

Center for Nuclear Power Plant Structures, Equipment and Piping

North Carolina State University

CHARTER

Objectives and Goals

- (i) To advance the state of knowledge related to nuclear power plant structures, equipment and piping through research.
- (ii) To educate future engineers in topics related to nuclear power plant structures, equipment and piping who will significantly add to the pool from which the industry must recruit highly qualified graduates.
- (iii) To disseminate the knowledge to the industry, government and public through special courses, seminars and symposiums.

The goal of the Center is to become a premier university-based research and professional organization for nuclear power plant structures, equipment and piping.

Nuclear power plants are an important part of the U.S. and the world electric power generation capacity and will continue to be important in years to come. Both the utilities and the regulators have taken an ongoing interest in the safe and economic design and operation of these plants. The industry has, in the past, committed a large sum of monetary resources to this purpose and will continue to do so in the near future. To assure efficient generating capacity in the future, the industry also needs to seek relicensing of the existing plants starting soon after the year 2000 -- as the present operating licenses expire. This process will require a further commitment of major resources. It is expected that, in a few years, the utilities will start ordering new nuclear power plants, thus necessitating additional investments.

A well planned and executed research program which advances the state of knowledge would reduce uncertainty in the design and performance of various systems and, thereby, improve both safety and economy. Useful research -- which addresses many immediate and pressing questions -- has been and should continue to be performed by industry and government organizations. As it has in the past, university-based research enhances industry and government research by adding to the knowledge base.

North Carolina State University (NCSU) started a successful biennial series of "Symposiums on Current Issues Related to Nuclear Power Plant Structures, Equipment and Piping," the first of which was held in December 1986. During the 2nd Symposium, held in Orlando, Florida, December 1988, A.K. Gupta, Symposium Chairman and a Professor of Civil Engineering at NCSU, discussed with the industry and government leaders present at the symposium the establishment of a research program on the general topic of the symposium (structures, equipment and piping) at NCSU. Those and later discussions resulted in the formation of a Board of Advisors of distinguished engineers from the industry and government to assist the university in establishing the research program. A Board of Advisors meeting was held in March 1989 on the NCSU campus. This meeting, and several communications before and after the meeting provided a general framework of the program. A Steering Committee consisting of the representatives of the supporting companies was established in 1991.

The program started with the support of four organizations in January 1991. These companies are Carolina Power and Light Company, Duke Power Company, South Carolina Electric and Gas Company, and Virginia Power. For the year starting January 1993, the following fourteen organizations are supporting the program: ABB Impell Corporation, B&W Nuclear Services Company, Baltimore Gas and Electric Company, Carolina Power and Light Company, Comision Federal de Electricidad (Mexico), Consumers Power Company, Duke Power Company, Electricit_ de France (France), Florida Power and Light Company, Niagara Mohawk Power Corporation, NOK (Switzerland), South Carolina Electric and Gas Company, Southern California Edison Company, and Virginia Power.

Relationships

The Center will be established in the Department of Civil Engineering. Initially, the Civil Engineering faculty will be primarily involved with the activities of the Center, and the research will be performed by graduate students working towards Master's and Doctoral degrees in the Department. As needs arise, the Center will seek participation of faculty and students from other departments in the College of Engineering and NCSU, and may also go outside NCSU for expertise available nationally and internationally.

The establishment of the Center will enhance the graduate program in the Civil Engineering Department. It would demonstrate the commitment of the university to research in the particular area that would make it possible to seek funds from the industry.

NCSU has an Electric Power Research Center (EPRC) and a Nuclear Reactor Program (NRP) in the College of Engineering. One of EPRC program areas deals with nuclear power, but does not address issues related to structures, equipment and piping of the power plant, the subject of the proposed Center. Broadly, the EPRC nuclear program deals with the physics of nuclear power, NRP's main activities are operator training, nuclear analytical chemistry laboratory services and fuel and material related research, and the proposed Center will perform research on the behavior and safety of structures and components subjected to external (such as earthquake and strong winds) and internal (such as thermal) forces. Technically, these are distinct fields, as are the people in the industry, government and academia who deal with them. Each field has one or more corresponding professional societies and code and standard writing organizations. All of these fields, of course, meet at higher management levels, where the issues are business and policy related and not technical. It would not be possible for EPRC or NRP to realistically support the objectives of the proposed Center, and quite importantly, generate the necessary funds from industry sources.

Therefore, it is clear that the proposed Center does not duplicate the objectives of any existing centers.

Director

The Director of the Center will be a member of the Civil Engineering faculty and will report to the Dean of Engineering for administrative oversight. The Director will be responsible for day-to-day operation of the Center in accordance with university and center policies and procedures.

Dr. Ajaya Kumar Gupta, Professor of Civil Engineering, is the proposed Director of the Center when it is established. Professor Gupta is Director of the Research Program in the Civil Engineering Department that would evolve into the proposed Center. He has pursued studies in the development of design methods for nuclear power plant structures and components for more than two decades. His interest in nuclear power plants started during his association in the early 70's with Sargent and Lundy, a leading design firm in Chicago. He continued this special

interest in his research at the Illinois Institute of Technology for four years and at NCSU, whose faculty he joined in 1980. As a result of his continuing work in this area, Professor Gupta has become an internationally recognized expert in the field. He is active on many professional committees and has participated in changes and developments of codes and standards. He presently serves on the Executive Committee of the Energy Division of the American Society of Civil Engineers, of which he was chairman during the year 1990-91. Dr. Ajaya Gupta is author of the recently published advanced reference book *Response Spectrum Method*, which covers ways to provide accurate seismic stresses. He received a prestigious ASCE Huber Research Prize (1982) for his contributions to engineering practice through research.

Steering Committee

Representatives of the member organizations (one from each) will constitute the Steering Committee which would be the main oversight body of the Center. The Committee will review the research proposals, will recommend the funding of the projects based on the review, and will also assist the Director in the operation of the Center. At least one meeting of the Steering Committee will be held every calendar year. The Chairman of the Steering Committee will be elected by the members of the Committee.

Other Committees

Other committees that would function in an advisory capacity can be appointed by the Director from time to time to enhance the effectiveness of the Center. For example, two such committees are in operation now: a Board of Advisors, consisting of a few selected leaders from the government and industry organizations, and a Faculty Committee consisting of the faculty members involved in the activities of the Center. Each project may have a project team consisting of the faculty members and the students participating in the project, representatives of the member organizations, and others who can contribute to the success of the projects and are invited by the Director to join the team.

Budget Estimates

The present budget estimate is based on the anticipated dues receipts from the member companies, which are: calendar year 1994 - \$200,000; subsequent years - \$300,000.

Space and Other Needs

No special space or other need is anticipated.

Effects on Instructional Program

As stated earlier, the Center will be established in the Department of Civil Engineering. The Civil Engineering faculty will be primarily involved with the activities of the Center, and the research will be performed by graduate students working towards Master's and Doctoral degrees in the Department. The graduate students will be supported from the funds received by the Center. This will strengthen the graduate program in the department, particularly in the area of Mechanics and Structural Engineering. The increase in the number of graduate students will make it possible for the department to offer certain courses on an annual basis that cannot be taught regularly now because of insufficient enrollment. The course offerings may even be expanded depending upon the need. The regular and expanded offering of the courses will benefit all the graduate students in the department, not only those supported by the Center. The knowledge gained through the Center-supported research will strengthen the teaching of graduate courses, sometimes even the undergraduate courses. Contact between the university faculty and students and the industry representatives have other intangible benefits that are well known.

Need for the Center

The Center will address issues unique to the design, construction and safe operation of the nuclear power plant structures, equipment and piping. At present, Civil Engineering faculty have a general awareness of the overall topic. They are highly competent structural engineers and researchers, but lack specific expertise applicable to the nuclear power industry. The Center would allow the faculty to focus on the problems of the industry. The funds that are becoming available through the industrial support would make it possible.

As stated above, the industry and the government are investing a great deal of resources on nuclear power plant design and operation and on the solution of related problems. However, either due to oversight on the part of the higher education community or the leadership of the industry and the government, or both, the participation of the university faculty in solutions to the nuclear power plant industry problems is practically nonexistent. In this respect, we at North Carolina State University are leading the way, and are serving society in the noblest way we know how.

Whereas we need industrial support to focus our energies on the industry's problems, the industry needs an indication of our commitment to solving their problems before it would make the resources available. A center is the best way to address the needs and concerns of the nuclear power plant industry.

Organizational Structure

