RDA PROPOSAL 580072

HYDROGEN CONTROL

SEPTEMBER 1980

Submitted To:
LAWRENCE LIVERMORE NATIONAL LABORATORY
P.O. Box 808
Livermore, CA 94550

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I. INTRODUCTION

During the accident at TMI-2, some hydrogen was released that burned inside the containment. This event has naturally prompted a high level of effort to find a means of mitigating the effect of hydrogen burn should another accident occur. Concern has been expressed at the Nuclear Regulatory Commission (NRC) that the containment structure associated with an operating reactor should be able to withstand the effects of a similar hydrogen release. As part of the approach to this problem, RDA was asked to give an independent view, specifically related to the Sequoyah nuclear plant. These views were presented by letter and in a briefing to the ACRS Subcommittee on hydrogen problems in Class 9 accidents.

Because of its background, RDA believes it can provide a valuable service to the Lawrence Livermore National Laboratory (LLNL) by aiding in the interpretation and evaluation of the laboratory's work on igniters as a means of mitigating the effects of hydrogen burn. To this end, RDA proposes a Statement of Work in Section II, followed in Section III by a brief discussion of the appropriate technical concerns. Section IV contains company background data; Section V, resumés; and Section VI, the cost and pricing information.

II. STATEMENT OF WORK

To aid LLNL in its work on hydrogen igniters for the NRC, RDA will:

1. Assist LLNL to analyze and evaluate the data from experiments on igniters for use in nuclear reactor containments.
2. Assist LLNL to evaluate the effectiveness of igniters in controlling hydrogen burning following a core-damaging accident, especially as applied to ice condenser containments.
3. Use the results of Tasks 1 and 2 to assess the need for further work and to suggest additional research, if required.
4. Identify any potentially better methods for controlling or mitigating the effects of hydrogen burning, if any exist, and indicate the needed research.

III. TECHNICAL APPROACH

Application of the LLNL igniter experiment results to the issues of full-scale hydrogen control and containment integrity must address questions of extrapolation with respect to scale (size), range of variables, and departure from typical reactor accident conditions. Extrapolation questions would include uncertainties about phenomena associated with convective flow fields surrounding an igniter and about the fidelity with which propagation processes are reproduced. The range of experimental variables such as H_2 and steam concentration (and perhaps O_2 concentration), total pressure, and initial temperature probably will not cover all accident conditions of interest, and methods of analytical extrapolation may be required. Reactor containment conditions may well involve fluctuations and gradients in both steam and hydrogen concentration, and will certainly present different wall effects from the experiments. These complications should be considered in assessing the performance of specific igniters and in evaluating the appropriateness of igniter strategies.

A complete and fundamental physical interpretation of the LLNL experimental results would be desirable, accompanied by analyses of reactor accident conditions. RDA will support the LLNL efforts toward those objectives by studying (1) the experimental data on igniter performance, (2) evaluations relative to previous work on H_2 ignition and burning, and (3) related theoretical analyses and engineering studies as mutually agreed upon.

IV. COMPANY BACKGROUND AND RESUMES

RDA was founded in 1971 by approximately 20 scientists from the Rand Corporation Physics Department and today is a company of about 420 skilled technologists and supporting staff, many of whom have achieved national and international recognition in their fields. RDA's corporate headquarters is located in Marina del Rey, California. Field offices are located in Washington, D.C.; Albuquerque, New Mexico; and Munich, Germany.

RDA's primary goal is to identify, analyze and solve problems of national importance in the areas of defense and energy. It is central to the company's policy that technical quality and integrity are at the forefront of all tasks. A strong internal monitoring system enforces this directive.

RDA's main business is with the U.S. Department of Defense (DoD) in the areas of strategic and tactical weapon systems, C^3, and nuclear weapons effects. A major part of RDA's research is in analyzing the performance of complex weapon systems or defense installations in the presence of adverse environments. This search for and analysis of vulnerabilities, failure modes and possible fixes for a variety of defense systems is an activity requiring many of the same kinds of disciplines and methods that are employed in nuclear reactor failure problems. RDA believes that these defense problems are highly relevant to a disciplined approach to thinking about reactor safety.

RDA technical personnel have been organized into groups of discipline-oriented departments, as shown in Figure 1, with the relative degree levels and areas of specialty shown in Figure 2. Brief resumes for the corporate officers and proposal contributors follow.

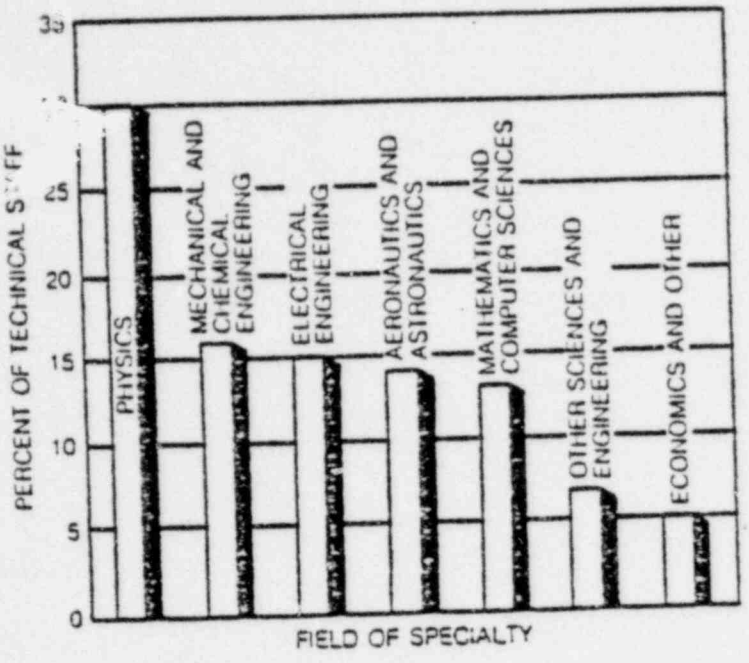

Figure 1. Field of specialty.

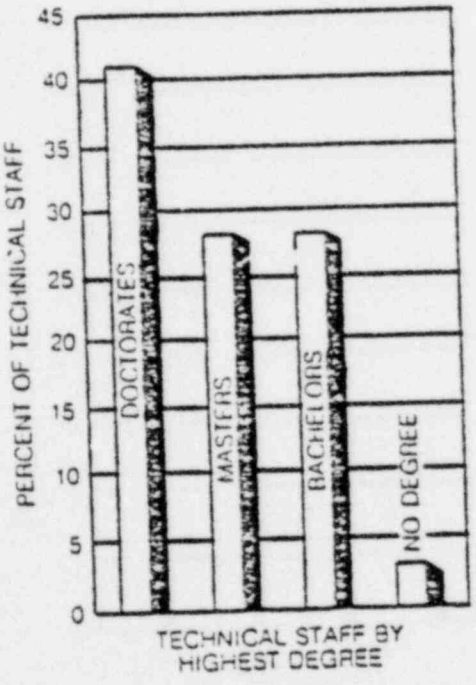

Figure 2. Technical staff by highest degree.

Albert L. Latter

Dr. Albert Latter has been President and Chairman of the Board of Directors of R & D Associates since it was founded in 1971. Prior to the formation of RDA, he was the Head of the Physics Department at The Rand Corporation. Dr. Latter's work at RDA is concerned mainly with nuclear weapon development and nuclear weapons effects, the concealability of nuclear explosions, and the survivability and defense penetration capability of the U.S. strategic forces. He has served as chairman or member of many national level scientific boards and advisory groups, including the Defense Science Board, the Air Force Scientific Advisory Board, the DNA Scientific Advisory Group, the Joint Strategic Targeting Scientific Advisory Group, and the U.S. Scientific Delegation to the Nuclear Test Ban Negotiations in Geneva. In addition to his many technical publications, he co-authored, with Dr. Edward Teller, the book Our Nuclear Future. Dr. Latter received the AEC E. O. Lawrence Award for his contribution to nuclear weapons effects and was cited in two successive years by the Air Force for his outstanding achievements.

Ph.D., Theoretical Nuclear Physics, 1951; University of California, Los Angeles.

Richard Latter

Dr. Richard Latter is Vice President and Secretary of R & D Associates and is a member of the Board of Directors. Prior to forming RDA, Dr. Latter was a member of the Research Council of The Rand Corporation, a position he held following his tenure as Head of the Physics Division. In addition to his extensive work in nuclear weapons development and effects, he has contributed to a number of strategic systems concepts, including MIRV antiballistic missile defense and penetration aids technology, and to the solution of scientific and strategic problems of arms control and national security. Dr. Latter has served as chairman or member of many national level boards and advisory groups, including the Defense Science Board, the AEC Plowshare Committee, the DoD VELA Advisory Committee, the Air Force Scientific Advisory Board, the DIA Scientific Advisory Committee, panels of the President's Scientific Advisory Committee, and various other panels and committees. In 1969, he was appointed the DDR&E representative to the Strategic Arms Limitation Talks (SALT) and a member of the U.S. SALT Delegation. Dr. Latter received the AEC E. O. Lawrence Award for his contribution to weapons development, weapons effects, and defense policy and strategy.

Ph.D., Theoretical Physics, 1949; California Institute of Technology.

Charles A. McDonald, Jr.

Dr. McDonald is a Vice President of R & D Associates. Prior to this, he was Technical Director for the Company. Before joining RDA, Dr. McDonald was Associate Director for Military Applications at Lawrence Livermore Laboratory responsible for all nuclear weapons designed by the laboratory including the Minuteman III and Poseidon MIRV warheads. As such, he was the principal liasion between the laboratory and the Department of Defense. The Spartan and Lance warheads were also designed under his direction during this period. Before becoming Associate Director, he was Division Leader of one of the two physics divisions in which nuclear weapons and devices and those explosives used in the Peaceful Uses of Nuclear Explosion Program (Plowshare) were designed. He became a staff member of the Lawrence Livermore Laboratory working on controlled thermonuclear research (Sherwood Program) in 1954. Dr. McDonald has been a member or chairman of many national level panels and advisory groups, including the Air Force Scientific Advisory Board (AFSAB), the AFSAB Munitions and Armaments Panel (formerly the Nuclear Panel), the Strategic Cross Matrix Panel, the Navy Polaris/Poseidon Steering Task Group, the Joint Strategic Target Planning Staff Scientific Advisory Group, the Army Missile Science Advisory Group, the Defense Nuclear Agency Scientific Advisory Group, several Defense Science Board ad hoc panels on various antiballistic missile problems, and other ad hoc groups and task forces. From 1972-73, Dr. McDonald served as a member of the Inter-Agency Advisory Group (U.S. Army) on tactical nuclear warfare. In 1974 he received the AEC E. O. Lawrence Award for his contribution to the field of nuclear weapons.

Ph.D., Physics, 1954; University of California, Berkeley.

Roland Herbst

Dr. Herbst is Director of the Program Management Office, which provides guidance for all matters connected with the fulfillment of RDA's program obligations. Previously, Dr. Herbst was Director of Research at RDA and was responsible for monitoring the technical progress on all contracts, recommending redirection or changes where appropriate, and reviewing and approving all milestone products generated before their delivery to the customer agency. Prior to joining RDA, Dr. Herbst was Deputy Director for the Strategic and Space Systems in the ODDR&E. In this position, he was responsible for the technical and budgetary review of the R&D programs concerning the U.S. offensive and defensive strategic systems and of the supporting space systems. While he was at the Lawrence Livermore Laboratory (LLL), Dr. Herbst was Division Leader of one of their two weapon design divisions, and was involved in weapon systems from their conceptualization to the underground testing program. In this role, and later as Associate Director for Nuclear Design, he worked closely with the AEC, ensuring the compatibility of the nuclear activities at the two agencies. Before joining the LLL, Dr. Herbst was at the Argonne National Laboratory. He has been a member or chairman of many national level panels and advisory boards, including the Defense Science Board Task Force on Arms Control, the DSB Vulnerability Task Force, the DSB Ballistic Missile Defense Panel, the Air Force Scientific Advisory Board Nuclear Panel, the JSC/Joint Target Planning Staff Scientific Advisory Group, and the SAMSO Advisory Group. Dr. Herbst was appointed Scientific Advisor, Negotiation of Treaty of Nuclear Weapon Test Suspension in 1959, and Scientific Advisor, Geneva Disarmament Conference in 1962. He holds the DoD Meritorious Civilian Award.

Ph.D., Theoretical Physics, 1953; St. Louis University.

Robert E. LeLevier

Dr. LeLevier is the Director of RDA's technical departments which are grouped into discipline-oriented fields. He has conducted studies on advanced strategic technology, nuclear physics, laser and laser system technology, high-altitude nuclear weapon effects, and intelligence analyses. Before coming to RDA, Dr. LeLevier was a senior staff member at The Rand Corporation where he authored over thirty reports on nuclear weapon effects. He provided theoretical estimates for planning blackout experiments on the TEAK and ORANGE high-altitude nuclear shots (1958), as well as applying the idea of ionospheric smog to explain the blackout data obtained on the high-altitude nuclear experiments conducted in 1962 at Johnston Atoll. He participated in the planning and analysis of all the U.S. high-altitude experiments of OPERATION FISH-BOWL during that year. As Chairman of DASA's Special Weapons Effects Group (now the Defense Nuclear Agency), he conducted a comprehensive analysis of the Soviet high-altitude blackout experiments conducted in Central Asia in 1962. This resulted in major changes in the U.S. ABM R&D program. In 1951, after obtaining his Ph.D. in Theoretical Physics at UCLA, he joined the University of California Lawrence Radiation Laboratory where he developed the first two-dimensional hydrodynamic code for use on high-speed digital computers. His work also included nuclear weapon designs and nuclear weapon effects analyses. Dr. LeLevier has been a member or chairman of many national level panels and advisory groups, including the Defense Science Board (DSB) ABM Hardsite Task Force; Chairman of the DNA Scientific Advisory Group on Effects (SAGE, 1966-1975); the DIA Clear Sky Panel; the Joint Strategic Target Planning Staff Scientific Advisory Group (SAG, 1968-1972); the President's Scientific Advisory Committee Strategic

Military Panel; the National Security Council Panel on Strategic Improvements; the DSB Missile Accuracy Panel; the JASON Group of the Defense Advanced Research Projects Agency; and the DSB Strategic C^3 Task Force (1972), Tactical C^3 Task Force (1973), BMD Task Force (1978), Summer Study Panel on Strategic Nuclear Systems Requirements (1978), and Enduring Strategic C^3 Task Force (1979).

Ph.D., Theoretical Physics, 1951; University of California, Los Angeles.

Harmon W. Hubbard

A founding member of RDA, Dr. Hubbard is an authority on nuclear energy applications, nuclear weapon design, effects and diagnostics. Dr. Hubbard managed the recent RDA work on nuclear safety and is involved in several nuclear weapon studies. He recently served as Director of the RDA Nuclear Weapons Effects Project for the Defense Nuclear Agency and is currently manager of a nuclear intelligence related program for the Air Force. Dr. Hubbard was manager of RDA's work for the Energy Research and Development Administration (ERDA) on a joint RDA-Los Alamos project (PACER) aimed at development of a pulsed fusion reactor. At the Rand Corporation, he managed a nuclear intelligence contract, and he evaluated and proposed various schemes for the design and applications of nuclear explosives. While at Aeronutronic Systems, Inc., he made the first calculation describing the initiation of detonation in a chemical explosive by shock and was co-discoverer of a simple criterion for detonation. He also engaged in nuclear test and hydrodynamic shock experiment planning and investigated the detonability of chemical propellants. At the Lawrence Livermore Laboratory (LLL), he was responsible for estimates of safety for critical assembly work related to nuclear weapon systems and participated in a variety of research projects. He serves on the Foreign Weapons Evaluation Group (Bethe Panel), which provides technical evaluations of foreign nuclear test data for the intelligence community and on DNA panels on nuclear test planning and computer code classification policy.

Ph.D., Physics, 1952; University of California, Berkeley.

James L. Dooley

Mr. Dooley is an internationally recognized expert in the field of high-performance engine design, development and production with 40 years of professional experience. From 1970 to 1974, Mr. Dooley was Vice President-Engineering and a member of the Board of Directors of McCulloch Corporation. For the previous 13 years he was Vice President-Advanced Development and a member of the Board of Directors of McCulloch. Earlier, he served as General Manager of McCulloch's Paxton Engineering Division and as Engineering Manager of their Rhodes-Lewis Division. Mr. Dooley joined McCulloch as part of their acquisition of the 750 person Rhodes-Lewis Company in 1957, where he was Vice President-Engineering and a member of the Board of Directors in addition to being a part owner. His early career included positions with North American Aviation and 10 years with Ingersoll-Rand Company. Mr. Dooley has been chairman or a member of many senior level government advisory panels including the California State Assembly Technical Advisory Board on the External Combustion Engine Project; the U.S. Department of Commerce Technical Advisory Panel on Low Pollutant Autos; the California Air Resources Board Technical Advisory Board; the White House Office of Science and Technology Ad Hoc Committee on Clean Unconventional Automotive Power Plants (now the ERDA Advisory Committee on Alternate Automotive Power Systems); and the National Science Foundation/U.C. Berkeley College of Engineering Combustion Research Program Advisory Committee. Mr. Dooley holds 18 patents, some of which are in worldwide use, and has 13 additional patents currently pending. He has authored or co-authored 19 technical papers in his field and is a Registered Mechanical Engineer in the State of California.

B.S., Mechanical Engineering, 1937; University of California, Berkeley.

Dennis Holliday

Dr. Holliday has worked on a wide variety of problems. His most recent research has been on the interaction of nonlinear water waves with nonuniform currents, a problem which has significant military implications, and on the economics of nuclear power. Before joining RDA, Dr. Holliday was a member of the Physics Department of The Rand Corporation. While at Rand, he worked on problems in the areas of quantum optics, quantum statistical mechanics, retirement plan formulation, and nuclear proliferation. Dr. Holliday is a member of the Working Group on Nuclear Proliferation and Arms Control of the California Arms Control and Foreign Policy Seminar, a group of California academic and industrial researchers who are interested in current problems in military affairs and arms control. During 1960 and 1961, Dr. Holliday was a NATO Postdoctoral Fellow in Theoretical Physics at the University of Lund in Sweden. He has published over forty scientific papers and reports and is a member of Phi Beta Kappa, Sigma Xi, and Tau Beta Pi.

B.S. with Great Distinction, Engineering Science, 1957; Stanford University.
Ph.D., Physics, 1961; Princeton University.

Ernest A. Martinelli

At RDA, Dr. Martinelli is Head of the Physics I Department. He is currently involved in a joint RDA-Los Alamos project for the Energy Research and Development Administration that is investigating the feasibility of developing a pulsed fusion reactor for producing commercial electric power. Dr. Martinelli has conducted research on the use of large underground cavities for seismic decoupling of nuclear explosions. His work on ARPA's evasion research program resulted in key contributions to the DIAMOND DUST experiment. Prior to joining RDA, Dr. Martinelli was at The Rand Corporation, where he proposed and designed nuclear weapons experiments that employed large vacuum chambers to test ballistic missile defense concepts. These types of experiments are employed in the U.S. underground test programs and yield information on the vulnerability of reentry vehicles to exoatmospheric explosions. Dr. Martinelli has been at the forefront of nuclear technology since his early days at the Lawrence Radiation Laboratory. He worked on the design of nuclear accelerators, and investigated such concepts as controlled fusion, nuclear rocket propulsion, and Plowshare technology. He was a starting member of the Lawrence Livermore Laboratory. Later, at Aeronutronics, a division of Philco-Ford, he continued with his work in advanced nuclear technology. He has served on numerous government committees concerned with nuclear and strategic weapons and systems. Since 1965, he has been a consultant to the Defense Nuclear Agency's Scientific Advisory Group on Effects and has served on the Foreign Weapons Evaluation Group since 1958. Earlier, at the Lawrence Livermore Laboratory he contributed to much of the early nuclear design work and weapons research. Dr. Martinelli has taught physics at Stanford University and at the University of California, Berkeley, and has received numerous academic and professional honors.

Ph.D., Physics, 1950; University of California, Berkeley.

George M. Safonov

Dr. Safonov has had over 25 years of professional experience. He is well known for his work on fission chain reacting systems and radioisotopes and for his pioneering work in neutronic methodologies. Dr. Safonov invented and developed the fission-electric conversion concept, which provided for the first generation of electricity in token amounts by an unconventional process. He joined RDA in September of 1972 and has worked on evaluating the feasibility of detecting nuclear radiations from submarines; proposed certain nuclear test instrumentation; and investigated the radioactive aspects of power generation from nuclear explosives. He is currently managing a study of the efficient use of waste heat from fission reactions. Before joining RDA, Dr. Safonov was a Senior Staff Physicist at TRW Systems Group where he consulted on nuclear engineering programs involving both reactors and radioisotopes. Also, while at TRW, he developed an aircraft blind-landing system based on the radioisotope Cobalt-60. From 1963 to 1969, while under contract with the Atomic Energy Commission, he was a consultant to The Rand Corporation and the Stanford Research Institute on nuclear reactors and weapons. During this period, he also served as a lecturer in the Nuclear Engineering Department of the University of California, Berkeley, and at Stanford University. From 1949 to 1963, Dr. Safonov was employed at The Rand Corporation where he originated procedures that permitted realistic analysis of nuclear weapons designed by using multigroup equations and computer processing methods. He also developed the "Cavity Reactor" theory and the "Fission-Electric" reactor. In the early 1950s, he worked with Dr. E. Teller and Dr. J. Foster on the analysis of certain weapons, including the first LRL weapon successfully tested in Nevada.

Ph.D., Physics, 1949; California Institute of Technology.

Samuel Zivi

Mr. Zivi has over 30 years' experience in engineering, product development, and energy-related research. He has made significant contributions in such diverse fields as laser technology, advanced electric batteries, nuclear safety, fluid mechanics, heat transfer and system reliability. Prior to joining RDA, he was with the Argonne National Laboratory for 7 years where, in his last position, he served as a Project Leader of a conceptual design effort for a utility lead-leveling battery utilizing an advanced high-temperature cell. Also while at Argonne, he served as Nuclear Safety Analyst at the Institute for Energy Analysis, Oak Ridge, Tennessee, where he conducted a study on public perceptions of nuclear power risks. He was also Project Leader of a Great Lakes thermal pollution study, which included both field operations and theoretical analyses. From 1959-1971, Mr. Zivi was with TRW Systems, Redondo Beach. During that time, he served as Manager of the Applied Optics Department, involved with the development of ruby laser holography equipment for commercial sales. Before that, he was Manager of the Applied Thermodynamics Department, which was primarily involved in contract and internally funded research on nuclear safety and space power systems. In his early career, Mr. Zivi was an Engineering Analyst in the areas of reactor kinetics and safety for the Atomic Energy Division of the American Standard Corporation. At Midwest Research Institute, he was an Engineering Analyst and Section Head for a group of engineers in work on antitank weapons, aircraft response to runway roughness, and cooling tower design. Mr. Zivi has published a number of journal articles and is a Registered Professional Engineer in the State of Illinois.

M.S., Mechanical Engineering, 1948; Washington University.

VI. COST AND PRICING

COST SUMMARY

Direct Labor

	Composite Hours	Composite Rate	
Senior Research Staff	358	22.99	$ 8,230
Research Staff Clerical & Support	65	7.46	485
Total Direct Labor	423		$ 8,715
Consultants			
Direct Labor Overhead @ 88.71		= $ 7,731	
Consultant Overhead @ 48.25		= -0-	
Total Overhead			7,731
Travel			1,932
Computer			-0-
Purchase Orders			825
Miscellaneous			-0-
Total Cost			$ 19,204
D&P & Other Support Burden @ 11.67			2,241
Major Subcontracts ($25,000 or more)			-0-
Subtotal			$ 21,445
G&A @ 6.05			1,297
Total Estimated Cost			$ 22,742
Profit/Fee			2,258
Total Price/Cost & Fee			$ 25,000

NOTE: FURTHER SUBSTANTIATION OF THE ABOVE COSTS APPEARS ON THE FOLLOWING PAGES

POOR ORIGINAL

RDA Proposal 580072 September 1980

DEPARTMENT OF DEFENSE
CONTRACT PRICING PROPOSAL

TYPE OF CONTRACT: CPFF

R & D Associates
4640 Admiralty Way
P.O. Box 9695
Marina del Rey, CA 90291
(213) 822-1715

PLACE(S) AND PERIOD(S) OF PERFORMANCE:
R&D Associates
4640 Admiralty Way
Marina del Rey, CA 90291

01 OCT 80 - 01 DEC 80

TOTAL COST: $22,742
PROFIT/FEE: 2,258
TOTAL: $25,000

TYPE OF PROCUREMENT ACTION: X NEW PROCUREMENT

LINE ITEM NO.	IDENTIFICATION	QUANTITY	TOTAL PRICE	REF.
1	Hydrogen Control	1 study	$25,000	See Atch

CONTRACT ADMINISTRATION OFFICE:
Defense Contract Administration
Services Region, Los Angeles
11099 S. La Cienega Boulevard
Los Angeles, CA 90045

AUDIT OFFICE:
Defense Contract Audit Agency
9920 S. La Cienega Boulevard
Inglewood, CA 90301

WILL YOU REQUIRE THE USE OF ANY GOVERNMENT PROPERTY IN THE PERFORMANCE OF THIS WORK? X NO

DO YOU REQUIRE GOVERNMENT CONTRACT FINANCING TO PERFORM THIS PROPOSED CONTRACT? X NO

HAVE YOU BEEN AWARDED ANY CONTRACTS OR SUBCONTRACTS FOR THE SAME OR SIMILAR ITEMS WITHIN THE PAST 3 YEARS? X NO

IS THIS PROPOSAL CONSISTENT WITH YOUR ESTABLISHED ESTIMATING AND ACCOUNTING PRACTICES AND PROCEDURES AND DAR SECTION XV COST PRINCIPLES? X YES

COST ACCOUNTING STANDARDS BOARD (CASB) DATA:
WILL THIS PROCUREMENT ACTION BE SUBJECT TO CASB REGULATIONS? X NO Exempted IAW 4 CFR 331.30(b)(1)

TYPED NAME AND TITLE:
JACK W. WHITE
CORPORATE CONTRACTS OFFICER

SIGNATURE: Jack W. White

NAME OF FIRM: R & D Associates

DATE OF SUBMISSION: 22 Sept 80

DD FORM 633

DIRECT LABOR RATES AND INDIRECT RATES

Direct labor rates bid in this proposal are based on the actual rates as of 1 Apr 1980; an annual escalation of 9% for all categories, which was developed based on actual rate increases, expected rate increases, and expected hiring practices for the next twelve (12) months, has been prorated to the midpoint of the anticipated contract term. The midpoint used in this proposal is 1 November 1980.

The direct labor rates indicated on the DD Form 633 are composite rates for categories of labor submitted to the DCASMA/ DCAA on 30 May 1980. The composite rates are based upon the categories, hourly rates and estimated hours shown in Figure 1.

RDA has an accounting policy which includes a Labor Overhead Rate, a Consultant Overhead Rate, B&P and Other Support Burden Rate, and a General and Administrative Rate. The B&P and Other Support Burden Rate is applied against all RDA direct costs and applicable overheads, exclusive of major subcontract costs (subcontracts of $25,000 or more). G&A is applied against all RDA direct and indirect costs, including major subcontract costs.

Data in support of the rates have been accepted by the DCAA for bidding and provisional billing purposes pending a more complete review in the near future.

DD Form 633 Description	RDA Labor Category	Hours	Rate	Direct Labor $	Composite Rate
Senior Research Staff	Senior Research Specialist II	170	25.88	$4,400	22.99
	Senior Research Specialist I	188	20.38	$3,831	
	Research Specialist			$	
	Subtotals	358		$8,231	
Associate Research Staff	Researchers			$	
	Associate Researchers			$	
	Assistant Researchers			$	
	Subtotals				
Clerical & Support	Clerical	65	7.46	$ 485	7.46
	Art & Editing			$	
	Subtotals	65		$ 485	
	TOTALS	423		$ 8,715	

NOTE: Above direct labor subtotals differ slightly from DD Form 633-4 amounts due to rounding effect, that is, total hours of each labor category (Senior Research, etc.) divided into total direct dollars for the category. The resultant composite rate is then multiplied by the total category hours, which sometimes creates a slight direct dollar difference between the back-up and the DD Form 633-4.

FIGURE 1. DIRECT LABOR BY CATEGORY, HOURLY RATE AND ESTIMATED HOURS

TRAVEL

The number of trips and the destinations listed below are the estimate of the Program Manager and are based on experience with similar contracts. Airfares are based on actual listed less than first class accommodations with an allowance for projected rate increases. Vehicle and mileage rates are those costs actually incurred on a corporate-wide basis and averaged for a daily rate. Hotel rates are those actually incurred in each given location. Taxi rates are based on actual experience.

5 1-day trips, Los Angeles, CA, to Livermore, CA	@ $ 186 =	$ 930
1 3-day trip, Los Angeles, CA, to Washington, DC	@ 1.002 =	1,002
		$1,932