AFFIDAVIT OF ROBERT K. WEATHERWAX

Robert K. Weatherwax does state under oath the following:

1. I am President of Sierra Energy & Risk Assessment, Inc., ("SERA"). A description of SERA and its technical capabilities are set fortn in Exhibit 1 hereto.

2. On or about April 5, 1984, I was contacted by MHB Technical Associates, consultants to Suffolk County, who inquired whether SERA was available to perform analyses of the reliability and availability of the AC power systems relied upon by LILCO in its Supplemental Motion for a Low Power Operating License. Subsequent to these initial discussions, SERA on April 13, 1984 made a formal proposal to Suffolk County and is now entered into a contract with Suffolk County to perform such analyses. A copy of the technical scope of the contract is Exhibit 2 hereto.

3. SERA is presently pursuing the technical work necessary for Phase I. We expect to complete Phase I by April 25, 1984. The delay from the April 20 schedule set forth in Exhibit 2 is due to illness of one of SERA's staffers.

4. In Exhibit 2 we estimated that our technical report could be completed by May 25, 1984, at the earliest, with testimony to be prepared shortly thereafter. This completion date has already been unavoidably delayed by 5 days due to the illness referred to in paragraph 3. I now am hopeful that we can complete the technical report by early June, 1984.

5. It is not possible for SERA to provide testimony concerning the LILCO Motion until after our technical report has been prepared. Accordingly, it is impossible for SERA to submit testimony in the NRC low power proceeding by April 20, 1984, the date established by the NRC's Licensing Board.

April 19, 1984

Robert K. Weatherwax

ROBERT K. WEATHERWAX

Subscribed and sworn to before me this 19TH day of April, 1984 in the City of SACRAMENTO, State of CAL.

Gary E. Yates

NOTARY PUBLIC

My commission expires: 5/20/87

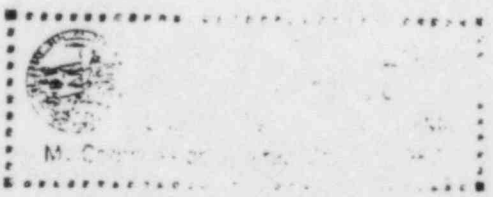

EXHIBIT 1

SERA
Sierra Energy and Risk Assessment, Inc.

April 13, 1984

Mr. Lawrence Co Lanpher
Kirkpatrick, Lockhart
1900 M Street, N.W., 8th Floor
Washington, D.C. 20036

Dear Mr. Lanpher:

Enclosed with this letter is the proposal specifying the terms and conditions according to whicn Sierra Energy and Risk Assessment, Inc. (SERA) would provide consulting services to Suffolk County, N.Y., in the matter of Long Island Lighting Company's motion for low-power operating license.

Please note that since the contract will be on a time and materials basis, including reasonable and actually incurred expenses, the labor and charges portrayed in our proposal are only approximate estimates.

To facilitate a timely delivery of Phase 1 products we have already initiated our efforts towards this project; relying on your verbal assurances that Suffolk County would approve a contract for SERA's services.

Yours truly,

ROBERT K. WEATHERWAX
President

RKW/ldb
Enclosures

cc: Gregg Minor, MHB, Inc.
Enclosures

PROPOSAL TO REVIEW EMERGENCY POWER SYSTEM PROPOSED BY LONG ISLAND LIGHTING COMPANY FOR USE DURING LOW-POWER OPERATION OF THE SHOREHAM NUCLEAR POWER STATION

1. ASSUMPTIONS

1.1 Phased Tasks

The work would be segmented into three phases as follows:

1) Preparation of detailed work plan for comparative assessment of newly proposed Long Island Lighting Company (LILCO) power system configuration for use during low power testing with the originally proposed power system configuration were it to have operated as intended. The work will be scoped to address the issues pending before the Nuclear Regulatory Commission (NRC) Atomic Safety and Licensing Board (ASLB) which is considering LILCO's new low-power motion.

2) Performance of the scope of analysis described in Phase 1 plan, and

3) Preparation and presentation of testimony regarding the results of the Phase 2 effort.

1.2 Relationship Between Phases

Phases will be conducted serially and each new phase would begin only with sponsor's acceptance of prior phase product and with an assessment by sponsor of the needs for such service in the Shoreham proceedings.

1.3 Schedule

Phase 1: April 9 - April 20

Phase 2: April 21 - May 25 (hypothetical)

Phase 3: May 25 - June 8 (Hypothetical)

The Phase 2 estimate is likely to be the very shortest time possible for accomplishing the work to be undertaken and is necessarily dependent upon obtaining large amounts of relevant input data on a rapid basis. The Phase 3 schedule is of course dependent upon completion of Phase 2.

1.4 Products

Phase 1: Detailed plan of work, including setting forth data required to perform Phase 2.

Phase 2: Technical Report.

Phase 3: Testimony and cross-examination support.

1.5 Technical Scope

The review would consider the availability of all offsite power sources as proposed in the LILCO motion and compare it with the system as designed featuring three operable and fully qualified diesel generator sets. All possible modes of failure will be considered, including common modes due to maintenance or operator errors, geographic proximity and other identified partial or complete dependencies. An important aspect will be the estimated probability of failure to restore power in 55 minutes using each of two configurations. In addition to considering the above failure mechanisms, the restoration analyses will include the impact of manually starting, synchronizing and loading the mobile diesel units.

2. PHASE 1 TASKS

2.1 Documentation Review

2.1.1 LILCO Supplemental Motion for Low Power Operating License

2.1.2 Pertinent portions of Shoreham PRA

2.1.3 Any available assessments and analyses by the LILCO and/or NRC

2.1.4 Chapter 15 of Shoreham FSAR

2.2 Review of Available Data Sources

2.2.1 Review GIDEP failure data for relevant information

2.2.2 Discuss achieved dispatch reliability of new DG set with manufacturer

2.3 Assess Appropriateness of SAI Assessment of Loss of Power Found in PRA

2.4 Prepare Basic List of Data Required From LILCO Regarding Operations, Maintenance, Testing, Etc.

2.5 Prepare Program Plan That Describes Methodology, Data Gatherings, Effort, and Schedule

2.6 Discuss Plan With Attorneys and Assist Technical Consultants as Requested

3. PHASE 2 TASKS

3.1 Review NRC SER and All Available Data on These Issues

3.2 View Shoreham and Collect Data on Proposed System Configuration

3.3 Perform Scope of Work Described in Program Plan

3.4 Discuss Results with Attorneys and Technical Personnel

3.5 Determine Appropriateness of Testimony Based Upon Results

4. PHASE 3 TASKS

4.1 Prepare Testimony

4.2 Present Testimony

4.3 Review Testimony of Others

4.4 Support Preparation of Cross Examination as Requested

5. LABOR HOUR ESTIMATE

Labor Catergory	Phase 1	Phase 2	Phase 3	
Principal	32	80	40	(8 hour testimony)
Senior	60	160	40	
Associate	40	80	20	
Secretary	20	60	16	
Total Hours	136	380	116	

6. ESTIMATED BUDGET

Consulting [1/]	Phase 1	Phase 2	Phase 3
Principal @ $65/Hour	$ 2,080	$ 5,200	$ 2,080
@ $97.50/Hour Testimony	-	-	780
Senior @ $40/Hour	2,400	6,400	1,600
Associate @ $22/Hour	880	1,760	444
Secretary @ $12/Hour	240	770	192
Labor Subtotal	5,600	14,080	5,096

ESTIMATED BUDGET (continued)

Expenses			
Reproduction	100	200	100
Computer Time	-	250	-
Travel	60 2/	1,060 3/	1,500 4/
Long Distance Telephone	100	200	100
Mailing/Shipping	75	150	100
Miscellaneous	65	60	104
Expenses Subtotal	400	1,920	1,904
TOTAL	$ 6,000	$16,000	$ 7,000

Footnotes

1/ No deposition effort is assumed. If and when needed, deposition charges are assessed at 1.25 times the above quoted hourly rates, by labor category.

2/ 1 round trip Sacramento to San Jose

3/ 1 round trip, 1 person, 1 day, Sacramento to Shoreham

4/ 1 round trip, 1 person, 3 days, Sacramento to New York City

EXHIBIT 2

SERA
Sierra Energy and Risk Assessment, Inc.

April 6, 1984

Mr. Richard Hubbard
MHB, Inc.
1723 Hamilton Ave., Suite K
San Jose, California 95125

Dear Dick:

This is to affirm the willingness of Sierra Energy and Risk Assessment, Inc. (SERA) to participate with MHB, Inc. in providing consulting services to Kirkpatrick, Lockhart, Hill, Christopher & Philips of Washington, D.C. in matters relating to the Shoreham nuclear power plant of Long Island Lighting Company (LILCO). SERA can either act in the capacity of a subcontractor to MHB or be directly sponsored by Kirkpatrick, et al.

Our task will involve performance of fault-tree analyses for the Shoreham nuclear power plant under 5-percent low-power testing conditions with the LILCO-sponsored temporary plant-system configuration and operation. Depending on the results of these analyses, we may or may not recommend an extended risk assessment for the facility. SERA is willing to perform such an assessment if so requested. At that point, we will also be willing to provide testimonial support if required.

I would act as Project Director and would be principally responsible for providing expert testimony if and when needed. I will be aided by Mr. Mohamed M. El-Gasseir, a senior staff consultant with SERA. Both of us will be able to devote part of our time in April, and more hours will be available later on. We trust that our scheduling details will be settled in the near future.

You will find with this letter an information package containing the following items:

- My resume and the resume of Mr. El-Gasseir
- A capability statement for SERA
- A list of recent and current clients
- SERA customer and activity mix
- A corporate bibliography
- SERA labor charges schedule

If you have any inquiry please do not hesitate to contact us.

Sincerely,

ROBERT K. WEATHERWAX
President

RKW:dm
cc: Lawrence Lampher
Enclosures

SERA
Sierra Energy and Risk Assessment, Inc.

ROBERT K. WEATHERWAX, JR.

EXPERIENCE:

Jan. 1981 - Present	President, Sierra Energy and Risk Assessment, Inc. Sacramento, California
July 1980 - June 1981	Visiting Scientist, Energy and Resources Group, University of California, Berkeley
July 1977 - December 1980	Chief Energy Forecaster, California Energy Commission, Sacamento, California
Jan. 1977 - June 1977	Staff Scientist, Science Applications, Inc. Palo Alto, California
May 1974 - Jan. 1977	Staff Scientist, School of Engineering Princeton University, Princeton, New Jersey
Jan. 1969 - April 1974	System Safety Supervisor, McDonnell Douglas Aeronautics Company, Huntington Beach, California

As the founder and Chief Executive Officer of Sierra Energy & Risk Assessment, Inc. (SERA), Mr. Weatherwax is presently involved in the twin topics of (1) risk assessment and comparison, and associated cost benefit analysis, and (2) energy demand and supply assessment, and policy evaluation.

He has had fifteen years of experience in nuclear safety analysis of commercial power generation and isotope power systems for space application. He has worked broadly in the area of nuclear fuel cycle risk assessment, and in reliability and failure mode assessment of complex systems. He has contributed to the original development of elements of fault tree, sequence tree (i.e., FAST), and event tree analyses; and has applied these methods to light-water nuclear power plants, nuclear fuel cycles, radioiosotope thermal generators, strategic weapons systems and launch vehicles. In an American Physical Society meeting, Mr. Weatherwax debated Dr. Norman Rassmussin on the merits of the Reactor Safety Study, WASH-1400 (to which he was the major contributor). He is an engineer by formal education with a minor in economics and has applied these disciplines in numerous systems engineering and evaluation efforts, particularly related to energy demand forecasting and policy assessment during the last several years.

As a McDonnell Douglas Astronautics Company (MDAC) employee, Mr. Weatherwax was principal author of a PSAR for the NASA 50 kWe space station power system. He later was manager for Environmental Impact and Risk Assessment on the MDAC team selected by the Air Force Weapons Laboratory (AFWL) to perform safety analyses of LES 8/9 and Viking missions. After leaving MDAC he continued as a consultant to MDAC, and subsequently became a consultant to Teledyne Energy Systems in their support of the AFWL's space nuclear safety responsibilities.

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Robert K. Weatherwax, Jr.
Resume Continued

Mr. Weatherwax has performed energy and risk analysis of fusion systems and nuclear reactor designs. At Princeton University, he modeled performance and cost properties of TOKAMAK fusion reactor concepts and associated power conversion technologies CIRCA 2000. Mr. Weatherwax managed the risk analysis of the Hanford (nuclear) Reservation Purex plant. He also managed the initiation of the risk analysis of a Swedish PWR under Swedish Government sponsorship. More recently, he has reviewed and evaluated the probabilistic risk assessments of the Indian Point and proposed Limerick light-water reactor power plants for the Union of Concerned Scientists and the Limerick Ecology Action Committee, respectively. In 1983, Mr. Weatherwax testified before the Indian Point Atomic Safety and Licensing Board regarding the probabilistic risk assessment of the Indian Point power plant.

Mr. Weatherwax's current research and development interests in the area of probabilistic risk assessment focus on the adequacy of existing fault-tree and event-tree methodologies for estimating low-probability events and representation of uncertainties in risk/benefit analysis. He is now involved in an AFWL project reviewing the probabilistic risk assessment of the space shuttle/Galileo - International Solar Polar missions. A list of risk assessment studies authored or contributed to by Mr. Weatherwax is appended to this resume.

Mr. Weatherwax's experience in energy forecasting includes work done at Princeton University, UC Berkeley and as Chief Energy Forecaster for the CEC. During this time, he performed research involving end-use, microeconomic energy demand forecasting models and implementation of data bases to various end-use forecasting models. He developed the first utility service area version of a residential end-use energy demand forecasting model and associated load shape forecasting model. As the Chief Energy Forecaster, he was responsible for forecasting electricity and natural gas requirements and peak loads for utility service areas for use in determining the need for power plants within California. Duties included technical direction of others in performing development and implementation of state-of-the-art microeconomic end-use models of energy consumption by fuel type and electric peak load by economic sector by utility service area. Other duties involved evaluation of cost effectiveness of conservation and alternative energy options and their potential energy impact, and management of twenty-five post-graduate level professionals.

SERA
Sierra Energy and Risk Assessment, Inc.

ROBERT K. WEATHERWAX

BIBLIOGRAPHY

Selected reports and analyses authored or coauthored by Mr. Weatherwax in the field of risk assessment include:

(With E. William Colglazier) Review of Shuttle/Centaur Failure Probability Estimates for Space Nuclear Mission Applications, Sierra Energy and Risk Assessment, Inc., Draft Report for Teledyne Energy Systems, SERA No. 83-57, June 1983.

(With E. W. Colglazier) "The 236U92 Penalty for Recycled Uranium", under publication review, Annals of Nuclear Energy.

Probabilistic Investment Decision Analysis Model, Sierra Energy and Risk Assessment, Inc., Report for the MCR Geothermal Corporation, SERA No. 82-13, April 1982.

"Comments on Assessment of Accidental Pathways, Subtask D Report (Draft), A. D. Little, Inc. dated February 1978", for Office of Radiation Programs, EPA, July 12, 1978.

Nuclear Safety Analysis Methodology for RTG Equipped Satellite Launches, MDC G6751, McDonnell Douglas Astronautics Company, Huntington Beach, California, May 1976.

Nuclear Fusion Systems Analysis Research, AMS Report No. 1250, Princeton University, October 1975.

"Probabilistic Fission Power Plant Risk Analysis: Its Virtues and Limitations", presented as an invited paper at the American Physical Society General Meeting, April 1975, and published in Bulletin of the Atomic Scientists, September 1975.

Probabilistic Risk Analysis of Nuclear Systems, Princeton University Seminar, May 1975.

(With C. Wildon, et al.) Launch Vehicle Reliability Considerations for Nuclear Safety Assessment, MDC G5983, McDonnell Douglas Astronautics Company, Huntington Beach, California, April 1975.

(With R. Luna, et al.) Site Defense Safety Analysis and Hazard Evaluation Report, MDC G4885, McDonnel Douglas Astronautics Company, Huntington Beach, California, October 1973.

"Applications of Multi-Phase Fault Tree Analysis", presented as part of industry course entitled RISK ANALYSIS given at Flow Research, Inc., Kent, Washington, February 1973.

"A Comparison of Fault Tree Quantification Techniques", presented to System Safety Society Symposium, University of Southern California, April 1972.

(With R. L. Gervais, et al.) Preliminary Safety Analysis Report, Volumes 1, 3, and 5 (NASA Space Station 50 KW isotope and reactor power supplies), MDC G0744, McDonnell Douglas Astronautics Company, Huntington Beach, California, January 1971.

SERA
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MOHAMED M. EL-GASSEIR

EXPERIENCE

Jan 1983 - Present	Senior Staff Scientist/Engineer, Sierra Energy & Risk Assessment, Inc., Sacramento, California
Oct 1980 - Oct 1981	Research Associate, Lawrence Berkeley Laboratory's Energy Analysis Program, Berkeley, California
Oct 1978 - 1980	Research Assistant, Lawrence Berkeley Laboratory's Energy Analysis Program, Berkeley, California
July 1977 - Oct 1977	Research Assistant on Project funded by the United States Council on Environmental Quality
July 1976 - Oct 1976	Consultant, National Research Council Committee on Nuclear and Alternative Energy Systems
Dec 1974 - July 1975	Assistant Lecturer, Department of Chemical Engineering, University of Tripoli, Libya
Oct 1972 - July 1975	Consultant to Libyan Government on the use of nuclear power for the generation of electricity
Oct 1972 - Nov 1972	Committee member investigating the feasibility of joint Egyptian-Libyan power projects
June 1972 - July 1973	Teaching Assistant, Department of Chemical Engineering, University of Tripoli, Libya

Additional Experience: Design of hybrid cooling cycle for power plants capable of conserving both energy and water (Ph.D dissertation project, current)

Constructed computer programs for the layout of heliostat fields of a solar central-receiver power plant

Modeling of the inter- and intragenerational transfer of resources with the objective of evaluating the effects of the discount rates on equity

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Sierra Energy and Risk Assessment, Inc.

MOHAMED M. EL-GASSEIR

Resume (continued)

At Sierra Energy and Risk Assessment, Inc. (SERA), Mr. El-Gasseir is currently engaged in an analysis of probabilistic failure studies conducted for NASA's Galileo and International Solar Polar missions. He is specifically evaluating the validity of the approach and methodologies pursued in these studies and in the accuracy of the data and computations performed. Mr. El-Gasseir is the principal author of a recent SERA report critiquing probabilistic simulation techniques presently used by the utility inudstry in system planning.

Mr. El-Gasseir is a chemical/engineer power generation specialist by education. His background and experience encompass areas as diverse as the dynamics of multi-phase flow systems, simulation of complex systems, numerical and analytic quantitative techniques and institutional analysis of utility related issues. Mr. El-Gasseir's current research interests in the field of probabilistic simulation and risk assessment include the development of efficient Monte Carlo techniques for power generation applications and of effective representation of interdependent time series and the search for a universal (non-monetary) yardstick for evaluating costs and comparing risks.

Mr. El-Gasseir has recently completed the design of a novel cooling cycle for a nuclear turbine/generator. The device combines two natural-draft dry towers with a spray pond. The design offers operating flexibility so that both energy and water can be conserved. It is particularly suitable for water-scarce regions.

At the Lawrence Berkeley Laboratory (LBL) Mohamed M. El-Gasseir was in charge of investigating the water quantity and quality issues of energy development in the Southwest. He developed the algorithms for computing the cooling water requirements associated with the various fuel cycles for generating electric power in California and Nevada. He was a member of a team designated by the Department of Energy (DOE) for its Regional Issues Identification and Analysis Program. Mr. El-Gasseir represented LBL on a DOE National Laboratories committee which was responsible for planning and funding water related energy research. He also conducted a study of the prospects for industrial water conservation.

As a consultant to the National Academy of Sciences Mr. El-Gasseir was a resource group member of the National Research Council Committee on Nuclear and Alternative Energy Systems. He carried out the study of the availability of water for synthetic fuel development in the U.S. and the impacts of this future industry on the nation's water resources. The results published in Science magazine heightened government and industry interest in the environmental problems of intensive development of synthetic fuels.

EDUCATION:

B. Sc., Chemical Engineering, University of California, Berkeley
M. Sc., Chemical Engineering, University of Rochester, New York
Ph. D. candidate, Energy and Resources, University of California, Berkeley, expected June 84.

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MOHAMED M. EL-GASSEIR

BIBLIOGRAPHY

El-Gasseir, M., et al., Analysis in Support of Assessment of BPA's Short Term Rates and Load Balances, Sierra Energy and Risk Assessment, Inc., Report to the Southern California Edison Company, SERA No. 84-126, March 1984.

El-Gasseir, M. (with J. Kaiser), Documentation and Users Guide to EUGAP the SERA Electric Utility Generation and Pricing Model, SERA No. 84-110, February 1984.

El-Gasseir, M. (with S. Huscroft and R.K. Weatherwax), Electric Utility Demand Forecasting and Resource Planning in Nevada: A Review of State-of-the-Art Methods and Recommendations for Regulatory Oversight, SERA No. 83-103, December 1983.

El-Gasseir, M. (with S. Valentine Huscroft and R.K. Weatherwax), The Legislative and Contractual Framework for Power Transactions in the Pacific Northwest, Sierra Energy and Risk Assessment, Inc., Report to the Southern California Edison Company, SERA No. 83-91, September 1983.

El-Gasseir, M. (with S. Valentine Huscroft and R.K. Weatherwax), An Analysis of WPPSS Delay Decision by the Bonneville Power Administration, Sierra Energy and Risk Assessment, Inc., Report to the Southern California Edison Company, SERA No. 83-85, August 1983.

El-Gasseir, M. (with S. Valentine Huscroft and R.K. Weatherwax), A Review of the Northwest Power Planning Council Regional Plan, Sierra Energy and Risk Assessment, Inc., Report to the Southern California Edison Company, SERA No. 83-82, August 1983.

El-Gasseir, M. (with R. K. Weatherwax), On The Bonneville Power Administration 1983 Proposed Wholesale Power Rates, Sierra Energy and Risk Assessment, Inc., Report to the Southern California Edison Company, SERA No. 83-67, July 1983.

El-Gasseir, M. (with R. K. Weatherwax), Pacific Northwest Electric Power Planning: Limitations & Opportunities, Sierra Energy and Risk Assessment, Inc., Draft Report to the Southern California Edison Company, SERA No. 83-51, May 1983.

El-Gasseir, M., in Energy and the Fate of Ecosystems, the Report of the Ecosystem Impacts Resource Group of the Risk/Impact Panel of the Committee on Nuclear and Alternative Energy Systems, National Research Council (National Academy Press, Washington D.C., 1980).

MOHAMED M. EL-GASSEIR
Bibliography (continued)

El-Gasseir, M., Energy Water Issues, in Energy Analysis Program FY-1979, LBL 10320, April 1980.

College of Engineering Interdisciplinary Studies, California Power Plant Siting with Emphasis on Alternatives for Cooling, 9177-1978 (University of California, Berkeley College of Engineering Report 78-2, 1978.

El-Gasseir, M., Solar vs. Non-Solar Energy: A case of Intergenerational Equity (to be published).

Harte, J. and M. El-Gasseir, Energy and Water, Science 199: 623-634, February 10, 1978.

Harte, J., et al., Environmental Consequences of Energy Technology: Bringing the Losses of Environmental Services into the Balance Sheets, Part II: Services, Disruptions, Consequences (Energy and Resources Group, University of California, Berkeley, ERG-WP-77-2, October 1977).

SERA
Sierra Energy and Risk Assessment, Inc.

CAPABILITIES STATEMENT

Sierra Energy and Risk Assessment, Inc., is a Sacramento based consulting firm specializing in energy demand, conservation, supply, and probabilistic risk analyses. SERA's employees and consultants represent an experienced, multidisciplinary team that provides to private and public clients, a broad spectrum of energy demand and supply analyses as well as detailed engineering, economic, and financial services. The educational backgrounds of SERA's employees and consultants include: engineering, economics, system science, physics, ecology, and law.

Current and recently completed studies include:

- Review and assessment of the probabilistic nuclear risk assessments of the Indian Point and proposed Limerick light water reactor nuclear power plants.
- Analyzing a major utility's long term forecast.
- Projection of future avoided energy and capacity payments for selected California utilities.
- Preparation of internally consistent projections of fuel prices, inflation rate, construction escalation rates, and borrowing costs for use in energy project financial feasibility analyses.
- Evaluation of the costs of competing electric power generation technologies reflecting recent tax changes and technology specific capital costs, operating and maintenance costs and plant availability.
- Institutional and economic feasibility evaluation of electricity wellhead generation using marginal natural gas resources.
- Evaluating the cost effectiveness and potential energy demand impact of solar applications in California during the 1980s.
- Evaluating the potentially cost effective and environmentally acceptable uses of coal in California during the 1980s.
- Appraising the potential availability and cost of Pacific Northwest power to California utilities.
- Investigating the economic concepts and California applications of avoided cost pricing of electricity as required by the California Public Utilities Commission.
- Developing a computerized electricity generation and dispatch model of the Pacific Gas and Electric Service Area to project cost of PG&E resources applicable to geothermal steam and average thermal electric generation sales contracts.

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- Assessing the average and avoided costs of electric power generation, and the potential interests of utilities in the Northwest, Southwest, and California in geothermal energy and geothermal energy-generated electricity production.

- Developing a stochastic financial model for use in estimating the risks and rewards of developing geothermal steam/brine electric power generation facilities.

- Comparative assessment of the utility of existing residential end-use energy demand forecasting models for use in quantifying the potential impact of conservation and solar technology.

- Performing a wide variety of tasks associated with energy demand forecasting in the commercial sector. Tasks include: development of an on-site survey instrument for collection of building energy-related data, estimation of energy utilization indices for buildings in California and the Pacific Northwest, and review and analysis of utility commercial building audit data.

CURRENT AND RECENT CLIENTS

- Applied Management Sciences
- Bonneville Power Administration
- California Council for Environmental and Economic Balance
- California Energy Commission
- California Foundation on the Environment and the Economy
- Chevron, USA
- Department of Defense Air Force Weapons Laboratory
- Department of Energy, Energy Information Administration
- Georgia Institute of Technology, Engineering Experiment Station
- Lawrence Berkeley National Laboratory
- Lawrence Livermore National Laboratory
- Limerick Ecology Action Committee
- MCR Geothermal Corporation
- Nevada Public Service Commission
- North Carolina Alternative Energy Corporation
- Ohio State Division of Energy, Department of Development
- Shearson/American Express, Inc.
- Solar Energy Research Institute
- Southern California Edison Company
- Southern Pacific Company
- Synergic Resources Corporation
- Teledyne Energy Systems, Inc.
- Union of Concerned Scientists

SERA
Sierra Energy and Risk Assessment, Inc.

SERA CUSTOMER AND ACTIVITY MIX (FY83)

Customers

60% Private corporations

30% Governmental support

10% Foundations and non-profit organizations

Activities

30% Electricity and gas supply planning and analysis

30% Electricity and gas demand forecasting and critique

18% Utility and industrial financial modeling and projections

12% Nuclear risk and reliability

10% Technology assessment

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SERA
Sierra Energy and Risk Assessment, Inc.

CORPORATE BIBLIOGRAPHY

Pacific Northwest Power Activities Report

This monthly newsletter, started in December, 1982 reports on current energy-related issues and activities as they occur in the Northwest, with particular attention paid to the potential for surplus power sales to California. The newsletter is read and used by selected California IOUs and public utilities and utility Regulators. Recent newsletters have highlighted the WPPSS proceedings (particularly activity related to the completion of Unit #3); Bonneville Power Administration (BPA) rates, forecasts, and conservation plans; and the actions of the Northwest Power Planning Council. This report keeps the reader up-to-date on Northwest technical, legislative and judicial activities, and on studies and forecasts produced by BPA, the Council or others of importance to California.

Documentation and Users Guide to EUGAP, the SERA Electric Utility Generation and Pricing Model, December 1983.

This documentation and users guide describes the theory behind and structure of the SERA electric utility dispatch model EUGAP as well as the products and data requirements of the model. The model dispatches the PG&E system on a least-cost-first basis to meet yearly area loads. It produces tables of capacity, capacity factor and heat rate and output by generation type, variable costs of generation, amounts of critical fuels used as well as the yearly geothermal steam price which is based on fossil and nuclear output and costs. The model also performs an economic analysis of a user-specified geothermal power plant, using the calculated yearly geothermal steam price.

Electric Utility Demand Forecasting and Resource Planning in Nevada: A Review of State-of-the-Art Methods and Recommendations for Regulatory Oversight, December 1983.

The report was intended to support the design of regulations for implementation of Nevada's 1983 resource planning legislation, Senate Bill 161. It details characteristics of state-of-the-art energy demand forecasting and supply planning methods and models, and evaluates the current efforts and future plans of the two largest electric utilities in Nevada, Sierra Pacific Power Company and Nevada Power Company. The report concludes with recommendations for short-term and long-term goals and requirements to be incorporated into the regulations.

Evaluation of the Ohio Edison Company 1983 Long Term Forecast Report, November 1983 (in preparation).

The report is the result of a two month detailed analysis of the demand section of the Edison forecast. The forecast's treatment of economics/demographics, conservation, price effects and forecast methods are reviewed for reasonableness and adequacy of documentation. The modeling types used (statistical (ARIMA), econometric, end-use, and customer use) are evaluated for appropriateness, specification and accuracy of data. The report is the basis of and exhibit to testimony submitted in public hearing.

The Legislative and Contractual Framework for Power Transactions in the Pacific Northwest, September 1983.

The report consists of 3 parts. Part 1 contains a review and an analysis of the 4 Congressional Acts that govern power transactions in the Pacific Northwest (PNW) and the status and function of the Bonneville Power Administration (BPA). In Part 2, 13 significant agreements and contracts between various PNW entities are reviewed. Recommendation for further investigations on each document are also presented. The final part examines and contrasts the Tennessee Valley Authority with BPA, focusing on ratemaking, budgeting, and export limitations. The comparison is in an anticipation of a possible Congressional move to grant BPA greater autonomy.

An Analysis of the WPPSS 3 Delay Decision by the Bonneville Power Administration, August 1983.

The report looks at the recent decision by the Bonneville Power Administration (BPA) to delay construction of the WPPSS 3 nuclear project. It examines a detailed study released by BPA in support of its decision. SERA's investigation included an evaluation of the various options available to BPA (in relation to WPPSS 3); in terms of their impacts on rates and the availability of surplus power for the California market.

A Review of the Northwest Power Planning Council Regional Plan, August 1983

This is a report on a review of the Regional Plan, recently released by the Northwest Power Planning Council (NPPC). The review is a follow-up effort on SERA's assessment of the draft version of the NPPC plan and focuses on the Council's responses to comments and criticisms made by interested parties about the Draft Plan, including those concerning the future role of natural gas in the Northwest energy supply complex, the future of the WPPSS projects, and the Council's treatment of the price-elasticity of demand for electric power and power exports to California.

Feasibility Study of a Wood-Fired Electric Power Plant, August 1, 1983.

This study evaluates the feasibility of an 11 MWe wood-fired power plant proposal. The evaluation includes a SERA-constructed forecast of world oil-prices, a range of avoided-cost projections (based on the oil-price forecast), an assessment of likely prices for forest-residue fuel woods, an estimation of total plant capital costs, and a detailed analysis of the prospects for long-term energy payment offers now under consideration by the California Public Utilities Commission.

Review of Shuttle/Centaur Failure Probability Estimates for Space Nuclear Mission Applications, August 1983.

This report evaluates the scope, methodology and accuracy of a series of reliability analyses of the NASA shuttle and Centaur upperstage rocket and their potential to cause the release of plutonium from a radioisotope, thermoelectric generator to be flown on the Galileo mission. Scope, methodology and methodology implementation problems are identified, described and where possible their effects quantified. It is concluded that the risk assessment as presented in the reviewed analyses is both too limited in scope and too imperfect in implementation to be relied upon in determining design improvements for the mission and in assessing actual mission risk. Revisions and augmentations to the existing analyses are identified that would correct the problem areas currently existing.

Recommended Modifications to the Short Term Integrated Forecasting System Gas Demand Element, July 28, 1983.

This report documents a new statistical and engineering model developed to forecast the national demand and supply of natural gas within the Short Term Integrated Forecasting System model used by DOE's Energy Information Administration (EIA). The new model discretely forecasts several supply and demand elements monthly for the ensuing 18 months and will be encoded and used to provide quarterly forecasts to be published in EIA's Short Term Energy Outlook. The model relies exclusively on published national level data. Econometric formulations are developed for the following demand elements: residential and commercial, electric utility, refinery, and non-refinery, and non-electric utility industrial engineering and policy insights are used to develop specific methods to project syn-gas production, gas in storage, and gas imports. Marketed production of natural gas (MPNG) is computed as the needed equalizer to bring into balance the above delineated supply and demand elements. U.S. natural gas plant liquids production is forecasted consistent with MPNG projections.

An Investigation of the More Efficient Geyser's Steam Generator Design, July 1983.

This report investigates the engineering, operational and economic aspects of the high efficiency steam turbine technologies being used in the SMUD GEO 1 steam geothermal power plant. Experience data are found to be too sparse to assess the new technologies' impact on turbine efficiency but sufficient information is available to project the level of efficiency improvement and the capital-costs. Economic assessments based upon no assumed degradation in reliability are then developed for commodity steam sales agreements and sales agreements based upon the PGandE "steam formula" from both the prospectives of municipal and investor-owned utilities. It is concluded that both retrofits of existing steam plants are cost-effective for municipal utilities but that retrofits are not cost-effective for investor-owned utilities (i.e., investors with higher discount rates).

On the Bonneville Power Administration 1983 Proposed Wholesale Power Rates, July 1983.

The Rate Design Process (RDP) used by the Bonneville Power Administration was examined in detail and on the basis of this process the rates applicable to firm power exports to California were recomputed. Although SERA has employed the same procedure the results were shown to be lower than is proposed by BPA. The report concludes with an assessment of BPA's explicit and implicit objectives as demonstrated through and by the RDP it uses.

Methodological Elements for Re-Estimation of Heating and Cooling Energy Use in Buildings, June 1983.

This report develops new estimates for selected, important elements that will be used to modify inputs to the end use demand forecasting model for the commercial sector widely used in California. Air conditioner coefficients of performance (COP) for eleven different California building types are developed to be used in developing building specific air conditioning energy utilization indexes (EUI). Also developed are new, building specific heating and cooling weather adjustments for eleven different California meteorological zones to be used to adjust historical EUIs and EUIs developed from digital computer model simulations. Based upon the primary data estimates it is concluded that chillers in the existing stock are substantially more efficient than heretofore thought and that the energy savings associated with statewide minimum chillers efficiency standards will be substantially less than had been previously estimated. The new weather adjustment factors take account of both temperature and humidity levels so should be able to more accurately adjust demand for the influences of weather. However, it is noted that the data base for which the estimates are developed is very soft for selected weather zones, particularly in some portions of the Bay area and L.A. basin.

Pacific Northwest Electric Power Planning: Limitations & Opportunities, May 1983.

The report provides a basis for understanding the recently established electric power planning process in the Pacific Northwest. It contains a critical review of studies commissioned by the Northwest Power Planning Council (NPPC), and of policy and issue papers and various other documents released by NPPC and the Bonneville Power Administration. On the basis of these reviews, the report outlines the planning constraints and the available modeling concepts pertaining to future electric power plans in that Region.

Update and Further Development of California Non-HVAC Energy Utilization Indices for the Commercial Sector, May 1983.

This report documents the CEC sponsored project to re-estimate EUI's and other parameters for the commercial sector and to modify, correct and expand existing computer codes for non-space conditioning end uses in California buildings. The product of this work is a set of inputs to the CEC Commercial Buildings and Peak Load end use demand forecasting models.

This effort required utilizing a revised version of the CEC onsite survey data base and the 1965-1981 F. W. Dodge construction additions data base in conjunction with a series of complex computer codes. These computer codes which are variously written in PL I or FORTRAN were extensively modified to more effectively utilize the information present in the data bases. In specific instances inputation and other data base enhancement techniques were used to expand and improve outputs.

Non-HVAC Energy Utilization Indices for the Commercial Sector, (A Re-estimation Based Upon California Onsite Survey Data), March 1983.

This report presents the methodology and results of a SERA development program to compute energy utilization indices, standard and non-standard fractions and hourly load profiles for five end uses in fourteen building types. The five end uses are lighting, refrigeration, gas and electric cooking, water heating, and miscellaneous uses. The results are used as inputs to an end use, microeconometric commercial sector energy demand forecasting model for use by the Bonneville Power Administration.

This estimation relied upon primary data from various California Energy Commission surveys of the California commercial sector and proprietory building floorspace additions data for California. These data were cleaned and then adjusted to reflect the Pacific Northwest region.

Feasibility Study of Incorporating Existing Audit Data in CEC Detailed Building Data Base, January 1983.

The report documents the study to assess the feasibility of using otherwise existing utility building audit data to supplement the CEC onsite Commercial Buildings energy survey. A systematic approach was developed and tested on twenty-six conservation audits from utilities throughout California.

The absence of audit form similarity, and the inconsistent level of information present in the utility surveys considered required careful data extraction development so that the method would function for all utilities considered. The study concluded that at best partial data sets could be produced for the most detailed surveys, and that, unless substantial importance is attached to conservation equipment data, the models do not represent a cost effective way to augment the existing Commercial Buildings data base.

A Survey of SCE's PNW Power Procurement Practices and Electricity Opportunities, Southern California Edison. November, 1982.

This project entailed five sets of tasks intended to evaluate Southern California Edison's power purchase position with the Pacific Northwest. These tasks included a review of the SCE management structure and how it relates to power purchasing questions, a review of specific technical planning questions such as the Regional Power Act and WPPSS activities (and how they relate to SCE), and past and future projected SCE purchase power activities (and savings) from not only the PNW but also intra-California sources and the Southwest. In addition the report provided an independent survey assessment of the Northwest power situation (probable energy scenario), and formulates policy for SCE regarding a California government/PNW interface.

Suggested Data Elements for An On-Site Commercial Building Survey, Georgia Institute of Technology, October 1982.

This report discusses the data that the On-Site Survey, for the ORNL Commercial End Use Forecasting Model, is designed to collect. This data collection effort improves previous efforts by adding building morphology and end use and load shape forecasting along with a micro-simulation decision approach to choice of fuel type and equipment efficiency.

Revised Energy Utilization Indices for End Uses in Commercial Buildings, California Energy Commission (CEC)., October 1982.

In this project, SERA performed an initial re-estimation of most Energy Utilization Indices (EUIs) used as inputs to the CEC Commercial Buildings End Use Energy Demand Model. Modifications were made to the EUIs for the air conditioning systems and to the refrigeration, cooking, lighting and miscellaneous EUIs to reflect augmented equipment performance data and to correct mechanical and methodological errors to earlier versions. In conjunction with these revised estimates SERA performed detailed analysis and documentation that described data sources, methodologies and computations used to establish the relevant EUIs.

A Survey of SCE PNW and PSW Surplus Energy Procurement Opportunities, August 1982.

This report describes the Pacific Northwest (PNW) energy situation as it relates to Southern California Edison's (SCE) prospects for continued purchases of surplus power from the region. It also reviews SCE's procurement of surplus energy from the PNW and Pacific Southwest (PSW) and projects potential purchases from each region for the next ten years.

The report emphasizes studies of the Northwest Power Planning Council and the rate making activities of the Bonneville Power Administration. Simplified energy planning and dispatch scenarios are created for the PNW from which surplus sales to SCE are projected with and without increased inter-regional transmission capability. Though the PNW is emphasized, this report also considers likely resources in the PSW and its projected supply/demand balances there as well.

Coal Use in California, California Foundation on the Environment and the Economy, August 1982.

The thrust of this year long two-volume report was to present the existing and forecast the future status of coal as an energy source for California. Utility applications for coal were stressed although industrial uses were examined as much as possible. An appropriate future level of coal use was derived which reflected the energy demand level technology of applications, comparative economics with intra- and inter-fuel technologies, environmental impact, and export potential. This appropriate level of coal use is compared to the current level of coal use and competing energy sources and a current trends forecast of the California energy supply plans. This report serves as a planning document for several large West Coast firms in making coal development and marketing decisions.

Assessing the Impact of Renewable Energy Technologies in the Residential Sector: A Model Development Program Plan and Evaluation of Existing Models, Solar Energy Research Institute., June 1982.

The objective of this report was to estimate the payoff from investments in renewable energy technology research and development programs. The result being the selection of most appropriate R&D activities for the DOE. The process for developing this analytical tool involved three program plan options outlined in terms of the product desired, development steps required, and the time and cost requirements. The three program plans included the conventional end-use microeconometric approach, a sample enumeration approach (a sample of the population of households in a given region and how it evolves through time), and the recommended approach -- an evolutionary mixture of the two previous approaches called the Partially Discretized Approach.

Probabilistic Investment Decision Analysis Model, MCR Geothermal Corporation., April, 1982.

This report is the culmination of a SERA effort to develop a probabilistic financial analysis model geared to geothermal well field development that would incorporate all of the attributes found in the existing MGC deterministic financial model. Specifically, the model includes pre- and post-tax annual cash flows, value of investment by partner share, gross revenues for steam production and rate of return on investment. In addition, the model takes account of the probabilistic nature of the field development effort by explicitly estimating the underlying risk and uncertainty associated with the various financial figures of merit. The model permits a more systematic assessment of geothermal return and permits updating of financial assessments as the various physical and economic characteristics become progressively more well defined.

The Status of Avoided Cost Pricing for Geothermal and Other Small Power Producers in California, MCR Geothermal Corporation., April 7, 1982.

The purpose of this report was to examine the form and extent that the California utilities have implemented the Public Utility Regulatory Policies Act of 1978 (PURPA). Specifically, this report examines the methodologies used by California utilities to estimate and pay avoided cost rates to Qualifying Facilities (QFs) and provide the necessary wheeling services as mandated by PURPA. Analysis is provided as to the equitable nature of each utility's method employed and the prospects for future utility implmentation of PURPA. Utility estimates of future avoided cost are included where available.

An Investigation of the Common Economic Indices Applied to the Pricing of Geothermal Steam in California, MCR Geothermal Corporation, February, 1982.

This report examined the several most prominent indices of prices that have been considered or actually implemented in geothermal steam purchase agreement. The indices considered were the Consumer Price Index, the Producer Price Index and the GNP Price Deflator. Each index is discussed in terms of its strong and weak points in regard to accuracy of implementation.

Solar Energy in the 1980's, California Foundation on the Environment and the Economy (CFEE)., June 1981.

This report reviewed the most common types of solar energy: water heating, swimming pool heating, passive solar building design, industrial process heat and the most promising types of electric power generation. The report compares the typical system and compares their life cycle costs with conservation and conventional technologies. In addition, various federal and California government programs to promote solar energy are surveyed and analyzed. Estimates of solar energy's potential contribution to California's future energy needs are developed.

An Assessment of the Economic Impact of the Bottlerock Geothermal Field Steam Pricing Formula, MCR Geothermal Corporation., 1981.

This report documented an analysis performed to assess the economic viability of the Bottlerock Geothermal Plant according to the PG&E steam pricing formula. Specifically, the analysis defined the parameters of the PG&E formula governing the purchase of geothermal steam. It also predicted the revenue per kilowatt-hour of electricity generation that would accrue to MCR due to application of the PG&E formula and compared the expected revenue for each kilowatt-hour from application of other existing steam purchase agreements. Finally, a discussion of limitations of steam revenue predictions and recommended further areas for examination are given.

SERA
Sierra Energy and Risk Assessment, Inc.

SCHEDULE OF LABOR CHARGES

Hourly Rates:

	Category	$/Hour
Robert K. Weatherwax, President	Principal	65
Mohamed M. El-Gasseir	Senior Staff	40
	Associate Staff	22
	Secretary	12

Testimony and Deposition Support:

Charges for testimony time on the stand are evaluated at 1.5 times the above quoted hourly rates. Charges for time spent in deposition are evaluated at 1.25 times the hourly rates above. Travel time charges are assessed at one-half the same hourly rates.

1722 I Street, Suite 19A, Sacramento, California 95814, 916/447-5421

AFFIDAVIT OF GEORGE DENNIS ELEY

George Dennis Eley does state under oath the following:

1. I am a qualified marine engineer employed by Ocean Fleets Consultancy Services, with offices in Thorofare, New Jersey and New York, New York. My company, a division of Ocean Fleets Ltd., a large European shipping fleet operator and part of the Ocean Transport and Trading group, is retained as expert consultants by Suffolk County, New York, with regard to the emergency diesel generators ("EDGs") at the Shoreham Nuclear Power Station. My principal area of expertise is diesel engines. My experience includes twelve years service as assistant and as chief engineer in ships powered by diesel engines. My professional qualifications are set forth in more detail in Exhibit A to this Affidavit. I have been involved through Ocean Fleets in providing services to Suffolk County regarding the EDGs since late December 1983.

2. From December 1983 until early April 1984, my EDG work for Suffolk County concerned the quality and reliability of the three 3.5 MW EDGs manufactured by Transamerica Delaval, Inc. ("TDI"), which LILCO proposed to rely upon for both low power and full power operation of Shoreham. My work on the TDI EDGs is continuing since LILCO still proposes to use the TDI EDGs during full power operation of Shoreham.

3. On March 20, 1984, LILCO filed a Supplemental Motion for Low Power License. LILCO in that motion revealed for the

first time that during low power operation of Shoreham, it would rely on four used 2.5 MW General Motors EMD blackstart mobile diesel generators, model 20-645 E-4, for a portion of the AC power required during low power operation. The TDI diesels regarding which I had previously devoted all my Suffolk County consulting time were not to be relied upon during low power operation.

4. On April 6, 1984, the NRC's Licensing Board ordered discovery to open on the issues pertaining to LILCO's motion. I conferred that day and early the next week with County counsel concerning documents I would need in order to assess the quality and reliability of the substitute GM diesels. The discovery requests were sent to LILCO on April 11, 1984.

5. On April 17, 1984, I received documents pertaining to the substitute GM diesels. I have been reviewing those documents on a nearly full-time basis since receiving them. I expect to complete my initial review of the documents I have received thus far by early in the week of April 23, 1984. I have formed no conclusions yet regarding the quality or reliability of those diesels. Before I can reach such conclusions and, hence, before I could be in a position to prepare testimony regarding these diesels, I must:

(a) Obtain further data via discovery, including data showing the present condition and running reliability of the diesels, why and how they were repowered and rebuilt, why the cylinder heads have been replaced so frequently and why the diesels must be run at at least 25% load

(b) Once document review is complete, perform an inspection of the substitute GM diesels.

(c) Prepare a technical report concerning my review of the documents and my inspection. I intend to confer closely in this regard with Stanley Christensen, the County's other diesel consultant, regarding the substitute GM diesels and also to confer with other users of diesels of this type to assess their suitability for nuclear service.

6. After I have completed the work described in paragraph 5, I could prepare testimony concerning the substitute GM diesels in a relatively short period, probably 1-2 weeks. Until that work is completed, it is impossible for me to provide expert testimony concerning the substitute diesels. Accordingly, it was impossible for me to submit testimony on the schedule adopted by the Licensing Board, i.e., by April 20, 1984.

7. I estimate that the work described in paragraph 5, will take approximately one month to complete, assuming prompt responses to additional document requests and that I can devote almost full time to that work. However, since I probably will need to continue to devote a portion of my time to work on the TDI diesels (see paragraph 3, supra), I think a more realistic time for completion of the work is about 45-50 days. I should be able to prepare testimony within an additional 1-2 weeks.

April __, 1984

George Dennis Eley

Subscribed and sworn to before me this ____ day of April, 1984, in the City of _____, State of _____.

_____
Notary Public

My commission expires: _____

CONFIDENTIAL

RESUME

Name: George Dennis Eley

Address: 117 Bortons Road
Marlton, New Jersey 08053

Home Phone: (609) 768-6699

Business Phone: (609) 848-2913

Licenses and Certificates: Combined First Class Certificate of Competency Steamship & Motorship. Higher National Certificate in Mechanical Engineering.

Society Memberships: Associate Member of The Institute of Marine Engineers. Member of the Institute of Port Engineers. Member of the ASTM Task Group on Pollution Abatement Equipment (F25.11).

Employment History

1981 - 1983 Marine Consultant with:-
Head Office:- Ocean Transport and Trading PLC.
India Buildings
Water Street
Liverpool, England L20RB
Telephone No. 011-44-51-236-9292
Address of U.S.A. Office:-
Ocean Fleets Consultancy Service
1501 Grandview Avenue
Midatlantic Corporate Center
Thorofare, New Jersey 08086
Telephone Nos. (609) 435-6457 & (609) 848-2913

1969 - 1981: - Third Assistant, 2nd And Chief Marine Engineer with above Company.

1966 - 1969: - Estimator and Contracts Engineer for British Shipbuilders at:-

Austin & Pickersgill Limited
Shipbuilders and Installation Engineers
P.O. Box 38
Southwick
Sunderland
Tyne & Wear, England
Telephone Nos. 011-44-783-57684

1959 - 1966: - Apprentice Fitter & Turner, then Contracts Engineer with:-

George Clark & N.E.M., LTD.
P.O. Box 8
Northumberland Engine Works
Wallsend, Northumberlan, England
Telephone No. 011-44-966-623141

Summary of Work Experience & Accomplishments

As a Marine Consultant with Ocean Transport & Trading, my duties have included:-

Negotiation and formation of a joint venture with the American Bureau of Shipping to provide fuel services to the marine industry.
My responsibilities have been to negotiate with Senior Officers of ABS and to formulate operational policy. My duties also include coordination of the various departments and efficient operation of the business. I have implemented the Data Bank System for the above business and control the staff so doing. I also act an an independent consultant on machinery damage investigations and run seminars for the following establishments on fuel technology.

1.) "Kings Point Merchant Marine Academy" on Professor Christenson's "Continuing Education on Diesel Technology" given to chief engineers studying for advanced certification.

2.) Maritime Safety International lecturing to chief and port engineers on poor quality fuel oil.

3.) Marine Engineers Benefit Association to chief and port engineers on poor quality fuel oils.

In addition I advise on system design for ships enginerooms and upgrade existing vessel so that they have full operational capability on lower quality fuel. I have worked in this capacity with major American shipping companies and normally negotiate the contracts for so doing with the vice presidents of those respective companies.

Prior to my employment as a Consultant, I was employed by the same company for 12 years as a Marine Engineer in all capacities up to the rank of Chief Engineer. In this capacity my responsibilities were for the efficient operation and maintenance of various diesel engines, boilers, air compressors, refrigeration systems which encompassed a high degree of automation. Coordination with different marine and hull classification societies was also a requirement as was the effective implementation of planned maintenance scheduling.

Before continuing my career at sea, I was employed by British Shipbuilders as a Contracts Engineer. During this period, my responsibilities were to produce ships specifications for newbuildings to a potential owners requirements, and also to handle all ships contract correspondence. It was also my responsibility to estimate the costs of various building projects and submit these costs for negotiation with the owners representatives.

Prior to my employment with British Shipbuilders, I served an Engineering Apprenticeship with George Clark & N.E.M. LTD., a Marine Enginebuilder. On completion of my apprenticeship I continued as a Draughtsman with this same company in the Engine Design Department until I was promoted to Contracts Engineer with duties similar to those held at British Shipbuilders.

AFFIDAVIT OF DR. CHRISTIAN MEYER

Christian Meyer does state under oath the following:

1. I am an Associate Professor in the Department of Civil Engineering and Engineering Mechanics at Columbia University in the city of New York. I am a graduate of the University of California, Berkeley, where I received my M.S. and Ph.D degrees in 1966 and 1970, respectively, in Civil Engineering. After my graduation, I worked for three years for Albert C. Martin & Assoc. in Los Angeles on earthquake resistant design of buildings. Following this, I worked for five years for Stone & Webster Engineering Corp. in Boston on analysis and design of nuclear power plant structures. Since 1978 I have been affiliated with Columbia University. My primary areas of research interest and expertise are in earthquake engineering and structural dynamics as well as analysis and design of structures.

2. On April 9, 1984, I was contacted by phone by Richard B. Hubbard of MHB Technical Associates. He was inquiring whether I and Dr. Jose M. Roesset, a professor of civil engineering at the University of Texas at Austin, were available to perform work on behalf of Suffolk County pertaining to LILCO's Supplemental Motion for a Low Power Operating License. The work was to review the seismic/structural integrity of the power systems relied upon by LILCO in that Motion. Mr. Hubbard sent me on that date a copy of the LILCO Motion. On April 10, Mr. Hubbard sent me FSAR Sections 2.5 (geology and seismology) and 3.7 (seismic design).

3. During the latter part of the week of April 9, 1984, I spoke several times with Mr. Lawrence Lanpher, counsel for Suffolk County, concerning the proposed work for the County. I indicated my interest in performing such work and it was agreed that Dr. Roesset and I should meet with the County's counsel at the earliest possible date to agree to the terms of a contract and to agree upon the details of the work to be performed. Because of existing schedule conflicts of Dr. Roesset and myself, the earliest date for such a meeting was Wednesday, April 18, 1984. [It turned out that Dr. Roesset could not attend the meeting because of a personal matter that arose on April 16; however, we conferred in detail with Dr. Roesset by phone on the 18th.]

4. Prior to the 18th of April, I had conferred with County counsel concerning the proposed work to be done and had reviewed a draft of the proposed work scope.

5. On April 18, 1984, an approved scope of work was prepared. A copy is attached hereto as Exhibit 1. As noted in

Exhibit 1, it will take at least 24 workdays for both Dr. Roesset and me to prepare a seismic/structural report which will address the ability of the AC power sources to withstand the forces of an earthquake. Given my other obligations, particularly completing teaching at Columbia this semester, the Phase I and II work described in Exhibit 1 cannot be completed until the end of June 1984. Dr. Roesset agrees with that schedule. Accordingly, it is impossible for me and Dr. Roesset to prepare testimony for this proceeding by April 20, 1984 or any time prior to completion of the Phase II work. I believe we could prepare testimony in a relatively short time period after completion of the Phase II work.

Christian Meyer

April 18, 1984

Subscribed and sworn to before me this 18th day of April, 1984, in the City of Washington, District of Columbia.

Renee Gier
Notary Public

My commission expires: July 31, 1986

PROPOSED SEISMIC ANALYSIS

To be Performed by
Drs. Christian Meyer and Jose M. Roesset

Introduction

This work will provide a review of the seismic-structural aspects of the onsite and offsite AC power configuration proposed by LILCO for use at the Shoreham Nuclear Plant during Low Power Testing. The analysis will be used by Suffolk County to assess the reliability and safety of the design and may be used in the ASLB hearings on the Low Power License for Shoreham. The key issue, therefore, is to reach independent technical judgments regarding whether the SSE, were it to occur at or near Shoreham, would adversely affect the AC power being relied upon by LILCO and, if so, to what degree.

Phase I

The scope of the analysis will be established in detail and documented in a work plan. It will describe the documents to be obtained via discovery or otherwise, the onsite inspections which will be required, the types of analyses to be performed, and the schedule for the above activities.

The input information shall include the docketed information (FSAR, SER, Motion for Low Power License, PRA, diesel data, and any other data that are available). In addition, a site visit should be performed as part of the Phase I work.

Phase II

This phase is the execution of the work plan developed in Phase I. The work will include analysis of four key parts of the AC electrical system proposed by LILCO: (a) the onsite power sources consisting of a gas turbine, transformers, the switch yard, and the 4 mobile diesel generators and all their interconnecting parts; (b) the offsite power sources, such as the gas turbines at Holtsville; (c) the transmission line systems connecting the onsite equipment to the local substations; and (d) the substation components used to switch or control incoming power to the site. The work would also cover supporting equipment, such as the fuel oil storage tanks for diesels and turbines whose failure could render other equipment unreliable (such as due to a fuel oil fire).

To perform the Phase II work, there will need to be at least one and probably several visits to the Shoreham site and to other locations to obtain first hand data on the varied AC power systems. It assumed in the time estimates (infra) that access to these systems for these purposes will not present a time-consuming obstacle.

The analyses will consider the effects of the SSE (0.2g's horizontally) on the ability of the equipment to function. Such factors as slides, trees falling, liquification, failures of rigidly connected components due to differential motion, interaction due to swaying or swinging power lines, failures of foundations, separation of buried cables or structures due to differential motion, and possible common-cause failures of components mounted on the mobile diesels or gas turbines will be considered. Specific items that will need to be examined include the following:

(a) The seismic fragility of the 20 MW gas turbine and its mounting, including the associated control equipment, fuel tanks, circuit breakers, added transformers (if any), and their connection through the 69 KV bus.

(b) The seismic fragility of the four 2.5 MW mobile diesels and their mountings, including the control equipment, fuel sources, circuit breakers, disconnects, additional transformers (if any), and their foundations.

(c) The 69 KV transmission system, including particularly the Wildwood substation (and associated transformers, circuit breakers, busses, etc.), the transmission system (above ground and underground) to the Shoreham, the RSS transformer.

(d) The 138 KV transmission system, including particularly the substation for the system (and associated transformers, circuit breakers, busses, etc.), the transmission system to Shoreham (including towers), and the NSS transformer.

An analysis may be performed to determine the soil structures in the vicinity of the key components such as mobile diesels, gas turbines, transmission lines, transformers, substations and buried cables, to assess the seismic impact of these soil structures on the related equipment.

The results of this phase shall be documented in a report which describes the analysis performed, the potential impact of the SSE, and the affected components. It is likely, in addition, that data developed in Phase II will be used as input data to other County consultants requiring seismic structural data.

In addition, a literature search will be performed to ascertain how electrical equipment and systems have been impacted in seismic events. (For example, the Sylmar Converter Station was severely damaged in the 1971 San Fernando earthquake.) The results of the search will be documented in the report.

Phase III

This phase involves the preparation of testimony based on the Phase II results and the presentation of the testimony at the ASLB hearing for a Shoreham Low Power License.

Relationship Between Phases

Each phase would be done serially and each new phase would begin only with sponsor acceptance of the prior phase product and with an assessment by Suffolk County of the need for such data in the Shoreham licensing hearing.

Schedule

Phase I:	Completed as soon as possible.
Phase II:	Schedule to be established in Phase I work. Completion goal estimated by consultants is no later than end of June 1984.
Phase III:	Testimony to be prepared two weeks after end of Phase II.

Labor Hours Estimate (these are minimum estimates)

Phase I:	4 days
Phase II:	20 days
Phase III:	7 days

AFFIDAVIT OF GREGORY C. MINOR

Gregory C. Minor deposes and says the following:

1. I am a partner of MHB Technical Associates, a consulting firm in California, and I have been working on the Shoreham operating license issues since 1977. My background includes 16 years in the nuclear industry while employed by General Electric's Nuclear Energy Division and 8 years as a technical consultant related to nuclear issues. I have a B.S. degree in Electrical Engineering from the University of California, Berkeley and a M.S. degree in Electronics from Stanford. A copy of my professional qualifications is attached as Exhibit 1. My consulting work for Suffolk County on the Shoreham licensing began in 1977 and has continued for the last seven years with only brief interruptions.

2. The LILCO application for an operating license for Shoreham was docketed with the Nuclear Regulatory Commission ("NRC") in 1976. At that time and during all periods subsequent until March 20, 1984, LILCO maintained that it would provide emergency AC power to Shoreham by two means: offsite AC power, consisting of 69 KV and 138 KV transmission lines; and onsite AC power, consisting of three 3.5 MW emergency diesel generators ("EDGs") manufactured by Transamerica Delaval, Inc. ("TDI"). This configuration was consistent with 10 C.F.R. Part 50, Appendix A, General Design Criterion 17, which requires that <u>both</u> an onsite and an offsite electric power system shall be provided.

3. On March 20, 1984, LILCO filed a Supplemental Motion for Low Power License in the NRC's licensing proceeding. In this motion, LILCO proposed a radically different configuration of AC power sources. This unprecedented configuration consisted of no onsite AC power sources (TDI's not operational) and a collection of additional equipment to augment the offsite sources, which additional equipment was not designed or qualified to nuclear safety standards. A 20 MW gas turbine was proposed to be added on the Shoreham plant site but outside the security fence. This generating source has no nuclear safety classification and was not qualified for seismic operation. It is proposed to be connected to the 69 KV bus and to be fitted with the ability to automatic start when no other AC power is available ("black start"). Four mobile EMD diesel generators manufactured by General Motors ("mobile diesels") are proposed to be brought onsite and mounted outside the reactor building but inside the security fence. These mobile diesels can each supply 2.5 MW and will be connected to the 4 KV bus (which is fed from the 138 KV bus). The mobile diesels are not qualified for seismic events nor are they designed, constructed and qualified to the nuclear safety and quality standards applicable to onsite emergency diesel generators.

4. To my knowledge, there is no other U.S. nuclear plant licensed with neither operational emergency diesels nor qualified backup power sources. In the case where another plant has relied on an offsite power source for AC backup power, the source was qualified according to NRC requirements for that purpose. Thus,

the LILCO proposal to operate Shoreham without any fully qualified AC power constitutes a unique and unprecedented operation application.

5. In adopting this unprecedented approach to backup power, the LILCO motion has raised new factual issues which are complex and require extensive analyses by qualified experts, particularly because there has been no occasion in this or other cases to address these specific issues. These issues include:

(a) How the existing offsite and added generating equipment will perform if there is an earthquake at Shoreham. Neither the gas turbine, the mobile diesels, the 138 KV line, the 69 KV line nor their associated control equipment have been qualified to withstand the seismic activity resulting from the design basis earthquake for Shoreham. (The non-operational TDI diesels had been so qualified.)

(b) Because the gas turbine is outside the main security fence, it does not have the protection afforded other vital equipment such as the originally proposed TDI diesels. Further, the four mobile diesels are in a much less protected location than the prior TDI diesels.

(c) The reliance on offsite power is increased by the mode of operation proposed in the LILCO motion and thus the offsite power system (including the enhancements by the mobile diesels and gas turbine) must be analyzed for reliability and availability, including the ability to survive design basis events.

(d) There are new interim procedures which must be written, reviewed and finalized for use in maintaining, testing, and operating the newly added generating sources. These procedures must be analyzed from both technical and human factors viewpoints to see if they will insure reliable operation.

(e) The overall reliability of the conglomerate system proposed by LILCO must be compared to the reliability which would be achieved with fully operational and qualified emergency diesel generators.

6. In design basis accident analyses, one of the additional failures which is postulated to evaluate the safety of reactor design is called the Loss-Of-Offsite Power ("LOSP"). Generally, this failure is used to analyze reactor system performance under, for instance, loss of coolant accident conditions and the ability of the nuclear service qualified emergency diesels to provide necessary power to safety and cooling systems. Thus, the offsite power is assumed lost and the safety of the plant is ensured by the availability of reliability onsite power. LILCO's motion reverses this usual analysis because the onsite power does not even exist to start with. Instead, LILCO tries to show how offsite power (including the added generating sources) can compensate for the lack of onsite power.

7. LILCO has suggested in a recent filing with the NRC that the County has been on notice for years of LILCO's offsite power system and thus cannot complain that the NRC's rapid hearing schedule comes as a great surprise.

> [T]he County has been on notice for years of the existence of virtually all of the factual issues it now portrays as being newly created. The same provision -- General Design Criterion 17 -- which the County now says prevents hearings on LILCO's power motion, also applied to Shoreham back in 1977-81, when the County was formulating its safety contentions. GDC 17 applies to the capacity of offsite as well as onsite electric power systems to support the performance of specified safety functions in the event of postulated accidents. GDC 17 also requires that provisions be made to minimize the probability of losing electric power supplies. See 10 CFR Part 50, Appendix A, Criterion 17, first and last paragraphs. In short, the same offsite power sources that Suffolk County now demands extended periods to examine were used in the Chapter 15 FSAR analyses for Shoreham and were available for litigation, with the required assumption that onsite power was lost, when Suffolk County was framing its safety contentions years ago. The only development since then concerning the reliability of offsite power sources is their enhancement by the addition of certain new power sources, a 20 MW gas turbine and four mobile diesel generators physically located on the Shoreham site (though not deemed "onsite" for regulatory purposes). The time to have raised GDC 17 issues (with the limited exception of the new sources) was years ago, not now.

LILCO's Response to Various Suffolk County/New York State Requests Dated April 16 and Received April 17, 1984, dated April 19, 1984, pp. 13-14.

I disagree strongly with the LILCO assertion. First, under NRC requirements, there never was an occasion to postulate the loss of both the onsite and offsite AC power sources; such a "double failure" was not deemed credible in NRC proceedings.

However, under the present LILCO proposal, one starts with no onsite AC power and must rely solely on the reliability of the offsite power. This constitutes an entirely new emphasis on the need for reliable offsite power, an emphasis that could not have been foreseen before March 20, 1984.

Second, there never was any need for the County to perform detailed analyses of LILCO's offsite power sources because LILCO's application for a license always was premised on the fact that there would be an onsite AC power system which was fully qualified for nuclear operations. The County has participated vigorously in proceedings before the NRC to ensure that any onsite power system that ever is relied upon by LILCO does meet all regulatory requirements. It was only after March 20, 1984 that the County learned that LILCO would propose to operate Shoreham without a highly reliable onsite AC power system, thus requiring the County to assess the reliability and other attributes of the LILCO offsite power sources.

8. In response to LILCO's motion, MHB Technical Associates, on behalf of Suffolk County, began in early April to contact experts in areas related to the issues presented in LILCO's unusual proposal. Beginning on April 4 and continuing to this date, MHB has been contacting potential expert witnesses and attempting to obtain their services for the County. This includes numerous contacts between myself and potential reliability experts, and also numerous contacts with seismic/structural analysts by myself and my partner, Richard Hubbard. We also attempted to contact

seismologists during this period. As a result, the County has secured the services of the Sierra Energy and Risk Assessment Company ("SERA") for reliability analyses and the services of Professors Roesset and Meyers for seismic/structural work. The County is also utilizing the services of Mr. G. Dennis Eley for purposes of analyzing the reliability of the new substitute diesels. Work during the last week has focused on integrating the efforts of the consultants contracted by the County.

9. Since March 20, when the LILCO Motion was received, a large portion of my time and of my colleagues at MHB has been devoted to review and analysis of the LILCO Motion. LILCO has suggested, however, in its April 19 NRC filing (referenced earlier) that the County has not been diligent in pursuing retention of expert consultants or in pursuing discovery. This is untrue.

(a) A large portion of the time after receipt of the LILCO Motion on March 20 was devoted to studying the Motion to understand its details. It clearly was not possible to go forward with discovery or the retention of experts until vital details were understood. Many of those details first became available at a March 29 meeting between LILCO and the NRC Staff which my partner, Dale Bridenbaugh, attended.

(b) The County did not retain experts prior to the Licensing Board's April 6 Order because the County's position was that for legal reasons, the LILCO Motion needed to be dismissed. It was the County's view that once the Licensing Board ruled on the threshold legal issues and assuming it ruled for LILCO, it would

permit a reasonable period for retention of experts and discovery. In my experience in NRC proceedings, a period of approximately 60 days is what is normally the rule in NRC proceedings. I have never heard of an 11 day period for discovery.

(c) The County could not start low power discovery until April 6, 1984, the date that the Licensing Board opened discovery. After receipt of the April 6 Order, MHB worked diligently with County counsel to retain experts and to get discovery filed. MHB took a lead role in each endeavor. Under these circumstances, getting document discovery filed by April 11, 1984 (3 business days after the April 6 Order) was certainly timely.

10. In the time permitted for discovery by the Board's April 6 Order (a total of 11 days), the County could not complete reasonable discovery. The County did not receive any documents from LILCO pursuant to its document requests until April 16, the day discovery closed. The County could not take meaningful depositions until receipt of the documents and until they had been reviewed by the County's experts. Thus, by not receiving the documents until the close of discovery, the County effectively was deprived of an opportunity to take depositions. Similarly, a site visit to examine in detail the physical aspects of LILCO's proposal could not be meaningful until after review of the initial documents produced in discovery; otherwise, the visit would not be focused on the key issues in controversy. The site visit was thus barred by the Board's unreasonably short discovery period.

11. We have now been reviewing the LILCO Motion for one month. My review of the available data and my discussions with the contracted experts convinces me after this initial review that there is a need for additional experts if the County is to perform a complete analysis. These include the following areas:

(a) Gas turbine experts to analyze the reliability of the 20 MW used gas turbine being installed onsite and the timing capability of the dead line black start system when used on this gas turbine design.

(b) Power system grid reliability experts to analyze the reliability of the LILCO grid and its interconnections to other systems. This is a key parameter in determining the expected number of demands on the backup onsite configuration proposed by LILCO.

(c) Human factors experts to analyze the necessary operator actions to synchronize and load the 2.5 MW EMD mobile diesels. These same experts would review and analyze the LILCO interim procedures (some are now in draft form), and the maintenance procedures once they are provided.

(d) QA experts to evaluate the impact of (1) proposed diesel and gas turbine maintenance practices, (2) construction and installation practices of the new non-seismic, non-Class I diesels and gas turbines, and (3) the history of construction, qualification and maintenance applied to

these non-Class I equipment on the reliability of their future operation.

(e) Geologists to analyze the terrain over which the offsite power is transmitted and the soil profiles where critical equipment is being located for the LILCO proposed interim solution for loss of offsite power.

12. I have reviewed the affidavits of Messrs. Weatherwax, Eley and Meyer. I agree completely with them that it was impossible for them to prepare testimony by April 20, 1984. Accordingly, the time period for review of materials and preparation of scientific analyses was so short that these experts were barred from presenting meaningful testimony.

Gregory C. Minor

April 20, 1984

Subscribed and sworn to before me this 20th day of April, 1984, in the City of Washington, District of Columbia.

Notary Public

My commission expires:

PROFESSIONAL QUALIFICATIONS OF GREGORY C. MINOR

GREGORY C. MINOR
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San Jose, California 95125
(408) 266-2716

EXPERIENCE:

1976 to PRESENT

Vice-President - MHB Technical Associates, San Jose, California

Engineering and energy consultant to state, federal, and private organizations and individuals. Major activities include studies of safety and risk involved in energy generation, providing technical consulting to legislative, regulatory, public and private groups and expert witness in behalf of state organizations and citizens' groups. Was co-editor of a critique of the Reactor Safety Study (WASH-1400) for the Union of Concerned Scientists and co-author of a risk analysis of Swedish reactors for the Swedish Energy Commission. Served on the Peer Review Group of the NRC/TMI Special Inquiry Group (Rogovin Committee). Actively involved in the Nuclear Power Plant Standards Committee work for the Instrument Society of America (ISA).

1972-1976

Manager, Advanced Control and Instrumentation Engineering, General Electric Company, Nuclear Energy Division, San Jose, California

Managed a design and development group of thirty-four engineers and support personnel designing systems for use in the measurement, control and operation of nuclear reactors. Involved coordination with other reactor design organizations, the Nuclear Regulatory Commission, and customers, both overseas and domestic. Responsibilities included coordinating and managing and design and development of control systems, safety systems, and new control concepts for use on the next generation of reactors. The position included responsibility for standards applicable to control and instrumentation, as well as the design of short-term solutions to field problems. The disciplines involved included electrical and mechanical engineering, seismic design and process computer control/programming, and equipment qualification.

1970 - 1972

Manager, Reactor Control Systems Design, General Electric Company, Nuclear Energy Division, San Jose, California

Managed a group of seven engineers and two support personnel in the design and preparation of the detailed system drawings and control documents relating to safety and emergency systems for nuclear reactors. Responsibility required coordination with other design organizations and interaction with the customer's engineering personnel, as well as regulatory personnel.

1963 - 1970

Design Engineer, General Electric Company, Nuclear Energy Division, San Jose, California

Responsible for the design of specific control and instrumentation systems for nuclear reactors. Lead design responsibility for various subsystems of instrumentation used to measure neutron flux in the reactor during startup and intermediate power operation. Performed lead system design function in the design of a major system for measuring the power generated in nuclear reactors. Other responsibilities included on-site checkout and testing of a complete reactor control system at an experimental reactor in the Southwest. Received patent for Nuclear Power Monitoring System.

1960 - 1963

Advanced Engineering Program, General Electric Company; Assignments in Washington, California, and Arizona

Rotating assignments in a variety of disciplines:

- Engineer, reactor maintenance and instrument design, KE and D reactors, Hanford, Washington. circuit design and equipment maintenance coordination.

- Design engineer, Microwave Department, Palo Alto, California. Worked on design of cavity couplers for Microwave Traveling Wave Tubes (TWT).
- Design engineer, Computer Department, Phoenix, Arizona. Design of core driving circuitry.

- Design engineer, Atomic Power Equipment Department, San Jose, California. Circuit design and analysis.

- Design engineer, Space Systems Department, Santa Barbara, California. Prepared control portion of satellite proposal.

- Technical Staff - Technical Military Planning operation. (TEMPO), Santa Barbara, California. Prepare analyses of missile exchanges.

During this period, completed three-year General Electric program of extensive education in advanced engineering principles of higher mathematics, probability and analysis. Also completed courses in Kepner-Tregoe, Effective Presentation, Management Training Program, and various technical seminars.

EDUCATION

University of California at Berkeley, BSEE, 1960.

Advanced Course in Engineering - three-year curriculum, General Electric Company, 1963.

Stanford University, MSEE, 1966.

HONORS AND ASSOCIATIONS

- Tau Beta Pi Engineering Honorary Society

- Co-holder of U.S. Patent No. 3,565-760, "Nuclear Reactor Power Monitoring System," February, 1971.

- Member: American Association for Advance of Science.

- Member: Nuclear Power Plant Standards Committee, Instrument Society of America.

PERSONAL DATA

Born: June 7, 1937
Married, three children
Residence: San Jose, California

PUBLICATIONS AND TESTIMONY

1. G. C. Minor, S. E. Moore, "Control Rod Signal Multiplexing," IEEE Transactions on Nuclear Science, Vol. NS-19, February, 1972.

2. G. C. Minor, W. G. Milam, "An Integrated Control Room System for a Nuclear Power Plant," NEDO-10658, presented at International Nuclear Industries Fair and Technical Meetings, October, 1972, Basle, Switzerland.

3. The above article was also published in the German Technical Magazine, NT, March, 1973.

4. Testimony of G. C. Minor, D. G. Bridenbaugh, and R. B. Hubbard before the Joint Committee on Atomic Energy, Hearing held February 18, 1976, and published by the Union of Concerned Scientists, Cambridge, Massachusetts.

5. Testimony of G. C. Minor, D. G. Bridenbaugh, and R. B. Hubbard before the California State Assembly Committee on Resources, Land Use, and Energy, March 8, 1976.

6. Testimony of G. C. Minor and R. B. Hubbard before the California State Senate Committee on Public Utilities, Transit, and Energy, March 23, 1976.

7. Testimony of G. C. Minor regarding the Grafenrheinfeld Nuclear Plant, March 16-17, 1977, Wurzburg, Germany.

8. Testimony of G. C. Minor before the Cluff Lake Board of Inquiry, Regina, Saskatchewan, Canada, Department 21, 1977.

9. The Risks of Nuclear Power Reactors: A Review of the NRC Reactor Safety Study WASH-1400 (NUREG-75/0140), H. Kendall, et al, edited by G. C. Minor and R. B. Hubbard for the Union of Concerned Scientists, August, 1977.

10. Swedish Reactor Safety Study: Barseback Risk Assessment, MHB Technical Associates, January, 1978. (Published by Swedish Department of Industry as Document SdI 1978:1)

11. Testimony by G. C. Minor before the Wisconsin Public Service Commission, February 13, 1978, Loss of Coolant Accidents: Their Probability and Consequence.

12. Testimony by G. C. Minor before the California Legislature Assembly Committee on Resources, Land Use, and Energy, AB 3108, April 26, 1978, Sacramento, California.

13. Presentation by G. C. Minor before the Federal Ministry for Research and Technology (BMFT), Meeting on Reactor Safety Research, Man/Machine Interface in Nuclear Reactors, August 21, and September 1, 1978, Bonn, Germany.

14. Testimony of G. C. Minor, D. G. Bridenbaugh, and R. B. Hubbard, before the Atomic Safety and Licensing Board, September 25, 1978, in the matter of Black Fox Nuclear Power Station Construction Permit Hearings, Tulsa, Oklahoma.

15. Testimony of G. C. Minor, ASLB Hearings Related to TMI-2 Accident, Rancho Seco Power Plant, on behalf of Friends of the Earth, September 13, 1979.

16. Testimony of G. C. Minor before the Michigan State Legislature, Special Joint Committee on Nuclear Energy, Implications of Three Mile Island Accident for Nuclear Power Plants in Michigan, October 15, 1979.

17. A Critical View of Reactor Safety, by G. C. Minor, paper presented to the American Association for the Advancement of Science, Symposium on Nuclear Reactor Safety, January 7, 1980, San Francisco, California.

18. The Effects of Aging on Safety of Nuclear Power Plants., paper presented at Forum on Swedish Nuclear Referendum, Stockholm, Sweden, March 1, 1980.

19. Minnesota Nuclear Plants Gaseous Emissions Study, MHB Technical Associates, September, 1980, prepared for the Minnesota Pollution Control Agency, Roseville, MN.

20. Testimony of G. C. Minor and D. G. Bridenbaugh before the New York State Public Service Commission, Shoreham Nuclear Plant Construction Schedule, in the matter of Long Island Lighting Company Temporary Rate Case, September 22, 1980.

21. Testimony of G. C. Minor and D. G. Bridenbaugh before the New Jersey Board of Public Utilities, Oyster Creek 1980 Refueling Outage Investigation, in the matter of Jeresey Central Power and Light Rate Case, February 19, 1981.

22. Systems Interaction and Single Failure Criterion, MHB Technical Associates, January, 1981, prepared for and available from the Swedish Nuclear Power Inspectorate, Stockholm, Sweden.

23. Systems Interaction and Single Failure Criterion: Phase II Report, MHB Technical Associates, February 1982, prepared for and available from the Swedish Nuclear Power Inspectorate, Stockholm, Sweden.

24. Testimony of G. C. Minor and D. G. Bridenbaugh on PORV's and Pressurizer Heaters. Diablo Canyon Operating License hearing before ASLB, January 11, 1982.

25. Testimony of G. C. Minor and R. B. Hubbard on Emergency Response Planning. Diablo Canyon Operating License hearing before ASLB, January 10, 1982.

26. Testimony of G. C. Minor, R. B. Hubbard, M. W. Goldsmith, S. J. Harwood on behalf of Suffolk County, before the Atomic Safety and Licensing Board, in the matter of Long Island Lighting Company, Shoreham Nuclear Power Station, Unit 1, regarding Contention 7B, Safety Classification and Systems Interaction, April 13, 1982.

27. Testimony of G. C. Minor and D. G. Bridenbaugh on behalf of Suffolk County, before the Atomic Safety and Licensing Board, in the matter of Long Island Lighting company, Shoreham Nuclear Power Station, Unit 1, regarding Suffolk County Contention 11, Passive Mechanical Valve Failure, April 13, 1982.

28. Testimony of G. C. Minor and R. B. Hubbard on behalf of Suffolk County, before the Atomic Safety and Licensing Board, in the matter of Long Island Lighting Company, Shoreham Nuclear Power Station, Unit 1, regarding Suffolk County Contention 27 and SOC Contention 3, Post-Accident Monitoring, May 25, 1982.

29. Testimony of G. C. Minor and D. G. Bridenbaugh on behalf of Suffolk County, before the Atomic Safety and Licensing Board, in the matter of Long Island Lighting Company, Shoreham Nuclear Power Station, Unit 1, regarding Suffolk County Contention 22, SRV Test Program, May 25, 1982.

30. Testimony of G. C. Minor and D. G. Bridenbaugh on behalf of Suffolk County, before the Atomic Safety and Licensing Board, in the matter of Long Island Lighting Company, Shoreham Nuclear Power Station, Unit 1, regarding Suffolk County Contention 28(a)(vi) and SOC Contention 7A(6), Reduction of SRV Challenges, June 14, 1982.

31. Testimony of G. C. Minor on behalf of Suffolk County, before the Atomic Safety and Licensing Board, in the matter of Long Island Lighting Company, Shoreham Nuclear Power Station Unit 1, regarding Environmental Qualification, January 18, 1983.

32. Testimony of G. C. Minor and D. G. Bridenbaugh before the Pennsylvania Public Utility Commission, on behalf of the Office of Consumer Advocate, Regarding the Cost of Constructing the Susquehanna Steam Electric Station, Unit I, Re: Pennsylvania Power and Light, March 18, 1983.

33. Supplemental testimony of G. C. Minor, R. B. Hubbard, and M. W. Goldsmith on behalf of Suffolk County, before the Atomic Safety and Licensing Board, in the matter of Long Island Lighting Company, Shoreham Nuclear Power Station, Unit 1, regarding Suffolk County Contention 7B, Safety Classification and Systems Interaction, March 23, 1983.

34. Testimony before the District Court Judge in the case of Sierra Club et al. vs. DOE regarding the Clean-up of Uranium Mill Tailings. June 20, 1983.

35. Systems Interaction and Single Failure Criterion: Phase 3 Report, MHB Technical Associates, June, 1983, prepared for and available from the Swedish Nuclear Power Inspectorate, Stockholm, Sweden.

36. Systematic Evaluation Program: Status Report and Initial Evaluation, MHB Technical Associates, June, 1983, prepared for and available from the Swedish Nuclear Power Inspectorate, Stockholm, Sweden.

37. Testimony of G. C. Minor, F. C. Finlayson, and E. P. Radford before the Atomic Safety and Licensing Board, in the Matter of Long Island Lighting Company, Shoreham Nuclear Power Station, Unit 1, regarding Emergency Planning Contentions 65, 23.D and 23.H, November 18, 1983.

38. Testimony of G. C. Minor, Sizewell 'B' Power Station Public Inquiry, Proof of Evidence Regarding Safety Issues, December, 1983.

39. Testimony of D. G. Bridenbaugh, L. M. Danielson, R. B. Hubbard and G. C. Minor before the State of New York Public Sercvice Commission, PSC Case No. 27563, in the matter of Long Island Lighting Company Proceeding to Investigate the Cost of the Shoreham Nuclear Generating Facility — Phase II, on behalf of County of Suffolk, February 10, 1984.