UNITED STATES
NUCLEAR REGULATORY COMMISS
WASHINGTON, D. C. 20555

Ramos

June 8, 1976

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E. L. Halman, Director
Division of Contracts
Office of Administration

STUDY OF CONTROL/COMMUNICATIONS FOR IE'S INCIDENT MANAGEMENT CENTER

IE is very anxious to initiate and obtain assistance in designing command and communication procedures for the IE Incident Management Center. Enclosed is a (1) work statement for a study that will provide such assistance and (2) a sole source justification for using MITRE Corporation (of Reston Virginia) as the contractor.

Based on conversations with MITRE, IE has budgeted $91,000 for this study under B&R 30-19-06, FIN B1222. This memorandum obligates the funds for this study and certifies that such funds are available under FY 1976 appropriation # 3160200.306. Please initiate such a contract as soon as possible.

L. I. Cobb
Assistant to the Director
Office of Inspection and
Enforcement

Enclosures:
1. Work Statement
2. Sole Source Justification

cc w/enclosures:
E. Volgenau, IE
H. D. Thornburg, IE
D. Thompson, IE
S. Bryan, IE
R. G. Gilbert, IE
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J. Lincoln, CON

8001210549

WORK STATEMENT

STUDY OF CONTROL AND COMMUNICATIONS REQUIRED FOR INCIDENT MANAGEMENT

The Office of Inspection and Enforcement (IE) has an interim Incident Management Center. This center focuses NRC's response to incidents. In particular, it should communicate the events in the field to NRC headquarters and direct additional NRC, Federal and other resources to resolve the incident.

The purposes of this study are to:

- Define the control, and communications alternatives associated with the preparation for incidents

- Define the command, control, and communications procedures for managing incidents

- Identify the authority and responsibility relationships within and between the NRC (with additional emphasis on NRC regional offices), other Federal Agencies, state and local organizations, and licensees

- Define the options for manning and equipping the IE Incident Management Center

- Define the options for manning and equipping the Regional Office's portion of the IE Incident Management Center.

BACKGROUND

The NRC has responsibility for responding to, evaluating, and managing the reaction to incidents and nuclear emergencies related to its licensees. This responsibility also includes coordination with other Federal, state and local agencies with concurrent or peripheral responsibilities in the event of an incident. NRC's role during incidents is described in NRC Manual Chapter 0502 and IE's Manual Chapter 1300. Recent experience (for instance, the Browns Ferry fire) exemplifies the urgent need for both prompt information assessment and the proper command and control capabilities so as to facilitate NRC's response to incidents.

It appears that additional capabilities emphasizing appropriate communications facilities are essential to effectively assess the nature of each incident and to coordinate NRC's and, in particular, IE's response. However, it is not clear whether it is necessary or practical to operate such incident management/communications facilities on a full-time basis or to activate them only when an incident occurs. Full time operation of incident management/communications facilities might speed response to incidents while permitting routine tracking of critical information. Instances of such routine tracking include tracking SNM shipments, monitoring the

collection and dissemination of generic, safety related data. On the other hand, full-time operation might not be cost offective for performing any or all of the anticipated routine tasks or even for rapid and dedicated conversion to an incident-response mode. The incident-activated alternative might be too slow in starting up and might be to infrequently used to justify the cost of establishing and maintaining the center's equipment information bases and procedures.

There are also policy questions which may have to be discussed as a part of this study. For instance, the question of control over ERDA resources responding to NRC-responsible incidents; the need for NRC to have more incident response equipment; and the need to define the extent of NRC's responsibility to "manage" a licensee incident. While the thrust of the study concerns the command and control aspect, other issues may have to be considered in order to scope incident response capabilities.

STUDY SCOPE

Identify authority/responsibility/coordination relationships within NRC (including the Regional Offices); and between NRC and other Federal, state and local agencies, and between all of these and NRC licensees. Consider how these relationships impact on required functions and capabilities of an incident response/operations facility.

Develop a range of credible scenarios with varying severity in terms of threats to public safety and health, threat to national security, rapidity of incident development, and difficulty of determining actual events.

Evaluate alternative command, control and communications facilities needed for the preparation for and management of incidents.

Consider and evaluate routine, operational uses of such facilities. Develop manning and equipment options for the information assessment and the command and control alternative proposed. Compare and contrast the facility alternatives and recommend the most viable alternative or alternatives. Provide the rational for the selection, including reasons why some alternatives were rejected. Provide background data about existing command and control facilities in use by other Federal agencies which have analogous missions.

Evaluate the need for facilities at the regional level and their potential interfaces with the various headquarters options.

TASKS

(1) Identification of NRC Mission and Communication Options

Analyze and describe the authority and responsibility relationships within NRC (including the Regional Offices) and NRC's relationships with other Federal agencies, state and local organizations, and licensees.

Identify NRC missions, roles and functional requirements for incident management as a function of several factors including: priority assigned to incident management, extent of NRC responsibility (including degree of autonomy), and kinds of incident of highest concern.

Prepare brief descriptions of existing and planned communication capabilities between the NRC Headquarters, NRC Regions, licensees, ERDA's Emergency Operation Center, ERDA Radiological Assistance Teams, Department of Justice/FBI, White House, IRAP signatories, Federal Preparedness Center, the Department of Defense, state and local agencies and other potentially involved organizations. Assess the impact of these relationships on the nature and operation of NRC incident response capabilities.

(2) Depiction of NRC Scenarios

Prepare and analyze scenarios of incidents by degree of impact on public health, public safety and national security. Incorporate into these scenarios those credible levels and incidents as defined in Manual Chapter 1300.

(3) Determination of Alternative Functional Requirements

Based on the factors described in tasks (1) and (2), define a range of functional requirements for information handling to support decision making, decision execution, and cooperation with other agencies.

(4) Description and Assessment of Present Systems and Processes

Summarize the contents of existing NRC emergency plans, interagency agreements, and command, control and communications capabilities. Evaluate the functional adequacy of present NRC arrangements in terms of their ability to accomplish the alternative functional requirements developed in task (3).

(5) Exercise and Evaluation of Incident Management Capability

Identify "alternative levels" of incident management control capability so as to exercise (and evaluate) the incident management capabilities of NRC. Families of exercises should be described which vary in terms of: incident severity, number of participants (within NRC headquarters and elsewhere such as NRC Regional Offices, states, and licensee), and their realistic possibility of occurrence. "Alternative levels" of capability to support exercises should be defined including scenario generation, exercise control, simulation of the environment, and monitoring of the performance of NRC's incident management.

(6) Development of Concepts of Operation

Identify and analyze alternative for (1) information collection and assessment and (2) command and control concepts of operation. This should include both headquarters and regional responses to incidents. Consider the role and effectiveness of incident management capabilities to support routine operations as well as incident management activities. Address the interfaces between NRC headquarters and the regional offices, and between NRC and other Washington area agencies.

(7) Development of System Design Alternatives

Prepare system design alternatives to support the functional requirements (Task (3)) and operational concepts (Task (6)) define above.

For each system design alternative describe the type of equipment (communications, information processing, and administrative) and the manning required for the NRC headquarters and NRC regional office incident management function. As appropriate, incorporate the use of portable emergency radio systems, mobile command posts and communication security devices.

In developing the system design alternatives, describe and draw on background data about existing command and control facilities in use by other federal agencies which have analogous missions.

Compare the cost and capabilities of alternatives in terms of their ability to successfully perform NRC's mission in the various scenarios. Recommend the concepts most capable of meeting NRC's needs and develop a time table to evaluate these in greater detail and to implement capabilities in a time-phased manner.

STUDY SCHEDULE AND OUTPUTS

This study is to be completed within 4 to 6 months. During that period the contractor will provide oral reports on progress towards completion of each of the tasks. Such oral reports are expected to be monthly in nature.

It is expected that each task will result in a written report. As each task is completed, a draft version (5 copies) of the task report will be submitted to IE for review and comment. Upon completion of all tasks a final version of all task reports will be submitted to IE as the study report (10) copies. The study report will include Introduction, Summary, and Conclusion sections.

The IE technical liaison for this study is the chief of its Field Operation Support Branch. Mr. Sam Bryan is presently serving as Acting Chief of that Branch. All draft task reports and the final study report should be sent to Mr. Bryan.

Monthly billings for effort expended on this study will be submitted by the contractor to the NRC Controller. Each billing should cite the following coded descriptors: B&R 30-19-06/FIN B1222-6. The billings should separtely identify costs related to (1) professional manpower effort (in man months) (2) travel, (3) special expenses, and (4) administrative and overhead costs.

SOLE SOURCE JUSTIFICATION

Use of Mitre Corporation on a Study of Control and Communication for Incident Management

MITRE Corp. is being recommended as the sole source contractor on an IE sponsored study of Control and Communications for Incident Management. This study is being funded under B&R 30-19-06, FIN B1222. The study is expected to require the efforts of 3 or 4 professionals each providing 3 tc 4 months of effort. Conversations have been held with MITRE Corp. personnel and they have estimated that they would request remuneration of $91,000.

MITRE Corp. has been involved in designing and evaluating command and control centers in many Federal Agencies. Their competence in this area is virtually unsurpassed. Attachment #1 lists representative MITRE Corp. efforts in command and control center design for the Department of Defense, Arms Control and Disarmament Agency, Environmental Protection Agency, Council on Environmental Quality, Federal Aviation Administration, and The Washington D. C. Police Department.

MITRE Corp. also has strength in nuclear and energy programs. One indication of this is their efforts on E.P.A.'s National Radiation Protection Program as described in Attachment #1.

Attachment #2, 3, and 4 are the resumes of those individuals whom MITRE expects to assign to this study. These individuals have obvious and extensive experience in designing, evaluating, and improving control and communication systems.

ATTACHMENT #1

Department of Defense National Military Command System (NMCS) Engineering

Since 1964, MITRE has been providing system engineering and technical support to the NMCS. Over the years, MITRE's technical support to the NMCS has covered a wide range of activities related to NMCS operations including requirements studies, communications system design and evaluation, computer system analysis and design, computer system concept formulation, technical monitoring of contractors, development of technical procedures, and operational planning analysis. Specific examples of this support are given below.

Emergency Message Automatic Transmission System (EMATS)

MITRE is supporting the Defense Communications Agency (DCA) and the Joint Chief's of Staff (JCS) in upgrading the EMATS, which is the JCS dedicated communications system for transmitting Emergency Action Messages (EAMs) to selected military subscribers.

Recent JCS requirements call for upgrading the existing EMATS to expedite the composition, verification, and transmission of EAMs to current plus additional military subscribers. To satisfy these requirements, MITRE has prepared the design specifications for the improved EMATS. The design approach calls for the upgrading and replacement of the existing EMATS control stations, central storage unit, and out-station terminal equipments. The improved EMATS will utilize a computerized terminal capable of automating a number of the associated message preparation and communications tasks.

Automatic Message Processing System (AMPS)

MITRE has provided system engineering efforts in support of DCA for the development of the AMPS. AMPS consists of computer systems located in the Pentagon and the alternate National Military Command Center (NMCC) which provide for the automation of the message distribution and communication center functions for the Secretary of Defense, the JCS, the NMCC, and the Defense Intelligency Agency.

Minimum Essential Emergency Communications Network (MEECN)

MEECN is the integration of the last resort emergency communications system into a single survivable communications capability to provide for the transmission of National Command Authority decision to the appropriate forces. The MEECN System Engineer, supported by the MEECN System Office within DCA, is responsible for the necessary action to assure this capability. Recent MITRE activities in support of the MEECN system Office have focused on specifying and conducting tests designed to isolate current communications problems and to quantifying current system limitations.

WASHPAX SYSTEM

MITRE is currently assisting DCA in upgrading the Washington Area Secure High Speed Facsimile System which connects national level military and civilian decision-makers. Areas of assistance have been focused on total system network operation, high capacity media (megabits), and terminal specification.

Expanded National Military Command Center (ENMCC)

MITRE has provided engineering planning for the enhancement of the NMCC to provide a larger and more effective facility for the National Command Authority.

Advanced Airborne Command Post (AABNCP)

MITRE is providing technical assistance to the AABNCP Project Office of the Command and Control Technical Center.

The center's responsibilities in AABNCP program include the technical and managerial supervision of those communications required to interconnect the AABNCP to the facilities of the Defense Communications System Minimum Essential Emergency Communications Network and the NMCS.

MITRE is assisting in the development of trade-off analyses, implementation guidance and subsystem specifications; the evaluation of proposals and the review of component, subsystem, and system designs as the AABNCP and the NMCS/AABNCP interface programs evolve from conception through design and development to implementation and test.

Assistant Secretary of Defense for Intelligence

MITRE is providing systems research, and planning and technical support to the Office of the Assistant Secretary of Defense for Intelligence (OASDI). Analysis and planning studies are being performed to define and examine ways in which warning and intelligence capabilities of the World Wide Military Command and Control System (WWMCCS) may be improved. Technical support also is being provided in analyzing special technical problems identified by OASID.

The first study undertaken by MITRE for OASDI was concerned with the definition and justification of those critical intelligence objectives that need to be accomplished by the WWMCCS in order that national defense policy might be successfully implemented.

ARMS CONTROL AND DISARMAMENT AGENCY (ACDA)

Crisis Control Study

The objective of this study was to determine the role that communication facilities, procedures and policy could play in preventing, controlling and terminating crisis situations and local conflicts with emphasis on the prevention of nuclear war. The project focused on the use of telecommunicati by the National Command Authority and ambassadorial level personnel.

The project included: (1) a review of past crises to determine the role telecommunications did play or could have played in crisis, control; (2) an analysis of potential crises; (3) an assessment of existing telecommunication systems and telecommunication technology relative to their applicability to crisis management and (4) the integration of the results of these analyses into concepts for policies to improve crisis management communications.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

National Radiation Protection Program

A National Radiation Protection Program was developed as a joint effort between the Office of Radiation Programs in the Environmental Protection Agency and MITRE. Topics covered include; (a) health risk rationales, (b) authority and jurisdiction, (c) standards, (d) governmental coordination, (e) strategic approach, (f) areas of concern (18 problem areas), and (g) priority selection.

Air Quality Monitoring Network and Data Base

The objective of this project is to determine the optimum configuration for Federal, regional, state, and local air monitoring networks and to provide a National Aerometric Data Bank for use by EPA. This project has involved a number of efforts which have accumulated in the development of a concept for a "National Aerometric Data Information Service" currently being implemented. A central element in this service is the National Aerometric Data Bank which was assembled and is operating on a computer facility in the MITRE/Washington complex and at the EPA facility in the Research Triangle Park, North Carolina.

COUNCIL ON ENVIRONMENTAL QUALITY

Monitoring the Environment of the Nation

The objective of this study was to identify parameters for determining the

state of the nation's environment; to develop a design concept for a system to monitor the environment; and to examine alternative configurations for the system.

FEDERAL AVIATION AGENCY

Since 1963, MITRE has provided comprehensive systems engineering support to the Federal Aviation Agency in the design and implementation of the en route National Airspace System (NAS), a nationwide automated air traffic control system. MITRE responsibilities have included analysis of system capacity and functional requirements; design of the overall system configuration of radar, communications, computers, facilities, and procedures development of detailed design requirements and performance specifications for hardware elements and operational software; assistance in RFP preparation and proposal evaluation; systems engineering monitoring and technical direction of contractors during development; assistance in the testing of subsystems and in systems integration testing and operational performance evaluation. MITRE has developed master implementation and test plans to guide the installation and testing of NAS components throughout the country and has established field sites for conducting system tests of the engineering model and the initial operational component of NAS.

WASHINGTON METROPOLITIAN POLICE DEPARTMENT (MPD)

Television Systems

MITRE developed a Master TV Development Plan for the Washington Metropolitan Police Department. The project was initiated with an analysis of MPD requirements. A comparative analysis of candidate requirements was performed to determine the effectiveness of television systems in the four primary categories of MPD operations:

(1) police training operations,
(2) administrative/clerical operations,
(3) routine patrol and investigation operations, and
(4) command level and emergency operations.

The final recommended system was composed of several diverse subsystems. These included city-wide simplex and duplex microwave links, airborne and mobile microwave links, baseband cable links, television origination and distribution systems, and several special television surveillance systems. Much of the recommended system is a key portion of the police chief's central command post.

Beyond defining the requirements for optimizing the configuration for, and designing the system, MITRE also provided detailed system specifications, made cost estimates, defined maintenance and support requirements, and provided detailed implementation and procurement schedules.

RESUME

CHARLES W. SANDERS

Mr. Sanders is the Associate Department Head of the Resources Planning Department and is currently managing and contributing to several telecommunication projects. The present work includes the second phase of an economic and technical analysis relative to future development and harmonization of the European telecommunications networks. This work continues to be sponsored by the European Economic Community. The results are to be used jointly by the EEC and the Consortium of European Post and Telecommunications (CEPT) Administrations Mr. Sanders is also a member of a group working on a study for the Arms Control and Disarmament Agency. The study is concerned with communication among Heads of State during a crisis situation.

PRIOR EXPERIENCE

Recently, he was a member of the Navy Strategic Systems Study Group (SSSG) and was concerned with command and control communications for advanced strategic weapon systems. The SSSG was sponsored by the Naval Surface Weapons Laboratory to develop concepts for new surface and submerged weapon systems for the 1985-1990 time frame.

In 1974 he completed the first phase of an economic study of the development of European Telecommunication Systems involving economies of scale, integration and standardization. This project was sponsored by the European Economic Community.

Also in 1974 Mr. Sanders was Project Leader of the Study of French Telecommunications for a Decentralized France of the year 2000. The project was concerned with all aspects of telephone, data and television services and system development.

During 1973 he was a member of the team concerned with the development of concepts for the operational test and evaluation of the AEGIS Weapon System for the Navy.

In 1972 he was the Project Leader for several tasks concerned with secure voice communications. The work included the requirements analysis and system design for a special secure voice system for a classified facility. In addition he was the Project Leader of the National Secure Voice Communications System Study which was done for the Office of the Assistant Secretary of Defense for Telecommunications. The project was concerned with requirements analysis and conceptual designs for a national level secure voice communication system for the 1975-1985 period.

Since 1967 he has been the Project Leader of several electronic intelligence system analysis efforts. The projects have been concerned with the analysis, design optimization and evaluation of collection and signal processing systems. Trade-off studies of the capabilities of receiving systems, signal processors and computer control have been a major part of this work.

Between 1963 and 1967 he was the head of the Communications Analysis Subdepartment which was concerned with the analysis and design of communication networks for the National Military Command System. He contributed to the analysis and design of digital and voice communication systems, as well as the analysis of defense satellite communication systems. The emphasis was on communications between computer systems and between computers and terminal devices.

Between 1960 and 1963 he contributed to the design of post-attack command and control systems for the Strategic Air Command and designed airborne communication networks and bomber strike reporting systems. The emphasis of the work was on survivable communications systems including satellite systems.

Between 1957 and 1960 he worked on the SAGE Air Defense System where he was responsible for the test and checkout of the BOMARC missile launch control equipment and the interface of the BOMARC system with the SAGE Direction Centers. He also contributed to the analysis of the registration of radar targets in the processing of simultaneous tracking by several radars.

EDUCATION

Creighton University, B.S., Mathematics, 1957.

George Washington University, Master of Engineering Administration, 1967.

MIT, Additional graduate work was done in the Electrical Engineering Department with the emphasis on Statistical Communication Theory.

PROFESSIONAL SOCIETIES

Institute of Electrical and Electronic Engineers.

ATTACHMENT A

28 July

RESUME -

WILLIAM B. WOODWARD

EDUCATION

Denver University, BS, Physics, 1951.

Brown University, MS, Applied Mathematics, 1958.

EXPERIENCE

The MITRE Corporation; July 1963 to present.

May, 1972 to present--Associate Technical Director, National Command and Control Systems Division. Responsible, on an associate basis, for overall direction of the Division's system engineering and analysis activities with prime emphasis on those related to Worldwide Military Command and Control System and to National Military Comma System developments. Also concerned with support to intelligence community customers, including special studies for the Office of the Assistant Secretary of Defense, Intelligence, and computer networking developments.

October 1969 to April 1972 - Department Head, National Systems Analysis Department. Department of 40 to 50 professional staff concerned with planning, analysis and engineering support to DCA for development of the NMCS. Department commenced planning for overall design of future NMCS, as well as doing detailed system engineering (both hardware and software) for critical NMCS subsystem Department initiated MITRE support to the Minimum Essential Emergency Communications Systems Office with emphasis on developi a comprehensive test and evaluation program.

October 1968 to September 1969 - Department Head, Systems Engineering Department. Headed a small staff of professionals doing special studies for the Joint Systems Integration Planning Staff (JSIPS) Performed studies evaluating the potential development and deploymen of indications and warning systems as part of the overall continental aerospace warning defense structure.

January 1966 to September 1969 - Department Head, Space Mission Control Systems Department, and Director, Houston office. Initiated Houston office support to NASA with the engineering develop

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of the Mission Control Center for late Apollo and post Apollo missions. The department, consisting of approximately 20 professional staff, conducted design reviews of the Mission Control Center systems used to control manned spaceflight missions. Also assisted NASA with system planning for the Apollo Lunar Surface Experiments program a future Apollo and manned orbiting laboratory missions.

July 1963 to December 1965 - Associate Department Head, Command Systems Department. Department consisted of 30 to 40 professional staff involved with the development, implementation, system test and evaluation of the command control system for the NORAD Cheyenne mountain complex. Specifically concerned with planning, conduct and evaluation of the large scale system tests (Category 2) immediately preceeding turnover of the system to the Air Force on it initial operational capability (IOC) date. Also assisted in developing plans for the operational system tests (Category 3) which immediately followed IOC.

May 1961 to June 1963 - Institute of Naval Studies, Staff Member and Project Leader. Participated in a major review (along with representatives from many Service Agencies and contractors) of Navy command and control systems. Headed a six-man study of the use of nuclear weapons in anti-submarine warfare.

January 1959 to May 1961 - The MITRE Corporation, Subdepartment Head and Site Leader at Montgomery, Alabama office. At the Montgomery site the MITRE Corporation managed a system engineering group consisting of approximately five engineering firms concerned with the development of the semi-automatic ground environment (SAGE) system. Managed groups concerned with the installation and test of the frequency diversity radars in the Montgomery SAGE Air Defense sector and with planning, conducting and evaluating SAGE system tests including live firings of Bomarc-B missiles. Managed small group of professional staff concerned with monitoring and evaluation of IEC and SDC development of software for the SAC Command Control System.

March 1956 to December 1958 - MIT, Lincoln Laboratory, Staff Member. Analyzed data storage requirements for SAGE software systems. Planned, designed, participated in and evaluated system development tests using the experimental MIT SAGE sector.

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September 1951 to March 1956 - Brown University, Research Assistant. Conducted theoretical and experimental research in str analysis of visco-elastic materials.

January 1950 to August 1951 - Denver University, Research Assistant. Designed infra-red spectrometers; conducted experimer evaluating the atmospheric absorption of infra-red solar radiation, including operation of high altitude laboratory in Colorado collecting analyzing and evaluating IR da

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Attachment 4

RESUME

DR. WALTER F. YONDORF

Dr. Yondorf is the Technical Director of MITRE's National Command and Control Systems Division. The division provides systems engineering and other scientific and technical support to defense and civil agencies. Its sponsors include the Defense Communications Agency, the Defense Special Projects Agency, Safeguard Systems Command, the Department of Transportation, the Treasury Department, the Washington, D. C., Metropolitan Police Department, the Advanced Ballistic Missile Defense Agency, the Air Force Systems Command, and the Advanced Research Projects Agency.

PRIOR EXPERIENCE

1962 - 1971: The MITRE Corporation

Dr. Yondorf's earlier assignments as Department Head and Associate Technical Director have included the development and implementation of a five-year plan for the improvement and automation of JCS strategic mobility planning, responsibility for requirements analysis of the National Military Command System, research in crisis management, and the design of nuclear exchange simulation models. In 1967 Dr. Yondorf was project leader of a special tactical warning and attack assessment system study for the Defense Communications Agency.

1960 - 1962: Laboratory for Applied Sciences, University of Chicago

Before joining MITRE, Dr. Yondorf was a Senior Staff Member at the Laboratories for Applied Sciences of the University of Chicago where he was engaged in strategic studies and the analysis of limited conflict. Earlier, Dr. Yondorf taught courses in Communications at the University of Chicago and served as Assistant Research Director of the University's Committee on Communication. As a Fellow of the Social Science Research Council, Dr. Yondorf undertook a study of the dynamics of integration in the European Common Market.

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EDUCATION

University of Chicago, M. A., Political Science, 1956.

University of Chicago, Ph. D., Political Science, 1962.

PROFESSIONAL SOCIETIES

American Political Science Association.

Armed Forces Communications and Electronics Association.

HONORS

Fellow of the Social Science Research Council, 1959-1960.

University of Chicago Fellow, 1958-1959.

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BIOGRAPHY

EDUCATION

Lamar State College of Technology, Beaumont, Texas
B.S., Mathematics, 1957
B.S., Electrical Engineering, 1958

Louisiana State University, Baton Rouge, Louisiana
M.S., Electrical Engineering, 1960
Ph.D, Physics, 1963 (Minor in EE)

EMPLOYMENT

Present — The MITRE Corporation
Division Staff
Energy, Resources and the Environment

also

Director, Solar Energy Laboratory

1969 - 1974 — University of Houston
Associate Professor Physics
Supervised research group and graduate students working on plasma physics, direct energy conversi and solar energy utilization. Taught electromagn field theory, plasma physics, and electronics for scientists.

1967 - 1969 — University of Houston
Assistant Professor of Physics
Duties similar to above.

1966 - 1967 — Texas A&M University
Assistant Professor of Physics
Duties similar to above.

1963 - 1966 — Oak Ridge National Laboratories
Research Physicist in the Controlled Thermonuclea Research Division (Project Sherwood)

Summer 1963 — Louisiana State University
Visiting Assistant Professor of Physics.

1961 - 1963 — Louisiana State University
Research Assistant in the Neutron Spectroscopy Laboratory
Nuclear research on neutron cross-sections using pulsed 1 mev van Degraff. Also constructed nano-second electronic equipment.

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Summer 1960 — Bell Telephone Laboratories
Member of the mechanical staff
Research and development work in microwave components.

1959 - 1961 — Louisiana State University
Instructor in Electrical Engineering

Summer 1958 — Convair Aircraft
Flight Test Engineer

EXPERIENCE

Electronic Instrumentation, Atomic and Molecular Physics (including mass spectrometers), Radiation Interactions, Electron Physics, Microwaves, Optics (Lasers), Plasma Physics, Nuclear Structure Physics (Low Energy Nuclear Physics), Neutron Physics, High Energy Pulse Systems (Capacitor Discharge), Nanosecond Electronics, Microwave Measurements, Direct Energy Conversion, Solar Energy Utilization, Nuclear Fusion.

MOST RECENT PUBLICATIONS

"Nonelastic Cross Sections of Pb^{206} and Pb^{208} for 14-Mev Neutrons," G. M. Haas and P. L. Okhuysen, The Physical Review, Vol. 131, No. 3, p. 1211, Nov., 1963.

"Properties of a High-Beta Plasma Produced by Electron-Cyclotron Heating," Dandle, England, Ard, Eason, Becker, and Haas, Nuclear Fusion 4, 1964.

"Electron-Cyclotron Heating Experiments in the Physics Test Facility," Haas, et. al., ORNL-3656, April 30, 1964.

"Electron-Cyclotron Heating Experiments in the Elmo Facility," Haas, et. al, Sec. 3.2, ORNL-3968, October 1965.

"Energetic Neutral Injection into an Electron Cyclotron Plasma," Ard, Dandle, England, Haas, Lazar, Plasma Physics and Controlled Nuclear Fusion Research, CN-21/101, Vol. II, 1966 (153).

"Ion Heating Using a Modulated Electron Beam," G. M. Haas and R. A. Dandl, Bulletin of the American Physical Society, 11, 766 (1967).

"Observation of Ion Heating Using a Modulated Electron Beam in a Magnetic Field," G. M. Haas, and R. A. Dandl, Physics of Fluids, Vol. 10, No. 3, March 1967.

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PUBLICATIONS (CONTINUED)

"Observation on the Interaction of a Modulated Electron Beam with a Plasma," G. M. Haas, Bulletin of the American Physical Society, 12, 192 (1967).

"Ion Heating at the Electron-Ion Hybrid Resonance Frequency," G. M. Haas and M. A. Bisner, Bulletin of the American Physical Society, 13, 1517 (1968).

"Dielectric Effects of Ion Heating by Inhomogeneous Time Varying Electric Fields," M. A. Bisner, T. V. Lautzenhiser, and G. M. Haas, Bulletin of the American Physical Society, 13, 1517 (1968).

"The Interaction of a Modulated Electron Beam with a Plasma," G. M. Haas and M. Bisner, Proceedings of the International Conference on Phenomena in Ionized Gases, Bucarest, Romania, September, 1969.

"Observation of Oscillation at the Ion-Ion Hybrid Frequencies," G. M. Haas, Physics of Fluids, Vol. 12, No. 11, November 1969.

"Beam Heated Ions in a Non-Beam Formed Plasma," D. R. Beeth and G. M. Haas, Bulletin of the American Physical Society, 15, 1409 (1970).

"Ion Test Probe Measurement of Radial Plasma Fields Induced by Modulated Electron Beam," T. V. Lautzenhiser, G. M. Haas, M. Bisner, Bulletin of the American Physical Society, 15, 1411, (1970).

"Investigation of Ion-Heating by a Modulated Electron Beam," G. M. Haas and M. Bisner, Physics of Fluids, Vol. 14, No. 3, March 1971.

"Solar Energy, A Review of the Field," G. M. Haas, Symposium on Energy, Resources and the Environment, The MITRE Corporation, McLean, Va. MITRE Report M72-50, February 1972, 241-340.

"Reply to the Comments of V. P. Ghatnagar and W. D. Getty," G. M. Haas, Physics of Fluids, Vol. 15, No. 3, March 1972.

"Large Scale Concentration and Conversion of Solar Energy," A. F. Hildebrandt, G. M. Haas, W. R. Jenkins, and J. P. Colaco, AGU Journal, EOS Vol. 53, July 1972.

"MITRE Photovoltaic Energy System: Basic System Concepts," G. M. Haas and S. Bloom, The MITRE Corporation, McLean, Va., MTR-6779, October 1974.

"Electricity From Photosensitisation of Titanium," J. Kenney, D. H. Weinstein, and G. M. Haas, Nature, Vol 253, No 5497, Feb 1975.

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