

MEMORANDUM FOR: Director, Division of Contracts

FROM: Director, E. Kevin Cornell

(This form is designed to accommodate varying kinds of procurement requests, including small purchases, sole source actions and competitive solicitations. Inapplicable items or those for which you have not developed information should be left blank. In such cases, project officer should contact Division of Contracts' personnel for appropriate guidance.)

Part I - Project Data

1. It is requested that the Division of Contracts take the following action:

- | | |
|---|--|
| <input checked="" type="checkbox"/> Issue a Request for Proposal
(RFP) Limited | <input type="checkbox"/> Execute a Modification to
Contract No. _____
with _____
Name of Person or Firm |
| <input type="checkbox"/> Issue a RFP to firms awarded
_____ Basic Ordering Agreement
(type) | <input type="checkbox"/> Award a contract on basis
of our acceptance of an
Unsolicited Proposal |
| <input type="checkbox"/> Award a Sole Source Contract
to _____
Name of Person or Firm | |

2. Title of Project and brief description of work: Human factors
evaluation of control room design and operator performance at TMI-2.

8001210 415
H

ROUTING AND TRANSMITTAL SLIP

Date

7/16/79

TO: (Name, office symbol, room number, building, Agency/Post)

Initials

Date

1. K. Cornell

CONCUR: W. Johnston

2. R. Haynes

W. Parler

3. ~~C. Miller~~

~~B. Doyle~~

4. G. Frampton

5.

Action	File	Note and Return
Approval	For Clearance	Per Conversation
As Requested	For Correction	Prepare Reply
Circulate	For Your Information	See Me
Comment	Investigate	Signature
Coordination	Justify	

REMARKS

RFP for Human Factors evaluation of control room design and operator performance on TMI-2. For your signature.

POOR ORIGINAL

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: (Name, org. symbol, Agency/Post)

Room No.—Bldg.

Gordon Chipman

Phone No.

5041-102

☆ U. S. GPO: 1978-0-261-647 3354

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206

8001210415

If a modification action is requested, briefly describe nature of action:

NA

3. I request that work; pursuant to this award/modification be performed from 7/25/79 through 12/31/79.
Month-Day-Year Month-Day-Year
4. The expiration date for receipt of proposals is 7 calendar days after issuance of RFP.
5. A preproposal conference is ☐ is not ☒ contemplated.
6. ☐ No classified information is anticipated.
☒ Privacy Act information is anticipated.
☐ Classified information is anticipated. See NRC Form 187, attached.
7. The Technical Representative or Project Officer is: Gordon Chipman,
Name
telephone number 492-8924.

Part II - Funds

1. Estimated Cost: 125K Current FY: 1979
Second FY: _____ Third FY: _____
Funds Availability: This certifies that funds in the amount of
\$ _____ are available for obligation in the current budget

for the subject work and/or that estimated funds in the amount of \$_____ have been included in next year's budget request for the work (if work is contemplated beyond this Fiscal Year).

B&R No.: _____ FIN No.: _____

Appropriation Symbol: _____ Signature of Certifying Officer _____

Part III - Duplication of Effort

1. ☐ I certify that, based on inquiries made with other NRC offices, no unnecessary duplication of effort will result from the conduct of the subject work (less than \$100,000.00).
2. ☐ Attached are the certifications executed by each of the members of the Contract Review Board (more than \$100,000.00).
3. ☐ Contract Review Board certification requests have been forwarded to Board members for concurrence and/or comments. Completed certifications will be forwarded.

Part IV - Attachments

- ☒ Statement of Work (Attachment No. 1)
- ☒ Evaluation criteria and their numerical weights (Attachment No. 2)
- ☒ List of firms to be invited to submit proposals in addition to general public notification (Attachment No. 3)

- ☒ Copy of letter designating Source Evaluation Panel members
(Attachment No. 4)
- ☐ Sole Source Justification, if applicable (Attachment No.)
- ☐ Unsolicited Proposal Justification, if applicable. Approval and execution of a contract with _____ on
Name of Proposer
the basis of an unsolicited proposal is recommended. (Attachment No.)
- ☐ Contract Review Board Certifications (Attachment No.)
- ☒ Special Requirements* (Attachment No. 5)

E. J. Call
Signature of Director

Limited RFP is being used in this case because of the limited time available to accomplish the work and the fact that a normal RFP would require a minimum of 47 days before receipt of proposals. The Commission has given the Special Inquiry very high priority and a tight schedule and it would be impractical to follow normal competitive procedures.

*This pertains to instructions concerning schedules, reports, data, Government-furnished equipment, or other special requirements.

SCOPE OF WORK

I. Background

Following the accident at Three Mile Island Unit No. 2, the Commission established a Special Inquiry to assure that the NRC will have the fullest possible understanding of the events at Three Mile Island. The purpose of that evaluation is to take whatever further steps may be necessary to prevent any similar accident in the future. A major area of investigation by the Special Inquiry is the response of the operating personnel to the events. Specifically, the Inquiry must determine to what extent the control room design, operator training and selection, operator performance, and other factors, significantly influenced the sequence of events. The work scope described below is essential to the completion of this objective.

II. Objectives

- A. Task A - Identify the factors which influenced the human engineering design aspects of the control room (CR).
- B. Task B - Describe the operator activity taking place in the early phases of the accident. Based on the actual operator performance and an understanding of the control room functional design, develop an understanding of the control room design factors which significantly influenced the outcome of the accident.
- C. Task C - Where significant actions/inactions by CR operators are found to result primarily from operator performance, as opposed to CR design, determine whether the problem is a result of the operator training received, the inherent capabilities of the operators, procedures or other factors.
- D. Task D - Evaluate the application of human factors principles to Three Mile Island Unit 2 control room design as reflected in the control room system characteristics and emergency procedures. Compare the application of these principles at TMI-2 with the approach to the design of comparable complex systems.

III. Statement of WorkTask A - Control Room Design at TMI-2

The Contractor shall:

1. Identify the criteria which directly influenced the CR design as specified by the NRC and standards organizations.
 - a. Review Title 10 of the Code of Federal Regulations, NRC Regulatory Guides and Standard Review Plans as provided by the NRC which dictated the design of the control room and point out those criteria which require the application of human engineering principals to such designs.

- b. Identify relevant standards and recommended practices published by organizations other than NRC which deal with nuclear power plant control room design.
 - c. Identify which of the criteria identified in 1.b. were utilized in the design of the TMI-2 control room.
- 2. Identify the actual design basis and operating logic which led to the as-built design of the control room. Review the design studies and analyses of Metropolitan Edison Co. and its associates as provided by the NRC leading to as-built design of the control room and determine what human engineering principles were applied.
- 3. Determine if the CR was designed in accordance with the design basis and criteria identified in 1 and 2 above.
 - a. Review control room contractual documents, Final Safety Analysis Report, Construction specifications and as-built drawing as provided by the NRC to determine the human factors aspects of the control room design.
 - b. Visit Three Mile Island site for familiarization and to complete accurate description of the control room in its pre-accident configuration.
 - c. In conjunction with the NRC Special Inquiry contract project manager ("NRC project manager") compare the human factors aspects of the actual design of the control room (as determined under 3 a and b above) with the criteria and bases that led to the design (as determined under 1 and 2 above).
 - d. In conjunction with the NRC project manager, and using the results of 3.c., identify those implicit philosophical or broad based design concepts which had a significant impact on the human factors design of the control room (i.e. single failure concept).
 - e. Determine if the quantity and prominence of information presented in the control room are consistent with the design bases and criteria.
- 4. Compare the design process for TMI-2 CR with that used in other nuclear plant control rooms of the same vintage.
 - a. In conjunction with the NRC project manager, identify a limited number of plants (at least 2) of the same generation as TMI-2.
 - b. Obtain reconnaissance level information (documents and discussions) on human factors criteria and design bases used.
 - c. Visit the control rooms identified above, and assess the degree to which these designs were constructed in accordance with their respective criteria. NRC will assist contractor in obtaining access to such control rooms.
 - d. On a broad basis and in conjunction with the NRC project manager, compare the process that resulted in the application of human engineering principles to the design of the control room of TMI-2 with that of the plants identified in 4.a above.

Task B - Control Room Activity

The Contractor shall:

1. Construct a full scale mock-up of the TMI-2 control room panels utilizing photographs for the panels identified in the table below. The mock-up must be transportable in sections. Drawings of the panels will be provided by NRC in conjunction with Task A.3.b. Visit the TMI-2 CR to provide familiarity with the actual CR layout.
2. Prepare a timeline diagram of the control room activities during the first 150 minutes of the accident.
 - a. Using event chronologies and operator interviews provided by NRC, define operator activities.
 - b. NRC will identify the critical timeline actions/inactions within the control room which significantly influenced the outcome of the accident.
3. Video tape an enactment of the timeline sequence of events for use in the analysis of operator performance.
4. Based on the emergency procedures and other formal guidance available to the operators, develop an idealized timeline.
5. In conjunction with the NRC project manager, identify the control room design factors which influenced critical actions/inactions (2.b. above). Emphasis should be placed on the most significant human engineering issues.

Table of Control Room Panels to be Modeled

Control Room Desk - CONS-1
 Computer Console - CONS-2
 Aux. Systems Control Console - CONS-3
 Plant Control Console - CONS-4
 Turbine Control Console - CONS-5
 Electric Control Consoles - CONS-6A, 6B, 6C
 Fire Detection Panel - PNL-7
 Coolant Systems Monitoring Panel - PNL-8
 Reactor Coolant Drain Tank Panel - PNL-8A
 Push Pull Control Panel - PNL-9
 Plant Equipment Temp. Recording Panel - PNL-10
 Radiation Monitoring Panel - PNL-12
 SFAS Panel - PNL-13
 Control Rod Drive Panel - PNL-14
 Containment Isolation Panel - PNL-15
 Turbine Supervisory Panel - PNL-16
 Turbine Auxiliary Monitoring Panel - PNL-17
 Station Electric Aux. Monitoring Panel - PNL-18
 Vital Power Panel - PNL-19
 Nuclear Instrumentation - CAB-20, 21
 HVAC Panel - PNL-25
 Diesel Generator No. 1 & 2 Panels - PNL-26, 29
 Computer Programmers Console - CAB-188A

Task C - Operator Performance

The Contractor shall:

1. Determine the adequacy of the training program to assure the operators' capability to diagnose problems and take appropriate actions during normal and emergency conditions.
 - a. NRC will provide documents describing operator training program, TMI-2 emergency operating procedures and will make available NRC operator licensing personnel to describe the regulatory program.
 - b. In conjunction with the NRC project manager, determine if the operator training was adequate in particular with respect to the significant actions/inactions taken by the operators on the TMI-2 accident.
2. Identify the basis for each significant action/inaction resulting from operator performance that cannot be attributed to inadequate training. Where additional interviews with operators are required, this will be arranged through the NRC project manager. Types of results that might be obtained include: mismatched operator aptitude, poorly defined lines of authority or task assignments within the CR, etc.
3. Evaluate the adequacy of the transfer of information between shifts, and between operators and maintenance personnel at TMI. Review NRC and Met Ed requirements for information transfer and the implementation of these requirements at TMI-2. Compare the information transfer procedures of TMI-2 with those used in the plants identified in Task A.4.a. above.

Task D - Application of Human Factors Principles to Control Room Design

The Contractor shall:

1. Identify the systems components and procedures in the control room which played a critical role during the first 150 minutes of the accident.
 - a. NRC will identify the critical timeline actions/inactions (critical points) within the control room which significantly influenced the outcome of the accident (B.2.b.) and provide applicable emergency procedures (C.1.a).
 - b. For each critical point, identify the systems, components and procedures in the control room which did or should have played a role in the decision process.
 - c. NRC will provide documentation of the chronology of events and existing operator interviews as necessary. Requirements for additional interviews will be coordinated through the NRC contract manager.
2. For each critical system, component and procedures identified in 1 above, identify the relevant human factors considerations. This will include the factors in the relevant Human Factors engineering standards.
3. Determine the degree of compliance of the critical system and component designs and procedures to the applicable human factors principles (standards).
4. Where areas of non-compliance are identified in 3 above, in conjunction with the NRC project manager, determine the impact on operator performance at critical points.

5. Utilizing the information obtained in Task A and B and in 1-4 above, and in conjunction with the NRC project manager, evaluate the integration of the control room design with the reactor system design in the context of human factor program development. This should include the utilization of task analyses of: the role of the CR operator; generating CR staff selection and training requirements; development and testing of operational procedures (including emergency actions); and the effectiveness of Licensee Event Reports (LERs) feedback.
6. Identify the approach taken by other agencies and organizations in the design of comparable complex man/machine systems with respect to the application of human factor principles and one example of advanced CR design concept being offered by a U.S. nuclear plant supplier. The agencies and organizations investigated should include comparable industries (chemical, etc.), the armed services and NASA.

The procedural and decision-making process employed by each selected organization will be compared to the process utilized in the design of TMI-2. Significant variations should be identified and their impact on the performance of the operation estimated in conjunction with the NRC managers.

IV. Deliverables

1. For all tasks A-D
 - a. Letter status reports every 2 weeks.
 - b. Preliminary final letter report of all findings by September 28, 1979.
 - c. NRC will provide comments by October 3, 1979 and Final Letter report of all findings incorporating NRC comments by October 10, 1979.
2. Contractor may be required to deliver the CR mock-up to the Washington, DC, metropolitan area before the termination of the contract. If the mock-up is not requested by the NRC by contract termination, the contractor may dispose of the mock-up.
3. The contractor shall be available to brief NRC Commissioners and other groups (not to exceed 10 briefings or hearings) regarding their work and findings on an as needed basis.
4. Except as specifically authorized by this contract, or as otherwise approved by the Contracting Officer, records or other information, documents and material furnishing by the Commission to the Contractor in the performance of this contract shall be used only in connection with the work performed under this contract. The Contractor shall, upon completion or termination of this contract, transmit to the Commission all records or other information, documents and material, and any copies thereof, furnished by the Commission to the Contractor or data developed by the Contractor in the performance of this contract.

EVALUATION CRITERIA

- | | |
|---|----|
| I. Experience of Staff | 50 |
| a. In evaluating the application of human factors principles in complex man/machine systems associated with control design, operator training and selection, and emergency procedures. (20) | |
| b. In evaluating the actual performance of operators responding to emergency situations using human factors principles. (20) | |
| c. With familiarity in nuclear plant operations, regulatory requirements and standards. (10) | |
| II. Management Approach | 30 |
| a. Does the management plan insure proper communications and adequate scheduling to meet program objectives and required coordination with the NRC project manager? (15) | |
| b. Has the offeror committed key individuals to the project and prioritized responsibilities to ensure sufficient control and timely project performance? (15) | |
| III. Technical Approach | 20 |
| a. Does the offeror's approach demonstrate an adequate understanding of the RFP's requirements, i.e., is the approach feasible in terms of the objective of the project? (20) | |

TOTAL POINTS 100

List of Firms to be Invited to Submit Proposals

Essex Corporation
333 North Fairfax Street
Alexandria, Virginia 22314
ATTN: Dr. Malone, 548-4500 X258 (Call for pickup)

Department of Nuclear Studies
Memphis State University
Park and Getwell
Memphis, Tennessee 38152
ATTN: Wayne Jones
Telecopy #(901) 454-2687 (manual)

MARA-TIME
120 Woodbine Avenue
Northport, New York 11768
Telecopy #(516) 757-8187 (3M)
ATTN: Peter Talbot

MITRE Corp.
Westgate Research Park
McLean, VA 22101
ATTN: Robert Ouellette 827-6224
Fax #827-6308 Verify 827-6250 (Call for pickup)

DUNLAP and Associates, Inc.
One Parkland Drive
Darien, Connecticut 06820
ATTN: Dr. Bloom
TWX 7104573353 ETEX DARN

The Aerospace Corp.
P.O. Box 92957
Los Angeles, California 90009
ATTN: Fred Finlayson
Telecopy #(213) 648-7181

LETTER OF DESIGNATION

MEMORANDUM FOR: Gordon Chipman
Panel Chairman

FROM: Kevin E. Cornell
Designating Official

SUBJECT: SOURCE EVALUATION FOR Human Factors Evaluation of
Control Room Design and Operator Performance

Pursuant to Chapter V of the NRC Procurement Handbook, I hereby designate you as Chairman of the Source Evaluation Panel for Project: Human Factors Evaluation of Control Room Design and Operator Performance.

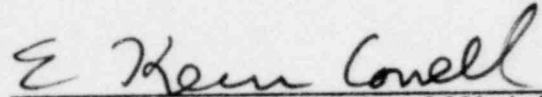
I hereby designate the following individuals as members of that Panel:
(Names of individuals and their organizational location.)

C. O. Miller - TMI Special Inquiry Staff
W. V. Johnston - TMI Special Inquiry Staff

The Source Evaluation Panel will conduct its business in accordance with the provisions of the NRC Procurement Handbook and applicable policies and procedures in the Federal Procurement Regulations. It will be the responsibility of the Chairman to determine that each Panel member is conversant with the instructions contained in the Handbook. Panel duties will take precedence over other normal duties of the Panel members.

The Panel may disclose only such information as may be necessary for the proper conduct of its duties and only to the extent and to those persons considered essential for that purpose. The right to information on a

need-to-know basis does not extend to the normal chain of supervision affecting any member of the Panel or arising out of technical responsibility for the action being evaluated except as specifically approved by the Chairman in writing on a case-by-case basis.


Signature of Designating Official

cc: Panel Members

Special RequirementsGeneral Conditions

All contact with the NRC staff and Metropolitan Edison Company and its associates and other NRC licensees will be coordinated through the NRC project manager.

The contractor shall notify the NRC project manager of information needed from Met Ed and the need for additional interviews. These will be obtained by the NRC project manager.

The NRC project manager will monitor the work of the contractor and will provide guidance in the critical evaluations as indicated in the scope of work. This will require frequent visits between the NRC project manager and the contractor.

Government Furnished Materials

Task A

1. Title 10 of CFR.
2. NRC Regulatory Guides (Division 1).
3. NRC Standard Review Plans.
4. Three Mile Island (TMI) - Preliminary and Final Safety Analysis Reports.
5. TMI-2 Construction Permit and Operating License Safety Evaluation Reports and supplements.

Items 1 through 5 above to be provided on execution date of contract.

6. Metropolitan Edison Company and Associates (Met Ed) contractual documents relating to CR.
7. Met Ed special study reports relating to control room and human factors considerations.
8. Met Ed CR and human factors design analyses.

Items 6, 7, and 8 above to be provided by August 6, 1979.

Task B - To be provided on execution date of contract:

1. Drawings of TMI-2 control room panels and layout.
2. Event chronologies and operator interviews.

Task C

1. NRC documents describing requirements for operator training and TMI-2 emergency operating procedures - to be provided on execution date of contract.
2. Met Ed documents describing the operator training program, the training received by the operators on shift at the time of the accident, operator selection criteria and qualification records of operators on shift at time of accident - to be provided by August 6, 1979.
3. Identification of the critical points of action/inaction in the event chronology which contributed significantly to the course of the accident - to be provided by August 6, 1979.

Privacy Act Considerations

1. Notification

This procurement action does require the Contractor to operate a system of records on individuals to accomplish an agency function in accordance with the Privacy Act of 1974, Public Law 93-579, December 31, 1974 (5 U.S.C. 552a) and applicable agency regulation. Violation of the act may involve the imposition of criminal penalties. Specifically, the Contractor may be required to maintain records of interviews and data regarding training, job performance and other relevant personal information. This information will be maintained for reporting requirements only during the life of the contract and it shall be returned to the NRC upon completion of the contract.

2. The Act

Privacy Act

(a) The Contractor agrees:

- (1) To comply with the Privacy Act of 1974 and the rules and regulations issued pursuant to the Act in the design, development, or operation of any system of records on individuals in order to accomplish an agency function when the contract specifically identifies (i) the system or systems of records and (ii) the work to be performed by the contractor in terms of any one or combination of the following: (A) design, (B) development, or (C) operation;
 - (2) to include the solicitation notification contained in this contract in every solicitation and resulting sub-contract and in every subcontract awarded without a solicitation when the statement of work in the proposed subcontract requires the design, development, or operation of a system of records on individuals to accomplish an agency function; and
 - (3) to include this clause, including this paragraph (3), in all subcontracts awarded pursuant to this contract which require the design, development, or operation of such a system of records.
- (b) In the event of violations of the Act, a civil action may be brought against the agency involved where the violation concerns the design, development, or operation of a system of records on individuals

to accomplish an agency function, and criminal penalties may be imposed upon the officers or employees of the agency where the violation concerns the operation of a system of records on individuals to accomplish an agency function. For purposes of the Act when the contract is for the operation of a system of records on individuals to accomplish an agency function, the contractor and any employee of the contractor is considered to be an employee of the agency.

(c) The terms used in this clause have the following meanings:

- (1) "Operation of a system of records" means performance of any of the activities associated with maintaining the system of records including the collection, use, and dissemination of records.
- (2) "Record" means any item, collection, or grouping of information about an individual that is maintained by an agency, including, but not limited to, his education, financial transactions, medical history, and criminal or employment history and that contains his name, or the identifying number, symbol, or other identifying particular assigned to the individual, such as a finger or voice print or a photograph.
- (3) "System of records" on individuals means a group of any records under the control of any agency from which information is retrieved by the name of the individual or by some identifying number, symbol, or other identifying particular assigned to the individual.

STATEMENT OF NON-PERSONAL SERVICES

1. Nature of Work - Determine to what extent the control room design, operator training, selection and operator performance at Three Mile Island Unit 2 significantly influenced the progress and outcome of the accident.

2. Factors Relevant to Personal/Non-Personal Services Are As Follows:

- a. Does the contractor have specialized knowledge or equipment which is unavailable to the Government?

Yes _____

No X _____

(If yes, explain.)

- b. Will this requirement circumvent personnel hire ceiling?

Yes _____

No X _____

- c. Does this service call for the exercise of personal judgment and discretion on behalf of the Government?

Yes X _____

No _____

(If yes, explain.) Contract manager will provide guidance to contractor on an intermittent basis.

- d. Are the services to be performed continuing, short term, or intermittent?

Short term

- e. Will the Government specify the qualification of, or reserve the right to approve individual contractor employees?

Yes _____

No X _____

(If yes, explain.)

- f. Will the Government assign tasks to and prepare work schedules for contractor employees?

Yes _____

No X

(If yes, explain.)

- g. Will the Government retain the right to supervise the work of the contractor employees, either directly or indirectly?

Yes _____

No X

(If yes, explain.)

- h. Will the Government reserve the right to supervise or control the method in which the contractor performs the service, the number of people he will employ, the specific duties the individual employees, and similar details?

Yes _____

No X

(If yes, explain.)

- i. Will the Government review performance by each individual employee, as opposed to reviewing a final product on an overall basis after completion of the work?

Yes _____

No X

(If yes, to what extent?)

- j. Will the Government retain the rights to have contractor employees removed from the job for reasons other than misconduct or security?

Yes _____

No X

(If yes, explain.)

k. Will the service be properly defined as an end product?

Yes X

No

l. Will the contractor undertake a specific task or project that is definable at the time of inception, at some point during performance, or will it be defined on a day-to-day basis?

Definable at the time of inception

m. Will payment be for results accomplished or solely according to time worked?

For results accomplished

n. Will the Government furnish the office or working space, facilities, equipment, and supplies necessary for contract performance?

Yes

No X

(If yes, to what extent?)

o. Will Government employees be used interchangeably with contractor personnel to perform the same function?

Yes

No X

(If yes, to what extent?)

p. Will contractor employees be integrated into the Government's organizational structure?

Yes

No X

(If yes, to what extent?)

DATE

July 16, 1979

Signature

Gordon Chipman

Name

Gordon Chipman

Title

TMI Special Inquiry Staff

DETERMINATION OF NON-PERSONAL SERVICES

I hereby determine the requirement set forth in Paragraph 1 above involves services that are non-personal in nature.

Date:

Contracting Officer