7. Reporting Requirements:

a. Start-Up Strategic Plan:

At the start-up, an initial detailed Center-level strategic plan containing ERC's strategic plans for research, diversity, university education, pre-college education, industrial/practitioner collaboration, technology transfer, and innovation will be submitted to the ERC's program officer electronically 90 days from the effective date of this Cooperative Agreement. The research strategic plan must include an updated ERC three-plane strategic planning chart and an updated 10-year milestone chart indicating the critical paths to achieve the major research goals and deliverables. The university and pre-college education strategic plans will include goals, deliverables, and a 10-year milestone chart as well. The industrial collaboration/innovation strategic plan will include goals, deliverables, and a 10-year milestone chart

b. Annual Report:

The Awardee shall submit an Annual Report which will contain specific information including, but not limited to, the following: the progress and plans of the ERC in all areas in achieving its vision with supporting data developed from the data submitted to the ERC Program's data base of indicators of progress and impact, information on revenues and expenditures, and proposed budgets. The annual report should also include plans, quantitative information on performance and the ERC's impact on diversity. The annual report is due at least five weeks prior to the annual site visit and at least 10 weeks prior to the anniversary date of the award. The annual report must be prepared according to the online document "Guidelines for Preparing ERC Annual Reports and Renewal Proposals," which is available at: http://chaffee.qrc.com/nsf/eng/ercweb/help/ann_rpt_guide.cfm

c. Data Tables:

NSF maintains a database, ERCWeb, to collect and report quantitative and qualitative data for all of the ERCs. Each center is required to enter data into the database annually as instructed the "Guidelines for Preparing ERC Annual Reports and Renewal Proposals" and the "Guidelines for ERCWeb Data Entry." Both documents can be found at the website http://chaffee.qrc.com/nsf/eng/ercweb/help/ann_rpt_guide.cfm. Many of the data tables required in the Annual Report are produced from the data submitted to the ERC database. The Center will print these tables directly from the database website and use them in their respective Annual Reports. Details, data collection requirements and procedures for entering data are available in the "Guidelines for ERCWeb Data Entry" document.

- d. **Renewal Proposal:**
In lieu of the third-year and sixth-year annual reports, respectively, the Awardee may submit a cumulative progress report covering the period from the beginning of the Center to that date and renewal proposal to NSF requesting support for an additional five-year period beginning at the end of the third year and for an additional four-year period beginning at the end of the sixth year of this Cooperative Agreement. The progress report/renewal proposal is due at NSF by a date agreed upon between NSF and the Awardee. If the Awardee chooses not to submit a renewal proposal, NSF support to the Center will be phased down over the two years remaining in the period of support provided by this Cooperative Agreement.
- e. **Summative Report:**
If NSF decides to carry out a summative review of the long-term impact of the ERC, a summative preliminary final report covering the period from the beginning of the Center to the anniversary date shall be submitted to NSF at least five weeks prior to the final 10th year summative site visit. More details are available at: <http://chaffee.qrc.com/nsf/eng/ercweb/start.cfm> on the “ERC Library” link.
- f. **Final Report:**
In lieu of an annual report, a final report prepared according to guidelines provided by the ERC will be due within 90 days of the expiration date of this Cooperative Agreement. Guidelines for the ERC final report are available on the following site: <http://chaffee.qrc.com/nsf/eng/ercweb/start.cfm> on the “ERC Library” link.

8. Program-Specific Terms and Conditions:

- a. **Awards Involving Pre-college Students:**
In accordance with sections 1869a and 1869b of title 42 of the United States Code, the Awardee will do the following:
 - i. Obtain from the school board or comparable authority responsible for the schools considering participation in the project, written approval prior to involvement of pre-college students in pre-college education research and development, pilot-testing, evaluation, and revision of experimental and innovative pre-college curriculum.
 - ii. Include in every publication, testing, or distribution agreement involving instructional materials developed under this grant (including, but not limited to, teachers' manuals, textbooks, films, tapes, or other supplementary material) a requirement that such material be made available within the school district using it for inspection by parents or guardians of children engaged in educational programs or projects using such material of that school district.
- b. **Diversity:**

The leadership, faculty, and students involved in an ERC shall be diverse in gender, race, ethnicity and persons with disabilities at levels that are benchmarked against the academic engineering-wide national averages. The faculty and staff of the ERC and the administrations of lead and partner universities receiving NSF funding shall devote the time and effort required to ensure that the diversity of the Centers' leadership teams, faculty, and students at all levels serves as a model for diversity within each institution and for the nation as a whole. The ERC will prepare and execute diversity strategic plans in collaboration with the home departments of the ERC- affiliated faculty. These plans shall articulate the ERC's diversity goals and intended actions but need not specify quantitative targets. The ERC also will be multicultural through the involvement of faculty and students from other countries by virtue of their role as faculty or students in the ERC's institutions and, through the involvement of faculty and students from the foreign partner universities. The involvement of foreign faculty and students also is expected to be diverse, representing a broad spectrum of cultures and countries. In fulfilling its obligations under the agreement and in compliance with the requirements of federal law, no university receiving federal funds will employ quotas or set-asides based on race.

Each ERC will:

- i. Demonstrate the existence of a partnership among the affiliated Deans of Engineering, other Deans, and the chairs of departments of the affiliated ERC faculty to increase the diversity of the Center's leadership team, faculty, undergraduate and graduate students, and graduates over the duration of NSF's support.
- ii. Develop and strengthen long-term core or outreach partnerships with predominantly female, African-American, Native-American, and Hispanic-American serving institutions.
- iii. Develop outreach connections with NSF programs focused specifically on increasing diversity of engineering students and faculty through the involvement of women, underrepresented racial minorities, and Hispanic-American students. This may include connections with one of the NSF's Louis Stokes Alliance for Minority Participation (LSAMP), and/or with one or more of the NSF-sponsored awardees focused on diversity such as the NSF Alliances for Graduate Education and the Professoriate (AGEP), Colleges and Universities that serve predominantly Native American Populations, and other ongoing NSF programs serving underrepresented groups.
- iv. Focus any Research Experiences for Undergraduates (REU) and Research Experiences for Teachers (RET) programs on increasing diversity.