STANDARD FORM 26, JULY 1966
GENERAL SERVICES ADMINISTRATION
FED. PROC. REG. (41CFR) 1-16.101

AWARD/CONTRACT

1. CONTRACT (Proc. Inst. Ident.) NO. NRC-03-81-130
2. EFFECTIVE DATE 4/3/81
3. REQUISITION/PURCHASE REQUEST/PROJECT NO. RS-NRR-80-138
4. CERTIFIED FOR NATIONAL DEFENSE UNDER BDSA REG. 2 AND/OR DMS REG. 1. RATING

5. ISSUED BY CODE
U.S. Nuclear Regulatory Commission
Division of Contracts
Washington, D.C. 20555

6. ADMINISTERED BY (If other than block 5) CODE

7. DELIVERY
☐ FOB DESTINATION
☐ OTHER (See below)

8. CONTRACTOR NAME AND ADDRESS CODE FACILITY CODE
(Street, city, county, State, and ZIP code)
The Franklin Institute
Franklin Research Center
20th and Benjamin Franklin Parkway
Philadelphia, PA 19103

9. DISCOUNT FOR PROMPT PAYMENT
NET.

10. SUBMIT INVOICES (4 copies unless otherwise specified) TO ADDRESS SHOWN IN BLOCK
Article 3.5

11. SHIP TO/MARK FOR CODE
U.S. Nuclear Regulatory Commission
Attn: Mr. Jack Donohew
Division of Licensing
Washington, D.C. 20555

12. PAYMENT WILL BE MADE BY CODE
See letter of credit procedures

13. THIS PROCUREMENT WAS ☐ ADVERTISED, ☒ NEGOTIATED, PURSUANT TO: ☐ 10 U.S.C. 2304 (a)( ) ☒ 41 U.S.C. 252 (c)(10)

14. ACCOUNTING AND APPROPRIATION DATA
20-19-01-06 B6891 31x0200.201 ($750,000.00 is covered by this appropriation only)

15. ITEM NO.	16. SUPPLIES/SERVICES	17. QUANTITY	18. UNIT	19. UNIT PRICE	20. AMOUNT
	Technical Assistance in support of NRC Reactor Operating Licensings Action Program II				
	This is a cost-plus-award-fee contract Incremental funding				

21. TOTAL AMOUNT OF CONTRACT $ 4,786,872.00

CONTRACTING OFFICER WILL COMPLETE BLOCK 22 OR 26 AS APPLICABLE

22. ☒ CONTRACTOR'S NEGOTIATED AGREEMENT (*Contractor is required to sign this document and return* 3 *copies to issuing office.*) Contractor agrees to furnish and deliver all items or perform all the services set forth or otherwise identified above and on any continuation sheets for the consideration stated herein. The rights and obligations of the parties to this contract shall be subject to and governed by the following documents: (a) this award/contract, (b) the solicitation, if any, and (c) such provisions, representations, certifications, and specifications, as are attached or incorporated by reference herein. (*Attachments are listed herein.*)

26. ☐ AWARD (*Contractor is not required to sign this document.*) Your offer on Solicitation Number ______, including the additions or changes made by you which additions or changes are set forth in full above, is hereby accepted as to the items listed above and on any continuation sheets. This award consummates the contract which consists of the following documents: (a) the Government's solicitation and your offer, and (b) this award/contract. No further contractual document is necessary.

23. NAME OF CONTRACTOR
BY J. R. Stover
(Signature of person authorized to sign)

27. UNITED STATES OF AMERICA
BY M J Mattia
(Signature of Contracting Officer)

24. NAME AND TITLE OF SIGNER (Type or print)
John R. Stover
Vice President - Administration

25. DATE SIGNED 4/3/81

28. NAME OF CONTRACTING OFFICER (Type or print)
M. J. Mattia

29. DATE SIGNED 4/3/81

26-103 8106190343

LISTING OF CONTRACT ARTICLES

THE CONTRACT SCHEDULE

Section 1.0 Description of Work

Article 1.1 Scope of Work

Independently, and not as an agent of the Government, the contractor shall manage and review 300 Reactor Licensing Actions associated with the engineering disciplines listed below. The specific licensing actions will be selected from the topics listed below for each discipline or similar topics of equivalent complexity. The specific review assignments will be made in accordance with the procedure set forth in Article 5.12 below.

Specific Topics

1.0 Reactor Systems Engineering

1.1 Reactor Vessel Overpressure Protection

Incidents have occurred at pressurized water reactors involving over-pressurizing the reactor vessel while the reactor was in a solid cold shutdown condition. The NRC staff has required that licensees propose plant modifications to provide an overpressure mitigating system and technical specifications to govern the availability and operation of the mitigating system. The systems proposed generally include electrical control and mechanical pressure relief features. The contractor will review the licensees proposals for compliance with NRC criteria and model technical specifications.

1.2 Conversion to Standard Technical Specifications

Each nuclear power plant operating license is restricted by a set of specifications for safe operation referred to as the plant technical specifications. These specifications include requirements for the minimum number of safety systems which must be operable in the various permissible modes of plant operation and other general safety requirements. The NRC staff has developed a set of standard technical specifications for each of the major types of licensed power reactors. However, these standard technical specifications have not been backfitted across the board to all existing reactors.

Licensees occasionally propose amendments to existing technical specifications for operating convenience and improved safety. In addition the NRC staff has instituted a program for the orderly conversion of existing plant technical specifications to standard technical specifications all reactors when practical.

The contractor will review proposed individual technical specification amendments and complete conversions of technical specifications for compliance with the NRC standard set for the type of reactor involved. Proposed deviations from the NRC standard technical specifications will be evaluated from an overall nuclear safety systems point of view. Plant specific inputs required for the standard technical specifications will be evaluated against the individual plant systems design.

1.3 Boron Solubility During Long Term Cooling Following a LOCA

During long term cooling following a LOCA, the concentration of boric acid in the reactor vessel should be maintained below the solubility limits to avoid precipitation by providing a flushing flow of coolant through the reactor vessel. This flushing is accomplished either by simultaneous cold and hot leg injections of coolant, or by simultaneous cold leg injection and hot leg suction of coolant. Either method is acceptable; however, areas of concern have arisen on the long term acceptability of these methods. Five CE plant owners (Millstone 2, St. Lucie 1, Palisades, Ft. Calhoun 1, and Calvert Cliffs 1 and 2) have been requested to address these concerns. The contractor will review the responses of the licensees and provide written technical evaluations to the NRC.

2.0 Electrical Engineering

2.1 Status Annunciator and Indication Instrumentation Power Supply Systems

Safe operation of a nuclear plant requires that sufficient information be available to operators at all times to bring the plant to a safe shutdown condition in the event of a loss of offsite power or some other emergency. The contractor will review information provided by the licensees to determine if the power supply and bus arrangements for the status annunciator systems and indication instrumentation are adequate to assure that at least one channel of information is available at all times. The power supply system status annunciator system will also be reviewed to determine if it is adequate to assure that the operators will be aware of any degradation which may have occurred.

2.2 Degraded Voltage of Offsite and Onsite Power Distribution System and Interaction of the Offsite and Onsite Emergency Power Systems

The contractor will review and evaluate licensee's submittals concerning onsite emergency power and distribution systems to assess the susceptibility of the associated redundant safety-related electrical equipment to:

a) Sustained degraded voltage conditions at the offsite power source.

b) Interaction of the offsite and onsite emergency power systems.

c) Voltage drop of the offsite and onsite power distribution systems.

The contractors evaluation will be based on criteria and positions established by the NRC staff.

2.3 RPS Power Supplies

During the review of Hatch 2 operating license application, NRC questioned the capability of the Class 1E reactor protection system (RPS) (and other Class 1E systems and components powered from the RPS power supply) to accomodate the effects of possible sustained abnormal voltage and frequency conditions from the non-Class 1E supply. These abnormal power conditions could be caused either by combinations of undetected single failures or by multiple failure caused by earthquakes. These abnormal power conditions could result in damage to the Class 1E systems and components with the attendant potential loss of capability to perform their intended safety function. NRC has determined that all BWRs may be vulnerable to the same potential failure as Hatch 2.

GE has proposed a design in conceptual form which will resolve NRC's concerns. The proposed modifications consist of the addition of two Class 1E "protection packages" in series between each motor generator set and its respective RPS bus, and the addition of two similar packages in series between the alternate power source and the RPS bus. Each protective package would include a breaker and associated overvoltage, undervoltage, and underfrequency relays. Each protective package would be testable and seismically qualified as Class 1E equipment. Some facilities may adopt the GE design; others are proposing plant-specific modifications.

The contractor will review the submittals of the licensees which request installation of the protective packages to make sure that they meet NRC criteria and provide written technical evaluations to the NRC.

2.4 Diesel Generator Reliability

Operation of a nuclear plant requires that the diesel generators supplying onsite emergency power are available on demand for safe shutdown of the reactor in the event of an accident or loss of offsite power. A report has been completed NUREG/CR-0660, "Enhancement of Onsite Emergency Diesel Generator Reliability." This report addresses operating experience problems that have had an effect on the reliability and availability of onsite emergency diesel generators at various nuclear plants, and recommendations for corrections of these problems. The report identifies thirteen problem areas which, with one exception, are generic to all emergency generator installations. The one exception applies to plants using emergency generators driven by diesel engines manufactured by the Electro-Motive Division of General Motors (EMD-GM). Information requests concerning these recommendations have been forwarded to all licensees of operating plants. The licensees will respond to these requests stating how they meet or will meet the recommendations. The Contractor will evaluate these responses to assure that each licensee has complied with and will implement the recommendations of NUREG/CR-0660. The end product will be the preparation of a Safety Evaluation Report (SER) for each operating plant.

3.0 Mechanical Engineering and Equipment Qualification

3.1 Electrical and Mechanical Equipment Environmental Qualification

The NRC staff has underway a program to systematically evaluate the ability of safety related equipment to function in the severe hostile environment it could be exposed to during a design basis accident (e.g., LOCA, Main Steam Line Break). The licensees and applicants for licenses are submitting documentation (topical reports, test reports, etc.) to demonstrate the ability of the equipment to function as required. The contractor will review this documentation for compliance with NRC criteria.

3.2 Seismic and Vibration Equipment Qualification

Equipment important to safety must be qualified to function in any vibratory environment that could result from normal operation or a seismic event. The utility licensees and applicants for licenses are required to provide data and analyses to demonstrate the qualification of this equipment. The contractor will review the licensees and applicants submittals for compliance with NRC criteria using a set of review guidelines to be developed by the NRC and contractor for different classes of plants and approved by the NRC prior to beginning the reviews. The review guidelines will be based on Regulatory Guide 1.100, IEEE Std. 344-1975, and the NRC Standard Review Plan Sections 3.9.2, 3.9.3, and 3.10.

3.3 PWR Feedwater Line Cracks

Cracks, cracklike indications, or fabrication defects have been found in the vicinity of feedwater nozzles at pressurized water reactors. The primary cause of cracking is thermal fatigue due to significant temperature differences between the top and bottom of the pipes when the facilities are at hot standby conditions and during startup and shutdown when the feedwater heaters are not being used.

The NRC PWR Pipe Crack Study Group has investigated the safety implication of this cracking incidence and will recommend both short term and long term corrective actions to minimize the potential for further cracking. The contractor will assist the staff to review the applicants/licensees surveillance programs to ensure that both short term and long term corrective measures to be recommended by the Pipe Crack Study Group are appropriately included in their surveillance programs. This work will require a strong background in the areas of stress and fatigue analyses, thermal hydraulics and reactor system operation, materials engineering, and ASME Code Sections III and XI.

3.4 BWR Feedwater Nozzle and Control Rod Drive Return Line (CRDRL) Nozzle Cracking

Cracking in feedwater nozzle blend radius or bore region has been observed over the past few years in the majority of operating BWRs with feedwater nozzle/sparger systems. The initiation of cracking is due to high cycle fatigue caused by fluctuations in water temperature within the vessel in the sparger-nozzle region during periods of low feedwater temperature when the flow may be unsteady and intermittent. Once initiated, the cracks are driven deeper by the larger pressure and thermal cycles associated with startup and shutdown. Cracks similar to those found in feedwater nozzles were also detected in CRDRL nozzles. The cause of cracking appears to be thermal fatigue.

The resolution of these issues was recently published in NUREG-0619 which contains the staff positions on implementation of corrective measures. The contractor will review the applicants/licensees surveillance program to ensure that the recommended corrective actions will be implemented. The contractor should have expertise in the areas of stress and fatigue analyses, reactor system operation, and materials engineering. Some knowledge of ASME Code Sections III and XI is also desirable.

3.5 Piping and Support Reanalysis

There have been several cases over the past couple of years where licensees have been required to perform piping and support reanalyses. These cases resulted from the discovery of either incorrect modeling assumptions or computer code errors. To resolve this type of problem the licensee must make an assessment of the extent of problem, obtain either verified modeling data or computer codes, perform reanalysis of the affected piping and supports and make any required field modifications. The contractor will be required to review and evaluate the information submitted by the licensee to document the appropriateness of his actions. This work will require a strong background in piping analysis and support design and experience in the application of the ASME Code, Section III.

4.0 Materials Engineering

4.1 Stress Corrosion Cracking in BWR Pressure Boundary Piping

Leaks and cracks in the heat-affected zones of welds that join austematic stainless steel piping and associated components in BWRS have been observed in 304 stainless steel with diameters of 8 inches or less. The incidence of cracking has also been observed in some large diameter (>20 inches) stainless steel piping in a foreign country. All the cracks were attributed to intergranular stress corrosion cracking (IGSCC) due to the combination of high local stress, sensitization of material, and high oxygen content in the water.

The NRC staff will shortly issue an implementation document, NUREG-0313, Revision 1, which sets forth the revised acceptable methods to reduce the IGSCC susceptibility of BWR Code Class pressure boundary piping. Contractor personnel with a strong background in stress corrosion cracking problems and inservice inspection of nuclear piping will review the BWR applicants/licensees technical specifications to determine if they comply with the staff's positions to be specified in NUREG-0313, Revision 1.

5.0 Radiological Engineering and Health Physics

5.1 Radiological Effluent Technical Specifications (RETS) Implementation for Operating Reactors

The technical specifications which govern the operation of a power reactor presently include limits on the amount of radioactivity which may be released in effluents. Those technical specifications for operating power reactors must be amended to implement the requirements of 10 CFR Part 50, Appendix I and 40 CFR Part 190. The NRC staff has sent the model standard RETS to operating reactors as an example of an acceptable method of implementation. The operating reactor licensees have submitted proposals to amend their technical specifications. The RETS include specifications on effluent monitoring, environmental radiological monitoring, and radwaste equipment operation. Also, the RETS are supported by an Offsite Dose Calculational Manual and a (Solid Radwaste) Process Control Program. The contractor will review the licensee's proposed amendments and supporting documents for compliance with NRC criteria.

5.2 Radiation Monitoring to Allow Containment Purging and Vent Value Closure During Power Operation

The NRC is presently completing a generic review of the radiological consequences of containment venting or purging during power operation. The generic evaluation includes an assessment of the thyroid and whole body doses at the site boundary for the expected normal operation, for operation at the maximum permissible values of coolant activity levels and coolant leakage, and under accident conditions ranging from a small leak to the design basis LOCA. Based on the conclusions of this generic study, NRC will require limitation of containment venting/purging operations to assure that the radiological consequences are within the

applicable regulatory guidelines by appropriate tech spec's. Depending on the specific plant parameters, operating reactor licensees may submit technical specifications which differ from the generic evaluations. The contractor is to review such submittals to determine: (a) the applicability of the generic evaluation to the specific plant and site, (b) the need to modify the generic requirements for venting/purging, and (c) evaluate the radiological consequences of any deviations from the generic evaluation. The contractor is to document his review in a plant-specific technical evaluation report.

5.3 Radiological Steam Generator Replacement Programs

Steam generators at several PWRs are experiencing continued tube degradation. At three plants (Surry, Turkey Point, and Palisades) the degradation has become severe enough to warrant replacement of the steam generators. All three licensees have submitted their plans for replacement to the NRC. NRC review of the Surry Plan is complete and its review of the Turkey Point Plan is almost complete. These planned replacements (replacement is complete at Surry II) will involve occupational doses on the order of 2000 man-rems per reactor unit. The contractor will review other licensees plans for compliance with NRC criteria and regulations. The review will include the preparation of Technical Evaluation Reports, Environmental Statements, and expert testimony for ASLB hearings on the subject. The NRC criteria will be those established in the Surry and Turkey Point reviews covering such topics as:

1) Occupational radiation exposure estimates,

2) Radiological effluent estimates, and

3) Licensee efforts to maintain occupational radiation exposure as low as is reasonably achievable.

5.4 Control of Heavy Loads Over Spent Fuel Pool

Overhead handling systems are used to lift heavy objects in the vicinity of spent fuel in both PWRs and BWRs. If a heavy object, e.g., a spent fuel shipping cask or shielding block, were to fall or tip onto spent fuel in the storage pool or the reactor core during refueling and damage the fuel, there could be a release of radioactivity to the environment and a potential for radiation over-exposure to inplant personnel. NRC has initiated a generic review of the potential for such accidents at all operating reactors. For those facilities where this review indicates that damage to spent fuel, as a result of a heavy load drop, cannot be ruled out, it will be necessary to perform calculations regarding the radiological consequences of such an accident. The contractor will perform the radiological consequences calculations, including an analysis of the releases resulting from the failed fuel, transport of the radio active material to the environment, and calculation of on-site and off-site doses. The contractor may review the licensee's submittals of the radiological consequences of such an accident.

5.5 Post LOCA Hydrogen Control

Hydrogen is generated following a loss-of coolant accident as a result of metal-water reacton in the core and by radiolysis of water. Several methods are typically used in order to maintain hydrogen at safe concentrations in the post accident containment atmosphere. These include: inerted atmosphere, hydrogen recombiners, and containment venting. The contractor will calculate the radiological consequences of venting the containment for post-accident hydrogen control. The analysis includes the calculation of decay factors for a source term specified by NRC, the transport of radioactive materials to the environment, and the resulting doses at the site boundary and low population zone boundary. The contractor may review the licensee's calculations of the radiological consequences of venting the containment. The contractor will review any licensee's proposed licensing amendments and supporting documents for compliance with NRC criteria.

6.0 HUMAN FACTORS ANALYSIS OF NPP CONTROL ROOMS, PROCEDURES AND PERSONNEL

Control room layouts found in present day nuclear power plants have been designed to accomodate the function to be performed rather than firstly relating to the human operator. This lack of human engineering in control room design as well as procedures to be utilized during all plant operating modes can lead to undesired consequences such as those which occurred during the TMI-2 accident. Therefore, several types of reviews and audits must be made to assure the adequacy of current day procedures, operator training and control room design. The contractor will review the licensee proposals, i.e., licensing actions, for implementation of NRC criteria developed in response to the TMI Action Plans.

6.1 Emergency Operating Procedures

The contractor will assist NRC in the preparation of guidelines to be implemented in a review of plant emergency operating procedures. Using these guidelines the contractor will review the procedures and prepare Technical Evaluation Reports to document the results of their reviews. The initial reviews will include the emergency operating procedures for such accidents as a small break LOCA, Steam generator tube rupture, Main Feedwater transient and inadequate core cooling.

6.2 Control Room Layout

A review of control room layouts will be performed using detailed guidelines furnished by the Staff. The contractor may be required to review and comment on the guidelines before beginning the reviews. It is anticipated that the reviews will include the use of common human factors monitoring equipment (e.g., light meters, noise level indicators). A Technical Evaluation Report will be generated for each control room reviewed.

6.3 Operator Qualifications

The contractor will review licensee's operator qualification and training programs against a set of NRC requirements with specific emphasis on:

a. Adequacy of licensee's examination program for replacement operators (see NUREG-0094, NRC Operator Licensing Guides).

b. Adequacy of licensee's requalification/certification program for existing operators and training facilities.

In addition the contractor will assist the NRC in developing requirements for licensee's training instructors and review the training programs for compliance.

7.0 Structural Engineering

7.1 Spent Fuel Pool Modifications

Modifications are frequently proposed by licensees to increase spent fuel storage capacity. The increase is accomplished by using higher density storage racks. The new spent fuel storage rack designs are reviewed for structural design, materials aspects, analysis procedures for all loads including seismic and impact loadings, loading combinations and structural acceptance criteria, and quality control for the fabrication and installation. The review is performed in accordance with Sections 3.7 and 3.8 of the Standard Review Plan and the associated branch technical position on spent fuel storage. The contractor will review the licensee proposed modification for compliance with NRC criteria.

7.2 Structural Reevaluations for New or Increased Plant Loads

The staff occasionally finds it necessary to re-evaluate nuclear power plant structures in the light of new seismic and plant accident data.

Experience indicates that, on reassessment, seismic inputs tend to be raised and new plant accident loads are developed that require the reevaluation of plant structures to withstand these loadings. The contractor will perform qualitative and quantitative assessments of the suitability of plant structures to resist such loads as measured against current or modified acceptance criteria. This work requires background and knowledge of nuclear structural analysis procedures and industry concrete and steel design codes and practices.

Article 1.2 Reporting Requirements

The contractor shall furnish a monthly letter-type progress report by the fifteenth of the month for the previous month being reported. This report shall state in concise form:

a. A short description of the project and objectives;

b. A brief statement on what was actually accomplished in completing each assigned task during the reporting period;

c. Funds committed during the reporting period;

d. What is planned for accomplishment during the next reporting perod;

e. Preliminary or interim results, conclusions, trends, or other items of information that the contractor feels are of timely interest;

f. Problems or delays that the contractor has experienced in the conduct of his effort;

g. Specific action that the contractor would like NRC to undertake to alleviate a problem;

h. Updated task and sub-task schedules, network flow chart, program milestone chart, program management summary, personnel assignments, and funding from those initially submitted in the plan of work and methodology.

The contractor shall prepare a report for each licensee submittal at the completion of his review. This report shall as a minimum include:

The licensee's submittals should be r viewed to determine the adequacy of the information presented with the information requirement stated by the staff. If the submittals are found to be incomplete, the contractor will provide requests to be transmitted to the NRC staff for forwarding to licensees to obtain additional information. The contractor will determine the extent to which the licensee's design criteria comply with criteria provided by the staff. The contractor will provide a written technical evaluation for each plant addressing the acceptability of the licensee's proposed design and technical specification modifications as appropriate and the adequacy of these modifications. Copies of all progress reports shall be submitted in accordance with the above criteria and shall be forwarded to the following NRC personnel:

Fee Determination Official (FDO)	-	Darrell Eisenhut
Performance Evaluation Board (PEB)	-	*
Evaluation Coordinator	-	A. F. Glagola
Performance Monitors	-	All current monitors

The contractor shall prepare and arrange the monthly progress meeting to be held each month. Final arrangements for the meeting (i.e., agenda, date, time, and location) shall be made with the NRC Project Officer named in Article 5.1-Sec.5.0. Generally, these meetings will be held at the contractor's facilities in Philadelphia, Pennsylvania.

* E. Butcher, M.J. Mattia, J. Donohew, G. Lainas, J. Olshinski.

Article 1.3 Level of Effort

Druing the performance of work under this contract, the contractor agrees to utilize personnel in the following categories for the approximate time indicated.

Category for Franklin Research Center	Approximate Person-Hours
Department Director	1,500
Laboratory Manager	3,000
Principal Scientist/Engr.	6,000
Sr. Staff Scientist/Engr.	14,712
Sr. Research Scientist/Engr.	19,500
Res. Scientist I/Res. Engr. I	9,000
Res. Scientist II/Res. Engr. II	6,000
Research Assistant	1,800
Res. Scientist III/Res. Engr. III	3,000
Report Preparation - Technical	1,500
Report Preparation - Tying	1,500
TOTAL	67,512

The contractor agrees to use his best efforts to accomplish all the work outlined or referenced above. His obligation will be deemed complete if the work is performed in accordance with high standards of scientific and professional skill, and the approximate level of effort has been digligently applied; except, however, all other requirements must be met including delivery of reports and materials as may be required under the contract.

Section 2.0 Performance and Delivery

Article 2.1 Period of Performance

Performance of this contract shall begin on April 3, 1981 and sha extend beyond April 3, 1984, unless the period is extended by amendment of the contract.

Article 2.2 Place of Performance

The work under this contract shall be performed at the Contractor's facilities located in Philadelphia, Pennsylvania.

Article 2.3 Option to Extend the Terms and Increase the Number of Reactor Licensing Action under the Contract

The Government may at its option increase the number of Licensing Actions to be reviewed up to a maximal of 300 and extend the term of the contract for an additional one, two or three (3) years. The Contracting Officer shall give preliminary notice of the Government's intention to exerci said option at least 120 days before this contract is to expire. Th Government at anytime within this 120 day period may exercise this c if at all, by written or telegraphic notice signed by the Contractin Officer and sent within the option period specified. (Such a preliminary