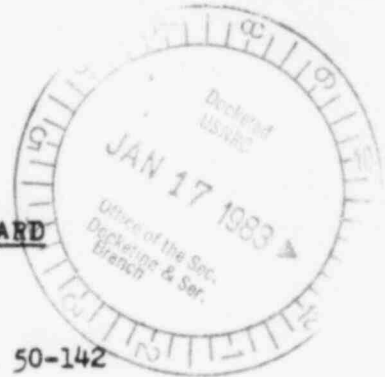


UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD



In the Matter of
THE REGENTS OF THE UNIVERSITY
OF CALIFORNIA
(UCLA Research Reactor)

Docket No. 50-142

(Proposed Renewal of
Facility License)

DECLARATION OF PROFESSOR W. JACKSON DAVIS

I, W. Jackson Davis, do declare as follows:

1. I am Professor of Biology and Environmental Studies at the University of California at Santa Cruz. A statement of professional qualifications is attached hereto.
2. I have reviewed portions of the following documents related to the UCLA reactor, including: 1980 UCLA application for license renewal and the 1982 amendments thereto; the NRC Staff's Environmental Impact Appraisal for the UCLA reactor; the AEC memorandum "Environmental Considerations Regarding the Licensing of Research Reactors and Critical Facilities"; the original Hazards Analysis for the UCLA reactor submitted by UCLA to the AEC in 1960; the UCLA Training Reactor Hazards Summary Report prepared by AMF for UCLA in 1959; the University of Florida Training Reactor Summary Report of October 1958; and certain other documents identified herein. My review was restricted to those portions of the above documents related to certain contentions raised by the Committee to Bridge the Gap and discussed below. These matters relate primarily to the adequacy of the application and the need for an environmental impact statement.
3. I have concluded, based upon the above review, that the application is seriously deficient. I have also concluded that the potential environmental impacts arising from the proposed action are of such significance that an Environmental Impact Statement is necessary.
4. The application for relicensing contains numerous materially inaccurate and misleading statements. These statements are such that they would tend to influence the review of the pending application by a responsible decision-maker or technical reviewer.
5. I conclude, further, that very little of the material submitted in the original 1960 application, the 1980 renewal application, and the 1982 amendments to the application was actually prepared by the Nuclear Energy Laboratory (NEL) nor independently verified by them, despite the clear implication in the documents to the contrary. This virtual plagiarization, without so identifying it,

caused numerous errors of analysis to be reproduced without correction, and other errors to be caused by the copying of analyses performed for other reactors with different characteristics or for this reactor when it had different characteristics.

Use of Material in Application of Undemonstrated Relevance or Accuracy

6. Perhaps the most stunning aspect of my review was the identification of verbatim reproduction of outdated materials and materials prepared for other reactors with characteristics different than those of the current UCLA reactor. From the point of view of environmental analysis, this procedure employed by the Nuclear Energy Lab is both misleading and highly inadequate. The submission of irrelevant material, related to the reactor decades before substantial modifications have occurred, or to different reactors altogether, evades the fundamental purpose of license re-appraisal. So many technical changes have taken place since the original hazards analysis was written that it is of undemonstrated applicability. A careful, thorough analysis of the existing facility under present operating characteristics is indispensable. The information provided by the Applicant to date is insufficient to enable such a judgment.

7. The bulk of the 1980 Safety Analysis Report was copied verbatim from the NEL 1960 Hazards Analysis. However, NEL had not written or performed the analysis contained therein, but rather had received from the manufacturer a dittoed Hazards Analysis with a few blanks to fill in. The manufacturer's Hazards Analysis, it turns out, was copied from the University of Florida's Hazards Analysis. Dr. Kaku and Mr. Norton have discussed in their declarations at some length the safety implications of this procedure, particularly the ramifications of using an analysis performed for a reactor with $\frac{1}{4}$ the excess reactivity and 1/10th the power and fission product inventory of the reactor currently being considered for relicensing. Mr. Norton further details the errors that were reproduced and magnified by this copying-without-verification, particularly due to the lower melting temperature of the UCLA fuel and the lower void coefficient. The safety and environmental implications of basing important federal actions on analyses neither relevant nor accurate for the project being assessed are grave. The errors identified by Dr. Kaku and Mr. Norton caused by the reliance on these copied analyses could have significant impact.

8. NEL has since withdrawn a portion of the original analysis (this withdrawal shall be discussed in a moment) but much of the Safety Analysis Report included in the Application remains verbatim copy of material in the Hazards Analysis, unverified or even contradicted by NEL itself.

9. An example of the negative impacts upon the environment that can result from such poor assessment practices relates to the matter of wells. Page III/3-1 of the current Application asserts: "No deep wells have been drilled on the campus of UCLA or in the vicinity of the campus." However, that statement was not based on any review of data, but was rather copied, along with virtually everything else on that page, from the 1960 Hazards Analysis, page 1.

10. NEL admits in answer to CBG's interrogatory #I-25 of May 20, 1981) that they reviewed no data to ascertain whether that statement was true. After CBG contended that the statement was false, and produced hydrology maps which I have reviewed and which do show wells in the vicinity of UCLA, NEL then investigated their own unfounded assertion and determined that it was indeed untrue. (See September 23, 1981, memo from NEL's C.E. Ashbaugh to I. Catton listing a number of "wells in areas adjacent to UCLA.").

11. I understand that it is now being asserted, not that the statement was true, but that the falsehood was not material. The basis for this assertion is an additional assertion--that neither accidental release of radioactive material nor release during normal operation can cause contamination of ground water supplies. In other words, it is now argued that, yes, the Applicant's statement was false, but it would not have mattered had the truth been told, because subsequent analysis has indicated nearby wells would not be at risk. I understand that the question of contamination of ground water is in dispute, but even were that not the case, to argue that failing to tell the truth about nearby wells (in fact, to tell a falsehood about them) is permissible if, once learning about the truth, subsequent analysis determined no environmental risk, is to completely misunderstand the environmental impact assessment process.

12. Any technical reviewer of environmental impacts, and any decision-maker responsible for ruling on those impacts, makes decisions as to which potential impacts about which to inquire further based on the information provided. If an Applicant says that there are no wells in the vicinity, the issue of potential contamination of groundwater is foreclosed, and no further assessment of that issue is required. False statements about the existence of such wells tends to influence the reviewer or decisionmaker to conclude that no further review is necessary of that particular potential impact. Therefore, such a false statement is very serious, whether it turns out, after the truth has been made clear (in this case, by an Intervenor) that contamination of groundwater can or cannot occur. It remains an unanalyzed impact if such a falsehood is permitted.

13. The matter extends beyond water wells. The existence of oil wells in the vicinity would indicate a potential wealth of additional geological and seismological data available for review which could provide new insight into, for example, the proximity of nearby earthquake faults. (Geological data acquired from drilling wells is a rich source of seismic information). False statements about the existence of such wells likewise would tend to influence a decision-maker who would otherwise review the new seismic data, which obviously can be very significant in the assessment of potential impacts of nuclear reactor siting.

14. I will return to the matter of false statements in the Application, particularly regarding the seismic issue, in a moment. First, however, a brief discussion about the response of the Nuclear Energy Lab to the identification of the errors and inadequacies in the materials copied from the 1960 Hazards Analysis. The response has been to remove some of the copied material entirely and replace it with material and analysis likewise neither prepared nor verified by NEL. Thus, the amendments are as inadequate as the material being removed.

15. Rather than performing environmental and safety analyses the accuracy of which NEL can attest to of its own knowledge, NEL has merely replaced the more embarrassing material it copied with analyses performed for NRC Staff that are more favorable to NEL than the analysis NEL had initially included itself. The inclusion by reference of the studies performed by

the reviewing agency makes a mockery of serious review. NEL has performed essentially no verification of the analyses it now relies upon, as it performed no verification of the previous analyses. Serious questions about the inability of NEL to understand its own reactor are raised by its inability or unwillingness to, in twenty-two years of operation, perform its own analysis of its own reactor.

16. The reliance upon studies, unverified by NEL, performed for the NRC Staff is deficient for other reasons as well. The purpose of governmental regulation in the environmental area is to provide an independent check of the activities of licensees. In the NEL case, however, the analysis submitted by NEL in 1980 indicated unacceptable risks associated with the facility (i.e., fuel melting and large radiation doses in case of accident). The studies performed for NRC Staff, which were intended to provide independent review of the Applicant's analysis, provided results somewhat more favorable to the Applicant's request for license than the analyses submitted by the Applicant itself. Rather than do a detailed analysis to resolve the discrepancies, the Applicant simply withdrew its initial proffered study and replaced it with studies prepared by the reviewing agency that were supposed to be confirmatory of the Applicant's initial analysis. That NEL actually performed neither set of studies, has no independent information about the assumptions used, nor has performed any thorough verification of its own tends to compound the inadequacies of both the 1980 and 1980 versions of the Application. Will NEL appropriately and thoroughly conduct safety and environmental reviews of proposed experiments, facility alterations, instrumentation modifications, and procedure changes if it is unable to conduct its own review, either for initial license or license renewal, of its own reactor?

17. Thus, the Applicant's submission of applications and analyses that it neither prepared nor truly verified, without even indicating in several instances that it was not the author of the material submitted, has several serious consequences: (1) it tends to reproduce serious errors which can impact negatively on public health and the environment, (2) it makes thorough review by the responsible agency far more difficult, and (3) it essentially removes an important public and environmental protection--careful safety and environmental impact assessment by the applicant, which can form the basis for careful review and decision by the delegated agency.

18. These problems are exemplified in the NEL copying, in its environmental section of its application, from an AEC memorandum about "environmental considerations" related to research reactors generally. NEL copied the material verbatim, without identifying its source or even that NEL was not the source. The clear impression given is that NEL performed an assessment of its particular facility and the reported conclusions arose from that assessment. The truth is that no assessment was conducted and the conclusions recorded in the application are merely considerations of a single NRC staffperson who was not even writing about the UCLA reactor at the time. There is, in fact, no indication that the author of the memo had ever visited the UCLA reactor or even reviewed its site or operating characteristics. At best, the memo could be said to be a generalization; but generalizations are only valid for some items in the category being considered. The purpose of site-specific environmental review is to determine site-specific environmental impacts; the UCLA Application implies that had been done for NEL, but that was not the case. The validity of the AEC memorandum was never demonstrated for the UCLA case.

Misleading and False Statements

19. The matter of NEL veracity on the seismic matter underscores these points. The Application (p.7) says, "No structural weaknesses (earthquake vulnerability) have ever been identified." And yet, the 1976 Annual Report says, "The February 1971 earthquake gave rise to minor problems that worsened with time and ultimately required a major maintenance effort in 1972." These problems involved breaks in the primary coolant piping and release of the radioactive coolant. These are serious matters about which the reviewer of the application should be alerted, rather than the existence thereof denied.

20. One related statement I find particularly misleading is that on page II/3-1 in which the Applicant says that the environment is safe from any credible accident at the reactor and then, as basis for that assertion, cites a study of the experimental vibration of the reactor. The clear implication is that the reactor is seismically secure and that the cited study demonstrated the truth of the preceding statements by no untoward developments arising in the tests. However, a review of the published and unpublished results of those tests indicate the opposite: that the relatively mild vibrations led to core displacement internally that first slowed control blade insertion time and then eventually resulted in a control blade sticking in the out position. These are serious matters about which a reviewer must be affirmatively put on notice, as they affect the proper function of very important parts of the reactor protective apparatus. Avenues of reasonable inquiry are foreclosed if a reviewer is misled into believing that no untoward responses were detected in the study cited, as is the clear impression provided by the citation.

21. I understand the NRC Staff asserts that the misleading citation is not significant because the results of the test had been reported to an NRC inspector some 12 years earlier. The fact that the truth was reported a decade earlier does not justify a misleading reference to it at present. The likelihood that a member of the Atomic Safety and Licensing Board in 1982 would be aware of the true 1968 results is quite small; s/he would not be on notice that important information would be obtained by pulling the old files, because the implication given by the Applicant is just the opposite. Furthermore, only a part of the information was reported to the NRC in 1968-- the power oscillations are not mentioned in the 1968 inspection report.

22. I understand it is also asserted that the misleading reference to the study is defensible because the true results are fully reported in the technical literature. The fact that the truth might be available in the cited article does not justify a misleading reference to the article; a decisionmaker is unlikely to check the article given the fashion in which it has been cited.

23. Furthermore, as indicated above, only a portion of the results were reported in the published literature. The discovery of power oscillations caused by variations in plate spacing induced by the vibrations is not available in the published literature. It is important in that those results contradict the assertion by NEL in the application at III/3-2 that any seismic disruption would decrease power, the opposite of what the vibration tests found. The Battelle study confirms the results of the vibration test and contradicts the cited assertion in the application that the reactor is optimally moderated and that any core rearrangement would be in the safe direction. Thus, the tests cited misleadingly produced results of importance to a decisionmaker who must rule on the application. The results are not fully available otherwise; even were they, that would not justify the misleading references.

Need for a Thorough Environmental Review

24. I have reviewed the Environmental Impact Appraisal prepared by the NRC Staff. I find the EIA wholly inadequate. It is certainly insufficient basis upon which to rest a decision of no significant environmental impacts, or of no suitable alternatives, or of the lack of need to prepare a full Environmental Impact Statement.

25. The EIA is inadequate for several major reasons. One, entire arenas of potential environmental impacts are ignored. Two, those that are touched upon are done so in the most superficial of ways. Three, the EIA relies almost exclusively on theoretical calculations, which are often directly contradicted by the empirical data. And lastly, environmentally superior alternatives receive virtually no assessment whatsoever.

26. The most fundamental failing of the Environmental Impact Appraisal is the lack of true appraisal, i.e., independent assessment. It appears to be in large measure an uncritical repetition of assertions made by NEL, without an independent attempt to verify. Thus, the fundamental duty placed upon the reviewing agency by environmental statute has not been fulfilled.

27. Some examples: On page 5 of the EIA, it is asserted that, "Since the reactor is in a laboratory-classroom building, removal of the reactor facility would not free the land for other use." That simply is not the case. At campuses such as those of the University of California, classroom and laboratory space is a scarce resource. Were the space now occupied by the reactor facility to be vacated, new construction (and the subsequent environmental impacts associated therewith) could potentially be avoided because of the new availability of space in existing structures. This is not addressed whatsoever in the EIA.

28. In the same section, it is mentioned that something less than a kilogram of uranium-235 was used in the last 20 years. But the EIA fails to assess the environmental impacts that resulted from the creation of that spent fuel. In the UCLA case, those impacts appear to have been quite significant, particularly because of the high degree of contamination and ensuing radiation exposures that resulted from the transport. Thus, both the direct effects of UCLA's apparent failure to detect the contamination prior to send it on its way, and the indirect effects of operation that nonetheless had a substantial environmental impact because of the creation of the spent fuel, are unassessed. I note that indirect impacts are central to any good environmental impact assessment, and indirect impacts are essentially ignored in this EIA.

29. In the section on "need for facility," the EIA essentially repeats verbatim the NEL assertions about the functions of the facility, again without independent assessment. A review of the use data indicates, however, that the stated functions are only a small fraction of the true use, which is largely commercial and that the educational and research functions originally of importance at the facility have significantly diminished. Thus, the actual need for the facility, and the reduction in need for the facility, are unassessed.

30. This error described in 29 above permeates the next section of the EIA, the one on alternatives. An examination of alternatives to the proposed action is at the heart of environmental assessment. Yet the review of alternatives contained in the EIA is so cursory as to be useless. It is asserted that the nuclear engineering and physics programs at UCLA would be eliminated if the reactor were shut down--a totally unsupported assertion contradicted by the evidence. The facility reports use of the reactor only 10 or so hours per quarter for instructional purposes, and for only a very few classes. Certainly both the nuclear engineering program at UCLA and the physics program would not have to be eliminated because of the loss of 10 hours per quarter instructional use.

31. The assertion that other facilities at other campuses could not be used is also unsupported. The University of California has several nuclear reactors on its campuses. The systemwide review committee on engineering has already said that these programs were underutilized and not cost-effective and has recommended that they be consolidated. Yet this option is unexamined in the EIA.

32. Even the assertion that the 50 miles to UC Irvine makes use of that facility impossible is without substantiation. It is common practice in the sciences for certain very expensive research or instructional tools, which are used only rarely, to be pooled. For example, we at UCSC do not have the resources nor the need for our own linear accelerator. Those few occasions where such a device is useful involve faculty and/or students going to a campus about 50 miles away and using their facility. This is common practice, and unanalyzed in the EIA.

33. Furthermore, as Dr. Cooperman indicates in his declaration, those few research functions necessary can be performed without a reactor at all, using the NEL neutron generator for the activation analysis service. Beyond that, activation analysis is a standard service provided commercially by a number of facilities in this state and elsewhere; it is standard scientific practice for non-perishable analysis to simply send samples away for analysis. Again, these alternatives are unanalyzed. As is the alternative of a simulator.

34. The above are only a few examples of the inadequacies in the EIA. They serve to point out the fact that a true independent assessment of the environmental impacts and potential alternatives to the proposed action has not been performed in this case.

35. A few comments about the need for a thorough environmental impact review for the UCLA reactor. It is my opinion that such a review, in the form of an Environmental Impact Statement, is essential. The four-page AEC memorandum on "environmental considerations" discussed above makes clear that non-power reactors have had only the most cursory review. The true environmental impacts remain unassessed. As Dr. Kaku points out in his declaration, although the fission product inventory in non-power reactors is substantially smaller than that of power reactors, the lack of containment structure, exclusion zone, and engineered safety features tends to compensate in terms of potential doses to the public. The data available in the UCLA case suggest, in fact, that the high population density immediately around the facility and other factors indicate doses both during normal operation and in case of accident far in excess of those routinely considered for facilities for which EISs are automatically performed. In other words, the environmental impacts of the UCLA reactor, because of its particular siting and other characteristics, may be very large. They should be thoroughly assessed.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

W. Jackson Davis
W. Jackson Davis, PhD

Executed at Santa Cruz, California, this 10 th day of January, 1983

Statement of Professional Qualifications

PROFESSOR W. JACKSON DAVIS

My name is W. Jackson Davis. I am Professor of Biology and Environmental Studies at the University of California at Santa Cruz.

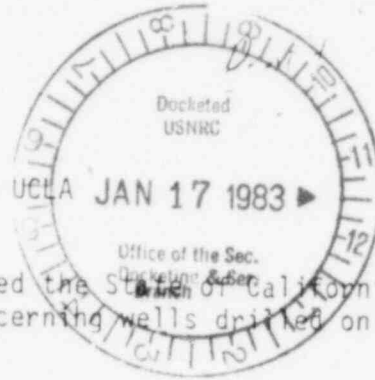
I received my B.A. in Zoology in 1964 from the University of California at Berkeley. I received my PhD in Biology from the University of Oregon in 1967. I spent the following two years at Stanford University as a Post-Doctoral Fellow in Neurophysiology. I joined the faculty at the University of California at Santa Cruz in 1969.

I have published approximately 100 scientific articles in various aspects of the physiology and behavior of marine organisms. I am the author of The Seventh Year (Norton, 1979), on environmental trends, and have published in numerous environmental journals as well. I teach courses on the environmental impacts of energy systems. My special research interest is assessing potential environmental impacts of past, current, and proposed radioactive waste disposal in the ocean.

I have written numerous reports for governmental representatives in this country and abroad on the environmental impacts of sea disposal of radioactive wastes. I was the Scientific Representative for the Republic of Kiribati at the August 1982 Plenary Session of the International Atomic Energy Agency, and served on the low level waste group. I was the Representative of Kiribati to the London Dumping Convention in 1981 and remain active in the scientific debate over amendments to the LDC's provisions regarding radwaste disposal.

13

TO: I. Catton
FROM: C.E. Ashbaugh
SUBJECT: Wells in Areas Adjacent to UCLA



On December 10 and 15, 1980, I visited the State of California Dept. of Water Resources, for information concerning wells drilled on or surrounding the campus of UCLA.

The Well Location Base Map used for reference use only is from the U.S. Dept. of the Interior Geological Survey, Beverly Hills Quadrangle or SW/4 Santa Monica 15 Quadrangle 1950. The one square mile grids studied were grids #14, 15, 16, 21, 22, 23, 26, 27, 28 with grid 22 encompassing UCLA and part of Westwood.

The following is a list of all known holes drilled within the above grid locations and what is currently known about them. Attachment #1 is the grid location overlay and attachment #2 is the current listing of reported ground water levels recorded by the State for the above mentioned grid locations, and attachment #3 is a xerox of the survey map.

LOCATION:	COMMENTS:
14-001	**WSP 14-61
14-001	**WSP 14-61
22-N-1	Amalgamated Oil Co.--Oil well--completed Nov. 4, 1909; reported as well #B-6-Q
23-F-01	**WSP-1461--[not in production--capped]
*23-J-1	El Rodeo School, Beverly Hills. Drilled by Well Water Supply, 11234 S. Norwalk, Santa Fe Springs, CA. Drilling completed on 1-9-63 as a flowing water supply (domestic use), well depth = 436' with a 10" diameter casing. With a 7 1/2 HP pump it pumps 135 gal/min with a 235 ft. drawdown after 12 hrs. Current use--emergency H ₂ O supply in case of nuclear war--tested once/yr.--Drilled as a result of the Cuban Missile Crisis. Frank Scott--Principal--telephone conversation 1-13-81--2775900
26-A01	Gulf Oil Co., 1801 Avenue of the Stars, Century City, CA. An Anode hole drilled to a depth of 185 ft. and completed 10-18-74.
27-N-1	Destroyed 1929

continued

LOCATIONS	COMMENTS:
27-N-2	Owner was H.K. Laird: completed 1899. Casing dia. = 3 1/2' x 3 1/2'.
27-N-3	Owner was Pacific Land Co. Well depth 525'.
27-N-5	Pacific Land Co.: completed 1902 with a 12" dia. casing.
28-B-01	U.S. Government Soldier Home: 11-27-34 end record.
28B-02	U.S. Government Soldier Home: completed 1916. Last measurement was on 5-4-32. Water depth recorded was 300 ft. Destroyed.
28B-3	U.S. Government Soldier Home: Last water level measurement taken 4-9-40. Water level at 262'. End = 1953.
28B04	U.S. Government Soldier Home.
*28-G01	U.S. Veterans Administration: Began records in 1951. Well depth is 250 ft.: [emergency source of H ₂ O--has not been used during last 10 yrs.--Tom Keenan] (1-13-81--Telephone conv. with CEA) 4793711 x 3871

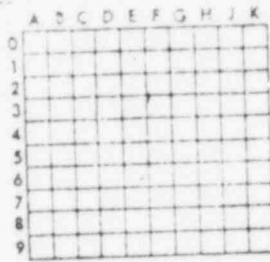
*Those for which there are current measurements
filled by the State of California.

**WSP 1461 means--U.S. Geological Survey Water
Supply papers--1461: Geology, Hydrology and
Chemical character of Ground Waters in the
Torrance, Santa Monica area, California--1959.

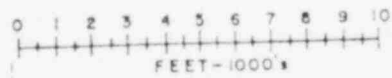
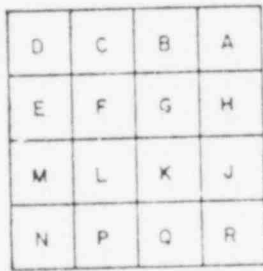
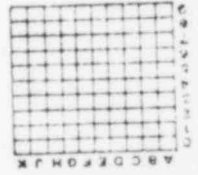
cc: N. Ostrander

Attachment 1

5350'
3598'
1230'



Los Angeles County
Flora Control District
LOCATION OVERLAY
FOR THOMAS GUIDE



6 7 4 3 2 1
4 5 6 7 8 9 10
11 12 13 14 15
16 17 18 19 20
21 22 23 24 25
26 27 28 29 30

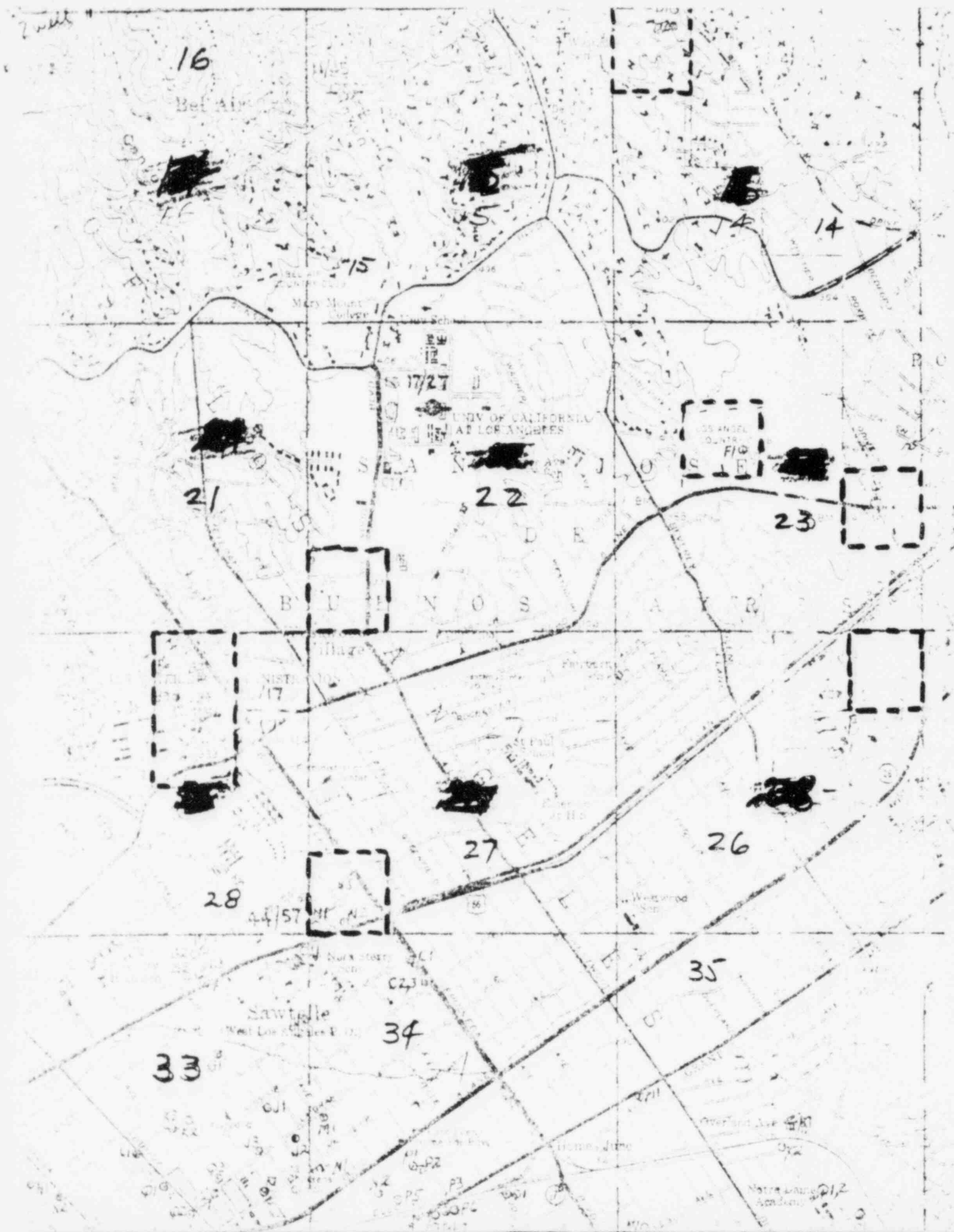
DATE 06/20/80

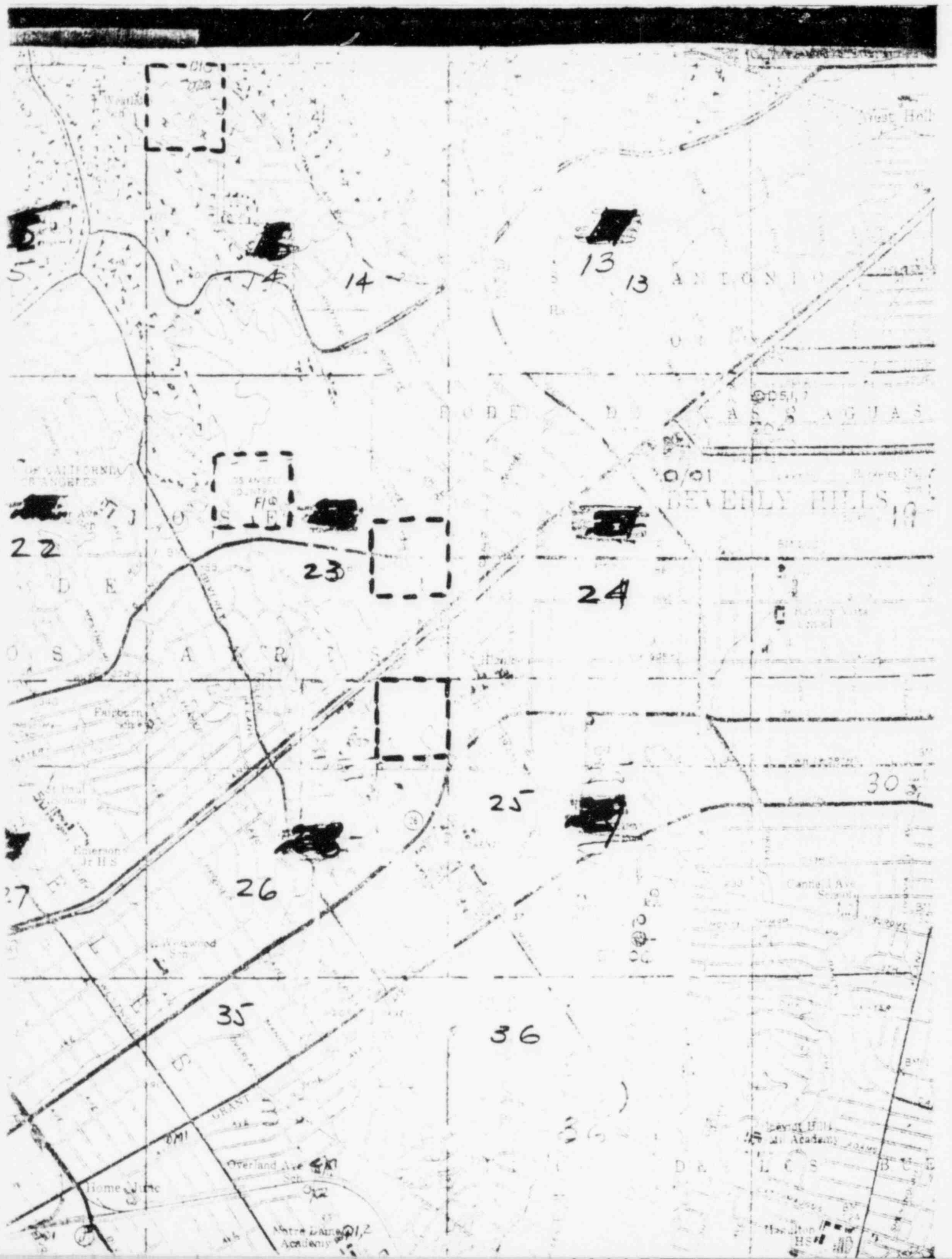
W018 GROUND WATER LEVELS AT WELLS

PAGE 1870

STATE WELL NUMBER	CO	GROUND SURFACE ELEVATION	DATE	GROUND TO WATER	WATER SURFACE AGENCY	STATE WELL NUMBER	CO	GROUND SURFACE ELEVATION	DATE	GROUND TO WATER	WATER SURFACE AGENCY
U-05	LOS ANGELES NB					U-05	LOS ANGELES NB				
U-05-A	LA-SAN GABRIEL RIVER WA					U-05-A	LA-SAN GABRIEL RIVER WA				
U-05-B	COASTAL PLAIN WA					U-05-A	COASTAL PLAIN WA				
U-05-B2	WEST COAST MSA					U-05-A3	SANTA MONICA MSA				
05S/13M-06000 S 19	36.0	10/28/77		22.7	1101	018/15M-25C01 S 19	225.0	11/13/73		176.0	09.0
		12/02/77		22.4							1100
		04/06/78		21.8							1100
05S/13M-06010 S 19	36.0	09/29/76		22.3	1101				11/02/73	70.1	263.9
		03/28/77		22.0					04/06/74	68.4	265.4
		04/29/77		22.1					11/15/74	70.3	263.7
		04/30/77		22.1					04/21/75	70.1	263.9
		02/29/77		22.2					10/23/75	70.4	263.8
		08/26/77		21.9					04/20/76	71.2	262.8
		10/28/77		22.9					11/03/76	71.6	262.4
		12/02/77		22.8					04/16/77	74.2	259.8
		04/06/78		21.3					11/17/77	71.4	262.6
									04/25/78	71.9	262.1
05S/13M-06015 S 19	9.3	09/25/73		18.5	1101	018/15M-29C01 S 19	353.0	10/30/73		73.8	280.0
		02/08/76		17.9					04/02/74	74.1	278.8
		10/23/75		18.8					11/15/74	71.7	281.3
		04/23/76		17.1					04/23/75	72.3	278.1
		11/04/76		16.9					10/23/75	72.9	280.8
									04/22/76	71.9	280.8
									11/06/76	76.5	273.6
									04/16/77	80.0	273.6
									11/15/77	81.2	271.8
									04/25/78	80.5	272.4
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		04/08/74		44.4(8)					11/15/74		
		11/08/74		44.9					04/21/75		
U-05-A3	SANTA MONICA MSA										
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		04/09/74		57.8							
		11/15/74		58.2							
		04/21/75		60.2							
		10/23/75		60.0							
		04/23/76		60.3							
		11/03/76		58.6							
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		04/06/74		FLOW							
		11/15/74		FLOW							
		04/21/75		FLOW							
		10/23/75		FLOW							
		04/22/76		FLOW							
		11/03/76		FLOW							
		04/19/77		FLOW							
		11/15/77		FLOW							
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018/15M-25C01 S 19		11/07/73		58.3	1101						

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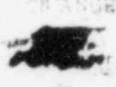
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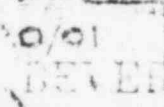
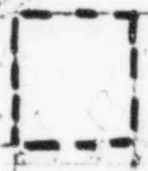
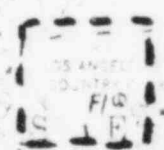
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UNIVERSITY OF CALIFORNIA
Los Angeles



Simulation of Earthquake-Induced Vibrations
in a UCLA Reactor Fuel Bundle

A thesis submitted in partial satisfaction of the
requirements for the degree Master of Science
in Engineering

by

Richard Lee Rudman

Committee in charge:

Professor Craig B. Smith, Chairman

Professor Ralph B. Matthiesen

Professor Robert B. Andrews

1968

control blades one through three are completely withdrawn from the core and regulation of the power level is achieved by moving control blade four. Since the shaker induced motion was horizontal and in a direction perpendicular to the control blade shaft it would be necessary for the force of the horizontal motion, acting on the center of gravity of the control blade, to be sufficiently large to raise the blade up in order to produce a higher power level. However, for a 100 kW run approximately 80% of the regulating blade remains in the core and a very large vertical component of horizontal force would be required to lift it from this position. Because of the magnitude of this force it is felt that blade motion is not a reasonable explanation for the observed power oscillation.

The last possible explanation is that vibration induced changes in the fuel bundle configuration are responsible for the power variation. Vittori⁽¹⁾ has shown that increasing the space between adjacent fuel plates results in a positive reactivity change. The moderator gap between adjoining fuel plates is approximately one-half of the optimum moderating distance. The present plate spacing is a nominal 0.137 in. while the spacing required for optimum neutron thermalization was experimentally determined by Vittori to be 0.290 in. Neutrons that are produced in one fuel plate are insufficiently

moderated when they come into contact with the adjacent fuel plate and the probability of fission is decreased. As the plate spacing is increased the neutron energy decreases due to greater moderation and the fission rate increases. Since the plates are secured only at their tops and bottoms and the direction of the reactor motion during the shake test was perpendicular to the plane of the plates it is possible that vibration-induced plate gap changes could produce an oscillating flux level.

1.2 The Approach

The purpose of this work is to predict reactor power oscillations based on a study of the vibration characteristics of a dummy fuel bundle. Three variables must be defined in order to estimate the magnitude of the power change: (1) the change in the plate gap dimension that occurs when the bundle is being vibrated at its resonance frequency, (2) the dependence of reactivity on the plate gap dimension, and finally, (3) the manner in which a sinusoidally varying reactivity is coupled to reactor power.

1.3 Fuel Plate and Bundle Description

The fuel loading of the UCLA reactor consists of 264 plates, with each plate containing 13 grams of highly enriched U-235. A typical plate is shown in Figure 1.1.⁽³⁾ The dummy fuel plates used in the vibration tests are