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7/30/81

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) "INTERVENOR'S DISCOVERY REQUESTS AS TO SER, EIA, NUREG/CR-2079, and NUREG/CR-2198"

TO: NRC STAFF AND ITS ATTORNEY OF RECORD, COLLEEN WOODHEAD.

Intervenor, COMMITTEE TO BRIDGE THE GAP, hereby requests that said Staff answer the following interrogatories fully and separately under oath, pursuant to the Board Order of July 1, 1981. Furthermore, also pursuant to that Board Order, Intervenor requests production of certain documents detailed herein.

It is intended by this set of interrogatories to elicit information not merely within your own personal knowledge, but obtainable on your behalf, such as by your attorneys, employees, investigators, and representatives. In particular, certain interrogatories are directed to certain of your consultant identified as responsible for the contents of certain studies to which these interrogatories go. All such interrogatories are to be answered fully and under oath; where complete information is not in the possession of the party responsible for answering, they should so

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state and provide what information is available. Staff and its consultants are reminded of the duty to supplement responses as per 10 CFR 2.740e.

No new studies are requested by these interrogatories. If Staff has no information in its possession or readily acquired, it should so state and provide what information it does possess. If any partial information is available, that information should be provided. If information is available in a form different than requested by Intervenor, who cannot know the form of information or categories in which it is organized in which you possess the information, please provide the information in what form and categories you do possess.

As per the Board's Order, responses are due to be served thirty days after service of this discovery request.

Respectfully submitted,

Mark Pollock
Attorney for Intervenor
COMMITTEE TO BRIDGE THE GAP

Dated at Los Angeles, CA
July 30, 1981

INTERROGATORIES AS TO THE SAFETY E[illegible]ATION REPORT

SER p. 1-2

1. SER states: "Our technical safety review w[illegible] respect to issuing a renewal operating license to UCLA has been based on the information contained in the renewal applicatio[illegible] and supporting appendices plus responses to requests for additional information." SER further indicates all of said information is available for review at the PDR and the LPDR.

a. Besides security information, and besides Applicant's responses to Staff's April 17, 1980 request for information as to 15 items and Staff's July 31, 1980 request for information as to 14 questions, what written requests for information have been made (by topic and date) and what written responses have been received (by date of response)?

b. Besides the items indicated in the quoted passage above and in response to 1a above, and besides the items identified on SER p. 1-3 (annual reports, reports by Inspection and Enforcement, and the Los Alamos and Battelle studies), what specific documents and records were reviewed by Staff in preparation of the SER? Please identify said documents and records by author, title, and date.

2. SER states: "This SER will serve as the basis for renewal of the license for operation of the UCLA facility at power levels up to and including 100 kw." Precisely what is meant by the phrase, "This SER will serve as the basis for..."?

3. SER states: The facility was reviewed against the Federal Regulations, applicable Regulatory Guides, and appropriate accepted industry standards."

a. Which particular Regulatory Guides (by number, title, and date) was this facility reviewed against?

b. Against which "appropriate accepted industry standards" was this facility reviewed against? Where said standards are in documents, please identify with specificity said documents.

4. As Staff has argued in the past (December 1, 1980, "NRC STAFF POSITION ON UNSTIPULATED CONTENTIONS") that dose values in 10 CFR 100 do not apply to research reactors such as the UCLA facility, and as Board upheld this position in its March 20, 1981 Order, on what basis does Staff now compare "calculated dose values with related standards in 10 CFR Part 100, the standards for accident considerations for power reactors"?

5. Precisely what shielding (by composition, thickness, density, and location) was added to the reactor

a. when the power increased from 10 watts to 10 kw
b. when the power increased from 10 kw to 100 kw
c. when new construction was added on the sides of the reactor facility
d. when new construction was added on top of the reactor facility.

Please provide all drawings that indicate said shielding.

SER p. 1-3

6. The SER refers to twenty years of operation "on a utilization level of 8.5 hours per week." Intervenor understands the 8.5 hour limitation to be part of Amendment 10, adopted in the mid-1970s, and has seen indications in operating logs and inspection reports of 16 hours/day operation for extensive periods during the 1960s. Please clarify SER statement.

7. The SER refers to other Argonaut reactors which have operated "for more than twenty years on a utilization level of 8.5 hours per week." Precisely where does the 8.5 hour figure come from, which Argonaut reactors does it refer to, and does Staff intend by that quoted statement that operation limited to an average of 8.5 hours per week has occurred during the twenty year operating history of these reactors?

SER p. 1-4

8. SER states that accident doses outside the reactor room "will probably not exceed 10 CFR Part 20 doses." Which specific 10 CFR 20 doses: for the public, for occupational exposures or some other standard?

9. SER statement that accident doses "will most certainly be only a small prtion of doses set out in 10 CFR Part 100 for offsite dose guidelines for power reactors." Applicant's Application indicates doses considerably in excess of said guidelires. By calculation and reference, specifically describe the errors Staff believes exist in Applicant's Appendix B of Part III of the Application that invalidate Applicant's estimates and thus validate Staff's far lower dose estimates.

10. SER states that Staff has determined the Applicant's management organization, conduct of educational and research activities, and security measures "to be adequate to assure safe operation of the facility." a) Precisely what does Staff mean by "adequate" in this context?, b) Does Staff consider these factors to be better than adequate?, c) Does Staff consider these factors to be excellent?, d) Compared to other research reactors, would Applicant be considered to be in upper third, middle third, or lower third of said reactors with regards the adequacy of said factors?

11. Precisely how does Staff define "as low as reasonably achievable" as used in the context of this page, and what is the source of that definition?

12. By what standards did Staff judge Applicant's compliance with ALARA?

13. On what precise bases did Staff conclude that releases of radioactive materials from the facility and public exposures from said releases cannot reasonably be lowered?

14. Where in the SER is the analysis showing ALARA being met?

15. Has Staff concluded that Applicant has adequately demonstrated that it will allocate the necessary funds to cover operating costs without compromising safety? If so, on precisely what basis has this determination been made?

16. When does Staff anticipate publishing its supplemental SER regarding the outstanding item, emergency planning?

SER p. 1-5

17. SER states that "The UCLA research reactor is an Argonaut-UTR reactor using about 4 kg of U-235 fuel enriched to apprximately 93% in a graphite-reflected, water moderated core."

a. Intervenor's understanding is that the Argonaut reactor at UCLA uses less than 4 kg of U-235 in its core loading. Is the core loading of the UCLA reactor more or less than 4 kg of U-235?

b. Do other Argonaut reactors have core loadings smaller than that at UCLA? If so, please identify the Argonaut and the size of its core loading in terms of kgs of U-235.

c. Application at Page III/-6-4 indicates the moderation for the UCLA reactor is "H_2O and graphite." Does Staff assert that the UCLA Argonaut reactor does not obtain moderation from its graphite? Please explain the SER quoted statement in this regard.

18. SER states the fuel in the UCLA reactor is contained in MTR-type plates. Describe the similarities and differences between the UCLA fuel and the MTR fuel.

19. Have leaks ever developed in UCLA's "watertight aluminum" fuel boxes? Have leaks ever developed in said boxes at other Argonaut reactors? If answer to either question is affirmative, please provide date, cause of incident, extent of leakage, and, if at a reactor other than UCLA, which reactor.

20. How old is the graphite used in the UCLA reactor?

a) Has any of the graphite used in the UCLA reactor ever been used in another reactor? If so, please indicate which reactor, its neutron flux (fast and thermal), and the number of MWdays during which the reactor ran while that graphite was in the reactor. In addition, please indicate the amount of said graphite that was previously irradiated, if such was the case.

b) Does Staff accept the NUREG/CR-2079 PNL-3691 estimate of how much Wigner energy the UCLA reactor could have absorbed to date? If not, please indicate, by calculation and reference, the figure Staff believes to be correct.

c) By the year 2000, what changes in characteristics, through irradiation, contamination, or aging, could occur in the UCLA reactor graphite, and what possible effect on reactor operations could those changed characteristics have?

d) Does UCLA have spare graphite bars (bars other than those currently in the reactor)? If so, precisely where and how are they stored, and in Staff's view, is the graphite thus stored adequately protected from the elements or other damage?

e) Please describe with specificity the analysis done and data acquired by Staff in assessing the current and potential condition of UCLA's graphite for its reactor, both in core and in storage.

21. SER refers to cadmium plates used as control rods for the UCLA reactor.

a) Are the control blades (rods) pure cadmium, or are they alloyed with or jacketed by some other substance? (Intervenor here does not refer to the magnesium shrouds).

b) If the blades contain substance(s) other than cadmium, please identify the substance(s), whether alloyed with or jacketed around or in some other configuration, the amount, thickness, chemical form, and other relevant specifications for the non-cadmium part of the control blade.

c) What is the melting point and boiling point of cadmium?

d) Does cadmium burn in air or undergo chemical reactions with air, water, steam, magnesium, graphite or aluminum? If so, at what temperatures and under what conditions?

e) If cadmium burns or vaporizes, are any toxic or carcinogenic products released? If so, what are the health effects associated with such release.

f) Why is cadmium rarely if ever used in control rods for reactors operating at considerably higher temperatures than the UCLA reactor?

f) Please specify the analysis that has been done by Staff as to the effects of a fire, earthquake, reactivity insertion, or other incident which causes the reactor temperature to rise to temperatures causing control blades to melt.

22. Can the control blades be withdrawn from the reactor core region through any other means than operation of controls at the control panel? Specifically, can the control blades be manually manipulated within the reactor room? If so, please describe in detail how such manipulation could be done and indicate whether Applicant has in the past ever done so, giving details and date.

23. SER indicates that the control blade drives are "located outside the reactor shield for accessibility." Do these drives have missile shields protecting them? If so, please describe the missile shield and their capacity (i.e. what size and velocity of missile can they withstand, or what impact force) and the calculations and references by which that answer is made.

Note: in the 24-31, control blades refer to the entire control device, not merely the cadmium plate.

24. In event of earthquake, what failure modes exist for the control blades? Please detail analysis of said modes.

25. What g force would be required to force control blades to "jerk out" of the core region?

26. What g force would be required to force control blades to break off and fall out of core region?

27. What g force would be required to cause binding of control blades, preventing blades from being inserted into core region?

28. What failure testing has been done of this type of control blade? Cite the studies by title, date, and publication information. What were the results of said studies?

29. How many scrams can the blades withstand (gravity drop scrams) prior to failure?

30. How many years of operation can the blades undergo prior to failure?

31. Please provide by calculation and reference the bases for answers 24-30 and describe the analysis Staff has undertaken of the matters raised in said questions.

32. SER states that the "four control rods and protected by magnesium shrouds."

a. Please describe precisely the chemical form of magnesium, the thickness and other dimensions of the shrouds, what (if any) other substances compose the shroud and how.

b. Please describe precisely the control blade stop (the device, barrier, or other mechanism or thing which stops the control blade after it has completed falling into the core region and prevents the blade from falling out of the core.)

c. Please describe any redundant control blade stop (i.e. any mechanism, device, or barrier which would prevent the blade from falling out of the core if the first barrier fails.)

d. Please describe all failure testing of the mechanisms, devices, or barriers identified in 32b and c above and the results of said testing.

e. Have the control blade stops at the UCLA facility or any other research reactor using similar control blade systems failed? If so, please identify each such instance by date, reactor, cause, and identify all documents related to said instances.

f. Can warping or other malformation of control blade shrouds prevent or slow down control blade insertion? If so, please describe how such an occurrence could exist.

g. Have such instances occurred at UCLA or other facilities with similar shrouds? If so, please specify each instance, date, and cause.

h. What is the melting, vaporization, and ignition temperature of the magnesium used in the control blade shrouds? Under what conditions will the magnesium ignite? What is the caloric release per gram of magnesium burned? What analysis has Staff performed regarding melting, vaprorization, or ignition of the magnesium with regards an accident at this reactor or any similar reactor?

33. Please describe all control blade malfunctions at the UCLA reactor individually, by date, describing incident, and outlining cause.

34. On what specific factual basis does Staff determine the control blade system to be reliable through the proposed license period?

35. What control blade malfunctions is Staff aware of at other Argonaut reactors? Please describe all such instances individually by date, reactor, description of incident, and cause.

36. What efforts has Staff made to ascertain what control blade problems have been experienced by other Argonaut reactors?

37. Is a bicycle-type chain used in the control rod drive system? If so, has it ever failed? Give details if known.

38. Has the control blade logic system at UCLA ever failed? If so, please describe each such incident.

39. SER states "The graphite prism is surrounded by a biological shield of both conventional and heavy (magnetite) aggregate concretes." SER states further the shield was designed in the late 1950's.

a. Reactor was designed in the late 1950's to operate at 10 kw in a building with no members of the public on floors above. Both conditions have since changed. Please detail with specificity all alterations to biological shield (and other shielding) since reactor was originally designed. In particular, please describe by drawing and description placement of all paraffin and lead.

b. What is the density of the magnetite and the conventional concretes?

c. What is the minimal thickness of the concrete shield?

d. What level (in curies and in mrem/hr. dose contact) of activation products has the shield acquired to date,&what level could be expected by end of license period (year 2000) if operating licensed limit were met for the next 20 years?

e. Applicant asserts maximum dose from streaming radiation outside biological shield is 200 mr/hr. Does Staff have any independent information by which to measure that assertion? If so, please provide said information.

40. SER states, "This shield was designed in the late 1950's with an adequate factor of safety against seismic forces for a Zone 3 earthquake area."

a. Precisely what is the numerical size of the "adequate factor of safety"?

b. Against what criteria does Staff determine the shield to have "an adequate factor of safety."? Please specify the particular code sections, industry standards, or other standards.

c. Precisely how much acceleration in the vertical & horizontal E-W, N-S) directions was the biological shield designed to withstand?

d. What is the largest capable fault near the reactor site?

e. How close is the nearest approach of said fault to the reactor site?

f. What is the accelerogram--that is, the shape of the curve of acceleration--for that fault at the reactor site in the worst case scenario?

g. What is the maximum ground acceleration possible and maximum possible magnitude in Richter Scale for that fault?

h. Show by calculation and reference how the maximum credible earthquake at the largest capable fault near the reactor site could be withstood by the reactor's biological shield.

i. Have earthquake design standards for reactor components such as biological shields changes since the late 1950s? If so, please detail how they have changed as such changes would relate to current standards for building a biological shield for a research reactor at the UCLA site.

j. Does the reactor have a seismic scram device other than the embedded switches in the monolithic shield? If so, please detail the nature of said device.

SER p. 1-6

41. Please describe all notification received by the Commission from UCLA at the time of the additional construction next to and on top of the reactor building in 1968. (Give title and date of all documents related thereto)

42. Please describe all analyses done by the Commission prior to 1974 of the effects of the new construction done in 1868 in terms of radiation protection to the public and seismic risk to the reactor. Give title and date of all documents related to said analyses.

43. Describe in detail all shielding additions made related to the new potential areas for public radiation exposure.

44. Was the Commission notified in advance of said construction, and did it grant approval for the 1968 building additions?

45. Did the Commission analyze, prior to 1974, the effects to public health of having the Math Science building constructed next to the reactor building and the placement of the exhaust stack where it now is in relation to the MS air inlet? If so, please provide said analysis; if not, please explain why not.

SER p. 1-9

46. Is air from the reactor room exhausted from said room only when reactor is operating, or is it exhausted at other times as well?

a. If exhausted only when reactor is operating, what prevents Argon-41 buildup in the reactor room?

b. If exhaust only when reactor is operating, does this mean negative pressure is maintained in reactor room only during operation?

c. If exhausted air is released from reactor room at times other than operation, please describe under what conditions air is exhausted and when not. During the day is the exhaust system in operation? Is it turned off at night?

47. Please detail precisely how Argon-41 produced in the reactor core is produced to begin with.

a. How much air is present in the core, at any one time, and where, from which the Argon-41 is activated?

b. How is the air with the Argon-41 removed from the core and released through the exhaust stack? And at what rate (cfm/minute of air containing Argon-41) is air removed from the core?

c. Precisely where in the core are there air pockets in which the Argon-41 is produced?

d. Is there a separate Argon-41 or air removal system from the core, separate from the exhaust fans which keep the reactor room at negative pressure? If so, please indicate where the core air system is located, how it operates, and whether it operates only when the reactor is operating or also when the reactor has been shutdown?

48. Is the 3rd floor area described on SER p. 1-9 fenced by a fence that cannot be climbed over?

49. Is there a door through which entry can be made into that area?

50. Is Staff aware of any times when that door has been left open or unlocked? If so, please indicate each such time and the circumstances.

51. Precisely what is the airconditioning system in the 3rd floor area used for? Does it provide cool air to reactor complex? Does air from reactor complex other than reactor room exhaust through that airconditioning system?

52. What is the function of the water demineralizing equipment used by the reactor facility thatis based on the 3rd floor?

a. Does radioactivity buildup during reactor operation in that demineralizer?

b. What are the highest direct radiation readings found at contact with the demineralizer?

c. Should the demineralizer malfunction and reactor operation continue, would reactor cooling water (either secondary or primary) generate or contain more radioactivity than it does normally? What would be the maximum radioactive content (in microcuries per ml) if such an occurrence were to happen?

53. Were the demineralizer to malfunction or be intentionally damaged, is it possible for effluent containing radioactivity in excess of 10 CFR 20 public exposure limits to be released into unrestricted areas (for example, via flooding of public walkways, engineering snack bar)? Please explain the basis for answer.

54. Is the demineralizer for secondary or primary coolant?

55. Is there another demineralizer for the other coolant loop? Where is this demineralizer located?

56. Where is the secondary effluent radioactivity monitor located precisely (3rd floor, 1st floor process pit, or where?)

57. Is the secondary coolant a closed or open loop? Does it recirculate or is it once=through, dumped after use in the sewer?

58. If the demineralizer were to malfunction or be intentionally damaged and the secondary effluent monitor likewise malfunction or be damaged by intent, what would prevent release of radioactively contaminated water off-site?

59. Is the demineralizer used to remove minerals from the coolant water so that those impurities aren't activated and don't become radioactive? If not, please describe precisely the use.

60. Has the demineralizer ever malfunctioned?

61 Has effluent from the demineralizer ever travelled beyond the confines of the 3rd floor equipment room? If yes, please give details and dates.

62. Has malfunction of equipment related to the demineralizer ever damaged other reactor equipment? If yes, please give specific details.

63. Item 1-5 of SER, "Comparison with Similar Facilities" consists merely of three sentences. Besides the Los Alamos and Battelle studies, what review of other Argonaut reactors has Staff performed in relation to this proceeding? Be specific.

a. Has Staff reviewed LER's and abnormal occurrence reports for other Argonauts in preparation for producing this SER?

b. Has Staff reviewed Annual Reports for other Argonauts in preparation for producing this SER?

c. Has Staff reviewed inspection reports for other Argonauts in preparation for this SER?

d. If the answers to a, b, or c are affirmative, please estimate what percent of the existing documents were so reviewed.

64. Do changes in water pressure in UCLA's secondary coolant system affect any reactor parameters such as coolant temperature, safety of having primary system at lower pressure, or any other reactor parameter? If so, please identify all such effects.

65. Please identify total annual usage of the UCLA reactor from 1960 to 1972.

SER p. 1-10

66. Precisely what does Staff mean by the term "confinement building" or "confinement room" as used at this page?

67. What is the difference between "confinement" and "containment" as the latter term is usually used regarding reactors?

68. What is the leak rate from UCLA's "confinement building" for air? What is the source for this answer--calculation, estimate, test data? Please provide said calculations, estimates, or test data.

69. Precisely what is meant by "concrete glass curtain wall" regarding the University of Washington?

70. The chart lists forms of "containment." Does Staff contend that the reactor at UCLA has a "containment" around it capable of containing fission products released in case of accident? Precisely on what does Staff base its answer?

71. SER chart indicates Iowa State and Virginia Polytechnic reactors operate on 90% rather than 93% fuel. Please explain why.

72. The chart indicates Iowa and Virginia reactors use only 144 fuel elements whereas UCLA uses 264. Please explain the difference.

a. How can Iowa and Virginia function with a core loading 55% that of UCLA?

b. What prevents UCLA from functioning as do the other two Argonauts with a loading of only 144 elements?

c. In what configuration is the fuel loading at Virginia and Iowa?

73. Please identify the reactor vendor or manufacturer for each of the five listed Argonauts.

74. Please identify the excess reactivity limits for each.

75. Please identify the fuel spacing and thickness of cladding for each, as well as the delayed neutron fraction and prompt neutron lifetime.

76. What prevents UCLA from operating at the power level of the reactor at Iowa State; i.e. why is a 10 kw power level limit satisfactory for Iowa but would not be for UCLA?

77. Please describe shielding differences between the five reactors.

78. Are LER's routinely transmitted between the five reactors or from staff? If not, why not?

79. What is the Argon-41 concentration at the point of emission for each of the five reactors?

80. Which, if any, of the other four reactors has an exhaust stack near unrestricted areas of campus buildings or near air inlets for such buildings? If any do, please identify all documents referring to such instances of which Staff is aware.

81. What is the licensed limit as to amount of SNM at each of the five facilities?

82. What is the date of first criticality for each of the five (year of starting would be sufficient answer)?

83. Which other Argonauts have applied for relicensing?

84. Of those which have not so applied, what are the reasons for not yet applying?

85. Has Staff approved the relicensing of any Argonaut within the last two years? If so, which and when.

86. Does Staff anticipate renewal of license of any Argonaut prior to ruling by the licensing Board in the UCLA reactor proceeding? If so, for which Argonauts?

87. Are there other research reactors awaiting relicensing besides Argonauts? If so, please estimate how many now face relicensing or will within the next three years.

88. Is Staff aware of any other contested research reactor relicensing proceedings--either for other Argonaut reactors or other types? If so, please identify said reactor(s).

89. Which of the five Argonaut reactors listed have ever utilized fuel of lower enrichment than 90%?

a. For each reactor so identified, please indicate period during which such fuel was used, its enrichment level, and why it no longer uses said enrichment.

b. Please identify all documents of which Staff is aware relative to use by other Argonaut reactors of lower enrichment fuel than 90%.

c. Is Staff aware of any reactor in the U.S. or abroad which utilizes flat plate-type fuel, aluminum clad and uranium-aluminum meat, of less than 90% enrichment at present? If so, please identify each such reactor and the enrichment of its fuel.

d. Does Staff assert that there are no reactors in operation currently utilizing fuel as identified in c above? If so, please provide the basis for said assertion.

e. Were the Board to place as a condition on the UCLA license that it use a lower enrichment fuel than it presently does, is it Staff's position that the UCLA reactor would be unable to function? If so, please explain and provide all facts Staff could produce to support such an assertion.

SER p. 1-11

90. Please update Table 1-6-1 for 1980 and add 1960 to 1972.

SER p. 2-1

91. Does Staff assert that the area north of the UCLA campus is undeveloped?

SER p. 2-2

92. Do the data recorded on this page represent residential population or does it include the campus non-residential population and the people normally in Westwood Village shops, restaurants, movie theaters, and office buildings?

a. If merely residential population, what are the figures if non-residential populations are added in?

93. Has the population around the reactor site (within 2.5, 5.0, 7.5, and 10.0 miles respectively) increased since 1960? If so, by what factor(s)?

SER p. 2-3

94. SER states, "In addition, there are several other commercial airports approximately 45 miles from the campus." Please identify all such airports, and their distance from campus.

95. Please provide all facts Staff can produce to support the statement, "There are no scheduled airline routes over the campus." Please indicate the source(s) of all such facts, and identify with specificity all documents which relate thereto.

96. What is the nearest scheduled airline route in relationship to UCLA and how close (in distance) is that nearest approach? At what altitudes do planes flying along said route fly, what is the largest type of plane that flies along said route(s), and how much fuel would said planes have at the time of nearest approach to the UCLA campus? How many planes annually fly along said route?

97. Does Staff assert that commercial planes never fly over the UCLA campus? If so, please provide all facts, and identify all documents that support said facts, that form the basis for that assertion.

98. If Staff does not so assert, please indicate how many commercial planes do fly over campus annually.

99. Do commercial airliners fly over or near campus when put on circling patterns awaiting landing at nearby airports? Please provide all facts and indicate their source that support your answer.

100. Please indicate all airports for private planes and so-called "light aircraft" within 15 miles of UCLA.

101. Do private planes and other "light aircraft" fly over UCLA? Please provide source and identify documents for all facts you can produce to support your answer.

102. What is the largest private plane or "light aircraft" that is permitted to fly over UCLA?

103. Do helicopters ever fly over UCLA? What is the largest helicopter that is permitted to fly over UCLA?

104. Do helicopters routinely land and take-off from UCLA campus itself? Provide all facts you can produce to support your answer.

105. How ... mmercial airliners per year
... ectly over the UCLA campus
... ithin one mile of the campus
c) fly within two miles of the campus
d) fly within three miles of the campus
e) fly within five miles of the campus
f) fly within seven miles of the campus
g) fly within nine miles of the campus
h) fly within ten miles of the campus

106. Please answer questions a through h for all airplanes and jets that are not commercial airliners.

107. Please answer questions a through e for all helicopters.

108. If Staff has information relative to plane and helicopter travel over and near UCLA that does not fit the categories in interrogatories 96-107, please provide the information that Staff does have relative thereto.

109. How does airplane density in the Los Angeles Basin compare with other areas nationally in which reactors are placed--i.e. is the LA Basin the third most crowded airspace in the country, the 8th most crowded, the 100th, for any comparable-sized airspace?

110. How many helicopter crashes occurred in Southern California in the twenty years the reactor at UCLA has operated? (If Staff does not have figures for twenty years but does for other time periods, please provide those.)

111. How many plane and jet crashes, other than those involving commercial airliners, occurred in Southern California in the twenty years the UCLA reactor has operated, or any alternative period of time for which Staff has figures?

112. Please answer question 111 for commercial airliners.

113. Please indicate the source of answers 110-112 and all documents relative thereto.

114. What are the chances (i.e. statistical probability) during the next twenty years of a

a. commercial airliner crashing on the UCLA campus
b. plane or jet other than commercial airliner crashing on the UCLA campus
c. helicopter crashing on the UCLA campus
d. commercial airliner crashing into Boelter Hall
e. plane or jet other than commercial airliner crashing into Boelter Hall
f. helicopter crashing into Boelter Hall
g. commercial airliner crash damaging reactor (either directly or through damage to building causing fire or building collapse)
h. g above for plane or jet other than commercial airliner
i. g above for helicopter

115. Please provide all calculations, references, and facts upon which those answers are based and identify all documents relative thereto.

116. Could the columns of Boelter Hall which support floors five through eight above the reactor collapse upon impact from a helicopter or non-commercial airliner plane or jet crashing into those columns? Please provide all facts upon which the answer is based.

117. How many columns would have to collapse or be damaged before the floors which they hold up would collapse?

118. Were those floors #5 and above to come crashing down on the reactor room ceiling, would the ceiling sustain the impact?

119. If the ceiling did not sustain the impact, what would be the maximum possible damage to the reactor?

120. What is the strength of the reactor room ceiling and the supporting columns in the third floor void area?

121. Please provide all facts, calculations, and references upon which answers 116-120 are based.

122. In case of changed weather conditions or other factors, are there commercial airline patterns (as opposed to routes) which get within five miles of UCLA? If so, please identify such patterns and the closest approach for each to UCLA.

123. SER states "There is no heavy air or railroad traffic..." By this does Staff mean air traffic is not heavy near the campus, or rather does Staff mean that heavy airplanes (i.e. big commercial airliners) do not regularly fly near the campus?

124. Precisely how close, in terms of miles, does Staff consider "close enough to the campus to constitute a threat to safe operation of the reactor?" Precisely where does that standard of closeness come from, and what is the numerical guideline so assigned? Does Staff have formal guides for determining adequate distance from overflights and concentration of said flights considered low enough to be adequately safe; if so, please identify such guides.

125. SER states: Winds blow from the ocean (wsw, sw) about two-thirds to three quarters of the daylight hours, as shown in Figure 2-3-1. For the remaining time winds are from inland directions." What is the frequency, severity, and duration of severe inversions?

SER p. 2-5

126. The atmospheric dilution figures provided are over what distance?

127. Precisely what measurements were done in connection with smoke release experiments by which a numerical atmospheric dilution was determined?

128. Precisely what measurements were done in connection with balloon releases by which a numerical atmospheric dilution factor was determined?

129. None of the tests mentioned by Staff produced dilution factors outside the range of $4\text{-}6 \times 10^{-3}$? If any results were outside that range, please indicate what those results were.

130. SER states: "The water table is estimated to lie 200 feet below the surface of the campus and its vicinity."
- a. Estimated by whom?
- b. Estimated how?
- c. Estimated when?
- d. What did Staff do to check the estimate.

131. SER states: "The reactor core lies about 10 feet above Westwood Boulevard which is the main drainage course and therefore the area most likely to be flooded from runoff from the watershed area North of the campus."

a. The reactor room floor lies how many feet above or below the loading zone to the west of the reactor room?

b. The bottom portion of the reactor core lies how many feet above the reactor room floor?

c. Does land rise to the North and West of the reactor room; i.e., is the reactor room built on a low portion of a hill rising to its north and west?

d. Did Staff consider runoff from those parts of campus that are on higher ground than the reactor (e.g. area around Moore and Knudsen Halls)? If so, please provide all such analysis.

132. SER states: "From the information provided in the application and a site visit, the staff concludes that there is no risk of flooding of the reactor from precipitation, runoff or rising ground water."

a. Did technical staff make only one site visit (aside from security matters) prior to preparing this SER?

b. If more than one site visit, please indicate how many, and the dates of said visits.

c. Please indicate the total number of hours spent on site by the technical staff responsible for this SER.

d. Is not the reactor room lower than surrounding areas immediately around the reactor room in order to make sure that water flow would not be from the room to the outside?

e. SER makes no statement about risk of flooding from causes other

than "precipitation, runoff or rising ground water." Please provide all analyses that have been made of risk of flooding of the reactor from causes other than these. Intervenor in this question refers to the risk of flooding the reactor, not the risk from flooding it.

133. The paragraph about "Hydrology" does not address the question of contamination of ground water. Please provide all analysis done by Staff regarding that matter.

134. The paragraph about "Hydrology" does not address the question of whether [illegible] exist in the vicinity or not. Please provide all information Staff can produce as to the existence of wells on campus or in the vicinity.

SER 2-6

135. SER states: "Though it is recognized that the UCLA campus may be path of an active seismic fault, it is difficult to determine and verify the degree of activity of such faults and the potential damage that can occur to the reactor or reactor building."

a. Which particular active seismic fault may UCLA be in the path of?

b. When was it most recently active, what was the size of the associated seismic event (in Richter scale and in ground acceleration maximum), what damage occurred from said activity?

c. Please provide the information asked in 135b above for seismic activity prior to the most recent seismic event along that fault.

d. Precisely why is it difficult to determine and verify the degree of activity of such faults? Particularly address why such determination is difficult in this case but has been accomplished in other reactor proceedings.

e. Precisely why is it difficult to determine the potential damage that can occur to the reactor or reactor building from such faults? Again, particularly address why such determination has been possible in other reactor proceedings.

f. Please provide all analyses performed by Staff in an attempt to "determine and verify the degree of activity of such faults and the potential damage that can occur to the reactor or reactor building" and indicate what difficulties were encountered in performing such analyses.

g. Please show by calculation and reference the shape of the accelerogram of the SSE at this site, the maximum ground motion (in each direction) associated with it, and the response spectra of the reactor and the reactor building in such a SSE.

h. Please provide all Newmark-type analyses performed for this site.

i. What is the maximum acceleration the reactor core is capable of sustaining without damage in the east-west, north-south, and vertical directions?

j. What is the specific potential event at the principal capable fault which limits reactor design at the UCLA site?

k. What is the strain energy release on that fault which is the limiting condition for reactor design at the UCLA site?

l. What is the accelerogram that would be associated with the event identified in 135j above?

m. What damage related to the 1971 earthquake was Applicant referring to in its 1976 and 1977 Annual (Specialized Activity) Reports?

n. What other seismically-related damage is Staff aware of for the reactor?

136. SER states: "In order to circumvent these factors, the staff obtained laboratory analyses of the impacts of earthquake induced core disruption on Argonaut-type reactors."

a. Did Staff specifically request dose estimates and/or fission product release estimates in case of earthquake-induced fracturing of the fuel?

b. Precisely where in each study can such estimates be found?

c. Los Alamos study deals with one earthquake effect--reduction of cooling to plates following scram; Battelle study considers briefly changes in core geometry, with another consideration of flooding, and elsewhere a consideration of reactivity accidents, fire, and chemical reactions, each considered separately. Please provide all analyses of fission product release and dose estimates consequential to an accident initiated by earthquake but which resulted in an occurrence which combined two or more of the effects the laboratory studies analyzed singly. For example, reduction in cooling following a temperature rise caused by earthquake-induced reactivity insertion. Please provide all analyses performed by or for Staff of such common-mode events; i.e. the possible permutations of two or more events caused by same initiating event (earthquake).

SER p. 3-1

137. Please provide all facts you can produce that support the statement that the reactor is "in a well drained location."

138. a Master's thesis prepared by Richard Lee Rudman entitled "Simulation of Earthquake-Induced Vibrations in a UCLA Reactor Fuel Bundle" dated 1968 refers to the October 1966 vibration tests of producing accelerations of a maximum of .01 g rather than the .1g reported in the SER. Please indicate which is the correct figure and show all facts you can produce to support that answer.

139. Please show, by calculation and reference (including page # and paragraph) the extrapolation that produces accelerations of .5g.

140. What analysis has Staff performed to verify the Applicant's conclusions from the "out-of-core fuel element vibration tests"? In particular, what analysis has Staff undertaken as to the effects of power oscillations in conjunction with other seismically induced reactor effects? Please show said analyses.

141. Does Staff consider the Uniform Building code in effect at the time of the reactor's construction to include design considerations for seismic forces adequate for construction of a reactor in the Los Angeles region today? Please show all NRC guides or other documents that indicate adequate seismic design for reactor construction in seismically-active regions can be met by following the guidelines of the 1959 Uniform Building Code.

142. SER states: "According to the information in the application, neither the reactor facility or other campus structures suffered any structural damage due to the severe earthquakes in 1952 and 1971."

a. Describe all efforts made by Staff to ascertain the accuracy of the information from the Application cited above and provide all independent information obtain by Staff.

b. What was the ground motion associated with the 1952 and 1971 earthquakes at the reactor site?

c. Where were the epicenters of said earthquakes and Richter scale magnitude?

d. What fraction of the maximum ground motion acceleration possible at the reactor site, given the various faults nearby, were represented by the ground motion associated at the reactor site in the 1952 and 1971 earthquakes.

<u>SER p. 3-2</u>

142. Precisely where (by page number and paragraph) in each of the two laboratory studies performed for the Commission is there an evaluation of the potential damage to the UCLA core from a hypothetical earthquake that <u>causes the reactor structure to collapse onto the core</u>?

143. Provide all analyses of the effects if the building structure above the reactor room fell onto the reactor and crushed the core.

144. Were any buildings built according to pre-1960 Uniform Building Codes damaged during the 1971 earthquake? Please indicate how many such buildings and the source of the facts which the answer is based upon.

145. Precisely, by page number and paragraph, for both laboratory studies, where is the analyses that indicates "fission product concentrations and doses significantly less than 10 CFR Part 100 guidelines for power reactors and probably within 10 CFR Part 20 limits."?

146. Precisely which 10 CFR 20 limits--occupational exposure limits, or for the general public?

147. SER states the studies were based on "equilibrium inventory of fission products." Please indicate, for 100 kw operation, the inventory maximally possible under those assumptions:

a. total fission product inventory
b. inventory total for the principal cesiums and strontiums (by each isotope)
c. total noble gas inventory
d. total volatile inventory
e. total nonvalatile inventory
f. total alkaline earths
g. total noble metals
h. total rare earths
i. total refractory oxides
j. individually, for each of the principal isotopes of Xe, Kr, Sr, Pu, Te, Ba, Ce
k. for I-131, 132, 133, 134, 135

<u>SER p. 3-3</u>

148. Please indicate the analysis undertaken by Staff to determine the adequacy of the control rod system as a whole and its respective parts.

149. Please indicate all control rod system problems or problems of the control rod system parts of which Staff is aware, by date of event, nature, and cause. Furthermore, please indicate whether Staff considers these problems to evidence control blade system unreliability; if not, please provide all facts you can produce to indicate system is not unreliable.

SER p. 4-1

150. Please provide all facts Staff can produce to indicate that the UCLA reactor is indeed a "research reactor."

151. Please indicate whether the majority of neutron activation analysis performed by the UCLA reactor is commercial, i.e. done for commercial firms.

152. Please provide all facts Staff can produce to show that the neutron activation analysis performed at the UCLA reactor is either research or education.

SER p. 4-3

153. Please show by page number, paragraph, and reference how the basic Argonaut reactor design was based on SPERT/BORAX destructive testing when the SPERT destructive tests did not occur until the early sixties.

154. Which of the five Argonaut reactors in the U.S. is not currently being reviewed for license renewal, and for what reason?

155. Please identify with specificity, and where possible, by page number and reference, the "latest mathematical models" referred to in the SER sentence beginning "Since four of the five existing..."

156. The Battelle study appears to Intervenor to assume that 2.3% delta k/k at room temperature (the UCLA limit) is equivalent to 2.6% delta k/k when the water is cooler than normal and thus, to be conservative, assumed that Argonaut reactors limited to 2.3% delta k/k could actually achieve 2.6% insertion under certain temperature conditions. Under current licensed limit, can UCLA reactor have 2.6% available under low temperature conditions? Please explain.

157. Battelle study on page 21 indicates "Based on the estimated peak temperature produced in the SPERT I destructive test, the fuel hot spot would be approximately 590°C..." Yet SER asserts the study showed maximum temperatures "of approximately 463°C." Please explain the discrepancy.

158. Please indicate by page number and paragraph where in reports of the BORAX tests it is indicated that there was "no fuel or cladding melting from an instantaneous reactivity insertion of $3.90." Please indicate said BORAX reports by date, author and title.

159. Please indicate the largest dollar and cent reactivity insertion during the BORAX tests that <u>did not</u> cause fuel or cladding melting; give reference and page number.

160. Please indicate by precise section number what part of the Technical Specifications limits positive reactivity to a maximum $.28. Indicate also whether that is limit for single irradiation port or for combined worth of experiments; if the former, please give the combined worth limit.

SER p. 4-4

161. Is the negative reactivity limit cited by the SER (-$0.92) for single ports or combined worth of experiments? If the former, please give the combined worth limit.

162. If the "excess reactivity in the reactor will not pose a threat to the public," why is Staff proposing to lower the excess reactivity limit?

163. Please show, by calculation and reference, all facts Staff can show as to the lowest level of excess reactivity sufficient for this reactor.

164. Are flammable materials permitted to be irradiated in the reactor, according to the Technical Specifications?

165. What analysis has been performed by Staff as to the propriety of permitting or not permitting the irradiation of potentially flammable substances? Please provide all said analyses.

166. SER states: "the proposed Technical Specifications limit the total excess reactivity to $3.00." Intervenor sees no requirement as to the temperature at which that reactivity limit is to be determined.

a. Is that $3.00 at room temperature?

b. If at some other temperature, what temperature?

c. If at room temperature, is it not possible that at a lower temperature the actual excess reactivity could be $3.54 or so?

d. If the answer to c above is negative, please provide, by calculation and reference, all factsyou can produce to support your answer.

167. Intervenor has before it proposed Technical Specifications by Applicant, contained in Application for license renewal, and proposed Technical Specifications by Staff, contained in the SER. Please explain the relationship of the two documents one to the other and in the licensing proceedings.

168. The limitationof $3.00 proposed represents a limit on installed reactivity or total that can ever be in the core at any one time?

a. If the former, could not more than $3.00 be in core through insertion of a positive worth sample?

169. Specifically what reports of the BORAX/SPERT Tests were reviewed by Staff in making the conclusions stated at 4-4.1? Please give title, author, and date.

SER p. 4-5

170. How rapidly is the core water completely drained?

171. What malfunctions of the core water dump valve is Staff aware of? Please identify each incident by date, nature and cause of incident.

172. Please provide all analyses performed by Staff of failure modes for the dump valve and possible consequences thereto.

173. Please provide all analyses performed by Staff of failure modes for the control blade system and possible consequences thereto.

SER p. 5-1

174. Please describe all tests that have been done, by year, to determine that the dump valve and the rupture disk operate properly.

175. Do the fuel boxes have deflector plates, as described in the 1960 Hazards Analysis, to prevent water from falling back into the fuel boxes ? If not, why not?

176. Explain why Staff concludes these systems are adequate to assure safe operation given the partial opening of the dump valve due to pressure loss and the potential for reactivity accidents caused by sudden closing of the valve after such a partial opening.

177. Describe the adequacy and sensitivity and operating history of the radiation tank which monitors the retention tank and indicate why staff feels that detector is adequate for preventing inadvertent release of radioactive material to the sanitary sewer.

SER p. 6-1

178. Precisely what does Staff mean by "confinement," in what NRC documents (and page) is "confinement" defined, and what standards exist to measure adequacy of such confinement for reactor effluents?

179. Is shutdown of ventilation fans, closing of dampers, and scramming of reactor all automatic when high radiationis detected or power lost, or do any of these actions require human action? If human action required, please identify specifically.

180. The ventilation system is shutdown by shutting off what mechanisms?

181. High bay ventilation intake fans take in air from what air source?

182. Is there a fan or air removal system in the reactor structure (core and biological shielding) to remove Argon-contaminated air from inside the biological shield to be vented through the exhaust stack? If so, where is that fan or system located and what is its capacity?

183. Is negative pressure maintained in the reactor room at all times? If not, when is it not so maintained?

184. What is the efficiency of the dampers; i.e. what leak rate is there?

185. What failures of the ventilation system is Staff aware of?

186. In event of high radiation being detected and shutdown of ventilation fans in reactor room and closing of dampers, what is the leak rate of contaminated air out of the reactor room, and what pathways does it take? Provide all data, facts, and references upon which this answer is based.

187. Precisely where is the radiation monitor located which initiates the automatic actions outlined at the bottom of SER p. 6-1? What is its trip point; how often calibrated; how often is the entire system checked or tested?

188. Is the scram and reactor room fan shutdown mechanism set to initiate action when airflow from the exhaust stack goes below 14,000CFM? If so, at what CFM level is it set to initiate such action?

189. Precisely where are the dampers located--precisely where in exhaust system?

190. From the 8th floor of the ventilation duct carrying reactor exhaust air to the exhaust stack, down to the reactor room, please indicate any and all obstructions (gratings, etc.) within the duct, including their location and composition.

191. What is the leak rate from reactor room exhaust air between the point it leaves the reactor room and the time it is exhausted out of the exhaust stack (i.e. of x curies of Argon-41 produced in reactor room, what percent of x does not get exhausted from the top of the 8th floor)?
   a. precisely where do those leaks occur?
   b. what is the gamma dose to the public from the effluent as it passes through the ventilation duct on its way to the eight floor stack?
   c. please provide all data, calculations, readings, and references upon which answers to the above questions are based.

<u>SER p. 6-2</u>

192. Precisely describe the airflow (where it comes from, where it goes to, and the quantity of air present at any one time) involved in air convection cooling of the fuel elements after the dump valve has drained the water into the dump tank.

193. When air pressure is removed from the dump valve, does some air flow continue from the source of that air pressure after the core has been drained?

194. What is the source of air pressure for the dump valve, and what is the capacity of that source (total volume of air contained, at what pressure)? Is it indeed air?

195. Precisely where is the dump valve located, and precisely where is the air pressure source?

196. What is the <u>maximum</u> fuel meat temperature during operation; provide all facts, data, and references upon which answer is based.

197. Is the core water always dumped during a scram? If not, under which conditions is it dumped and which not?

198. At the end of the day, is the core water always drained from the core? Please explain.

199. What is the procedure to be followed in case of fire--scram through insertion of control blades and dumping of water, or is water to be left in the core to protect the fuel from the fire? Please provide the detailed procedure in such a case, and all documents identifying such procedures.

200. What is the procedure to be followed in case of fire while the reactor is shutdown (control blades inserted)--is water to be added to core for fire protection? Please provide all procedures.

201. Did the UCLA reactor have an emergency core cooling system when it ran at 500 kw? If not, why didn't the Commission require such a system at that time, given the conclusions of the Los Alamos study that loss of air convection at 500 kw can result in fuel melting after shutdown?

202. SER states: "Part ofthe safety of its operation depends on rapdily emptying the water (moderator) in the core if the reactor scrams shutting down the reactor." Precisely what procedures are to be followed in case of fire in fighting that fire and what fire-fighting agent (e.g. water?) is to be used, and how? Please provide all procedures for dealing with fires, and indicate all analyses by Staff as to how fire should be handled at the UCLA or other Argonaut reactor.

203. SER states: "There is no need for an emergency core cooling system for this reactor since fuel temperatures during operation get up to only 120°-160°F..." Since temperatures during operation are not temperatures during an emergency, does Staff contend that emergency core temperatures cannot exceed 160°F?

204. Please provide all analyses by Staff indicating that core temperatures in an emergency could not reach levels necessitating emergency cooling for any combination of possible accident (i.e. power excursion followed by loss of convection cooling by air).

SER p. 7-1

205. SER refers to 2 safety channels as well as 1 linear power channel and 1 log N and period channel. Elsewhere on same page SER refers to the power level instruments as safety channels. Are there 4 different channels, or is the linear device and the log N device the two safety channels referred to? Please expalin.

206. The 4 rod position channels--is that one channel per rod, or is there redundancy?

207. Is there one primary coolant flow channel and one secondary coolant flow channel, or are there two of each?

208. Is only one core level indicator necessary for operation?

209. Please describe all inhibits or interlocks or scram features that would prohibit insertion of a -2.3% delta k/k worth sample in the reactor while the control blades are inserted, slow withdrawal of said blades to bring reactor up to power, and then removal of said sample without first re-inserting the control blades.

210. What analysis has Staff done, and what facts acquired, as to the operating history, maintenance, and malfunction record of the channels, safety functions, and inhibit, interlock and scram systems? Please indicate each malfunction as to nature and cause of which Staff is aware.

211. Please indicate which of the inhibits, interlocks and scram systems can be by-passed, and how.

212. Please indicate whether any of said inhibits, interlocks, or scrams systems have been by-passed.

213. Please indicate whether Applicant has ever inappropriately by-passed said systems and, if so, when, which system, and what was the result.

SER p. 7-4

214. If an inhibit condition arises, can it be cleared, permitting operation to continue, without resolving problem that caused the inhibit; e.g., is there an inhibit override mechanism that permits the inhibit to be cleared without actually resolving the cause of the inhibit? Be specific as to all such override mechanisms or situations where such override can occur.

215. When was the control rod-drive-down response added to the inhibit?

216. Would the inhibit at period less than 6 sec and scram at less than 3 seconds be able to operate fast enough to prevent a power excursion if the excess reactivity were inserted rapidly and were sufficient to cause a period in the millisecond range? Please provide all calculations and facts to support your answer.

SER p. 7-5

217. What investigation has Staff undertaken to assure that the types of instrumentation at the UCLA facility are capable currently and during the next twenty years of performing their functions reliably? Please indicate all facts acquired through said investigation as to the reliability of said instrumentation.

SER p. 8-1

218. Does the reactor facility have no onsite emergency power system whatsoever, even for key or limited uses? If it does have some limited backup power systems, please indicate the nature of said systems and for what instrumentation.

219. In case of an emergency situation involving loss of power and need to enter reactor room, what lighting would be available?

220. How much air (in volume) is contained in the core and in the reactor structure inside the biological shield at any one time, and what is the flow rate (via natural air convection) of that air?

SER p. 9-1

221. Are the fuel plates stored in one or two cabinets?

223. What are the dimensions (internal) of the cabinet(s)?

224. How many drawers are there per cabinet?

225. What is the make and model of the criticality alarm, precisely where is it placed, how often is it calibrated and tested, has it ever failed such tests, and what is its "trip point?"

226. What is the criticality alarm's power source in case of the normal power system to the reactor facility failing?

227. What is the spacing between plates in the cabinet drawers?

228. Were the cabinet(s) to be filled with water, what is the probability of a criticality incident occuring? please provide all calculations.

229. Is there a sprinkler system above the cabinet or nearby?

230. Are there tanks of water, or heavy water nearby? If so, what volume of water or heavy water to thet contain.

231. Would flooding the filing cabinet with heavy water produce a chance of accidental criticality? What probability?

232. Has flooding (from piping, water tanks, or other causes) ever occurred in the area where the fuel is kept? Please describe each such incident.

233. Is the cadmium lining of each drawer's bottom removable?

233. What rating of fire resistance is there for the cabinet?

234. What is the melting temperature of the material of which the cabinet is made?

235. Were a fire to take place around the file cabinet, reaching the melting point of cadmium, could the cadmium in molten form work its way (or drip) out of the drawers to the bottom of the cabinet?

a. if so, what is the probability of criticality were firefighters then to flood the area with water?

236. What is the thickness of the shielding on top of the storage holes and storage pit for irradiated fuel? What is the shielding made of?

237. What is the dose rate at the surface of a fuel plate (maximum) while in the reactor core?

238. What is the maximum dose rate at the surface of a fuel plate after removal from the core?

239. What is the maximum dose rate on top of the irradiated fuel hole with an irradiated element stored inside at its "hottest" possible level? Please provide all data, and calculations upon which answers237-239 are based.

240. What is the minimum dose rate at 3 feet unshielded from irradiated fuel that has been stored at the facility (i.e. of irradiated fuel stored at UCLA during the license period, what is the minimum dose rate for that fuel at any point during that period)?

241. What is the lowest dose rate at 3 feet, under NRC regulations and UCLA's proposed Technical Specifications, of irradiated fuel that can be permitted to be stored on site? (i.e. UCLA is not permitted to have on site irradiated fuel of less than x dose rate at 3 feet unshielded). Please indicate which regulation or specification makes such a requirement.

242. What is compressed air used for at the facility?

243. Is the back-up compressor automatically turned on when compressed air pressure from the general supply drops, or does this require manual intervention? If not automatic, please indicate how personnel know of drop in pressure, at what level of drop they are made aware, and what must be done to switch to the back-up compressor.

244. Please complete the last sentence on this page from the phrase "the other inhabited" to the beginning of next page "is a safety feature". (pages 9-1 to 9-2).

SER p. 9-2

245. SER refers to "periodic inspections" to insure there is little flammable material available for a fire.
   a. Who performs these inspections
   b. How often have they been performed, at what interval.
   c. If referring to fire inspections, please identify all inspection reports of which Staff is aware.

246. How many fire extinguishers are there in the NEL facility, at what locations, and of what type?

247. Please identify the Fire Chiefs who have been made familiar with NEL.

248. In the event of fire on weekends or at night when no health physicist is present, what are the instructions to fire fighters as to whether to proceed into reactor room to fight a fire? What are the fire departments policies regarding fighting a reactor fire? What written procedures exist for fighting a fire at the UCLA reactor?

249. Is water to be used to fight a fire which involves the UCLA reactor?

250. What instruction has the Fire Dept. received regarding possible reactivity insertion by flooding the reactor?

251. What "lessons learned" from the Windscale fire have been applied to preparations for fighting a fire at UCLA? Where can those "lessons learned" be found in documentary form?

252. Did NRC Staff contact local fire chiefs and watch commanders to determine adequacy of their fire response? If so, please indicate which specific individuals were so contacted (by name, address and phone number) and the facts obtained through said contact.

253. What instructions do the fire departments have, and what is their policy, regarding what radiation level is considered too high for them to send their fire-fighters into an area involved with flame?

254. What radiation detection equipment do the fire departments have and would bring in case of reactor fire?

255. Were the nearby fire departments to receive a report of a fire engulfing much of Boelter Hall, do they have a formal policy of going first to the reactor?

256. What are the probabilities of a metal-water reaction should water be used in fighting a reactor fire that had produced melting of the fuel cladding and fuel itself?

257. How many hours of burning would be required, starting from a building fire, to reach fuel melting temperatures? Provide all calculations, data, and references.

258. Does the UCLA reactor room have a fire-fighting sprinkler system? If so, what amount of water would be sprayed on the reactor per minute were those sprinklers turned on?

259. Does UCLA have an overhead deluge or foam system for its reactor? If yes, please give the specifications.

260. Battelle study, p. 43, indicates a graphite fire would produce heat but little smoke. The Staff proposal for installation of smoke detectors in the reactor room does not indicate the level of smoke necessary for activation of the system--please provide said information and indicate whether a graphite fire, with air exhausted through ventilation system, could burn for any extended time without producing enough smoke to set off alarm. If so, how long?

261.Please indicate all small fires or explosions of which Staff is aware that have occurred (a) in the Nuclear Energy Lab, and (b) in Boelter Hall since the reactor was built. Please indicate also what efforts Staff has made to determine frequency of such fires or explosions.

<u>SER p. 10-1</u>

262. Does Staff consider the NEL's neutron activation analysis activities for Dr. Kalil's uranium ore assaying company part of the UCLA reactor's "experimental program"? If so, please indicate precisely what is experimental about said activity.

263. What is the pneumatic tube made of (composition) in the reactor core region?

264. How rapidly (in msec) does the pneumatic tube insert and withdraw samples from the core region?

265. What is the maximum reactivity worth of a sample that can be pneumatically inserted that is <u>physically</u> capable of being inserted in the reactor?

SER p. 11-1

266. Is the threshhold of sensitivity of the NEL monitoring capability sufficient to determine the 10 CFR 20 discharge levels are met before discharge to the sewer? Please indicate the numerical sensitivity of said system(s).

267. How much air (in volume) leaks into the core region per hour?

SER p. 11-2

268. SER states that the maximum allowable discharge of Ar-41 from the reactor stack is 1.65×10^{-5} μCi/cc. "If that value is exceeded, the alarm rings at 1.8×10^{-5} μCi/cc and the operator shuts down the reactor or the ventilation system." Please explain what is meant by saying if 1.65 is exceeded, the alarm rings at 1.8?

269. How often is the alarm tested?

270. Where precisely in the exhaust stack or elsewhere is the monitor placed?

271. What is the maximum concentration of Argon-41 determined in the last five years to be emitted from the exhaust stack?

272. What is the current, most conservative estimate of Argon-41 concentration at the point of emission?

273. Does this estimate include correction (upward) for the 30% discrepancy determined by UCLA between grab samples and stack monitor?

274. Does this estimate include correction (upward) for the drop over time noted by UCLA in its Argon concentration readings?

275. If answer to either 273 or 274 above is negative, please explain.

276. What is the error bar that should be given to the figure provided in answer to 272, and on what basis (including all calculations and data) is that judgment made?

277. Has the alarm setting been altered since the discovery of either discrepancy (described in 273 and 274)? If so, what is the current alarm point?

SER p. 11-3

278. How often are the alarms described at this page tested? Is there an indicator light or other device to alert control room operator that the alarm or the radiation monitor or the connection between them is not working?

279. Does the Exhaust Duct Monitor automatically shut down ventilation fan, close automatic damper and scram reactor; or does it merely annunciate at the control panel indicating to anyone there to shut down the fan, which initiates the other actions?

280. Is it correct that Amendment 10 to the license provided for a reduction factor for Argon-41 concentration of 460, composed of a power use factor (18.8%), occupancy factor (10%) and dilution factor (.115)? If not correct, please specify specifically what aspects of that statement are not correct.

281. Amendment 10 to the license also mandated that the licensee report to the commission any change that would affect that reduction factor--is that not correct? If not correct, please specify what did occur.

282. UCLA has since reported to the Commission an increase in occupancy factor--is that true? If so, please indicate what increase there has been reported. If not, please indicate what is wrong with the statement.

SER p. 11-4

283. In what directions do the morning winds blow?

284. When SER states that the ventilation intake on the Math Science building is "about the same elevation" from the discharge of the exhaust stack, precisely how much higher or lower is it?

285. Staff states that "UCLA was required to implement a two year environmental survey program as part of the requirements of Amendment #10 to corroborate the estimated doses." Since the SER later says that the values obtained are incorrect, is not UCLA then not in compliance with Amendment 10 for failing to have corroborated the estimated doses? If not, please explain with specificity why not.

286. Please indicate why the Pauley Pavilion TLD (on campus, out of prevailing wind pattern) consistently showed a lower dose rate than either the control TLD placed in Sunnyvale (400 miles north of campus) and in Culver City (roughly five miles south of campus) and yet was not used as the control. How would use of that control numerically alter the readings?

287. Why is the failure to shield the TLDs not an indication of inadequate radiation monitoring practices?

288. What hard data, actual readings, does Staff possess to indicate to it that the values from the TLDs are "much greater than actual exposure from the Ar-41"? What measurements has Staff undertaken to determine the contribution from brick and concrete parts of the Boelter structure? Please provide all facts, readings, and other data that Staff can produce to support its claim that UCLA's TLD readings are "incorrect" and probably much greater than the actual exposure from the Argon-41?

289. Please show by calculation and reference how a TLD reading 44 mr/yr during the TLD study, when "adjusted for maximum permitted operating schedules, would become 90 mr/yr.

290. What is the beta dose at the stack?

SER p. 11-5

291. On what basis does Staff estimate peak concentrations of 1.65×10^{-5}?

292. Does Staff have any information indicating peak concentrations higher? If so, please provide said information.

293. SER indicates 5% operating factor stipulated in the Technical Specifications. Amendment 10 determined the operating factor to be 18.8%. Please indicate why the use of the 5% figure is not a violation of Amendment 10 conditions.

294. At what distance and what point is meteorological dilution factor estimated to be 4.67×10^{-3}? Is this average factor over a year of different weather patters?

295. Aside from the Rubin thesis, on what basis did Staff determine the numerical value of 4.67×10^{-3} it is now using? Please provide all data and measurements taken.

296. Precisely where in 10 CFR 20 does Staff get the 1% dose correction factor (10 CFR 20, with unspecified section, is given as reference)?

297. On what basis does Staff assert that dose correction factors valid in 1954 for the chimney of the Harwell Pile (BEPO) are valid for the UCLA roof conditions, meteorology, and exhaust stack system? Please provide all facts, by calculation and reference, that indicate that is a valid assumption.

298. Is either the dilution factor or the dose correction factor based on data from facilities where exhausted air was hotter than ambient when exhausted? If yes, please indicate specifically which factor was so based and how staff corrected for the difference.

299. How did Staff correct for the fact that the rooftop concentration may be lower than concentration some distance on top of roof, which could also be giving a gamma dose?

300. What actual radiation measurements does Staff possess or is Staff aware of that indicate exposure due to Ar-41 at the ventilation intake is less than 2 mr/yr? Please provide all actual measurements of radiation that so indicate.

SER p. 11-7

301. Please indicate precisely how the meteorological dilution factor was arrived at by Staff.

302. Aside from the Rubin study, please indicate how smoke release studies provided numerical verification of the dilution factor.

303. Staff indicates calculations by the UCLA meteorology department verify the dilution factor. The only contribution by the meteorology department Intervenor can find in the referenced item is an essay "The Non-Buoyant Bent-Over Plume" in which no calculations of concentration at the point in question can be found by Intervenor. Please indicate by page and paragraph where in that work such calculations can be found.

304. Was it Staff's impression that the text of UCLA's answer to Question 8 was by Meteorology Professor Wurtele in SER Ref. 6?

305. What analysis did Staff undertake of the models proposed by Professor Wurtele, particularly the statement on page 3, "Thus, in this example this simple theory says that either (1) the air intake is within the plume, in which case it is receiving a high concentration, or (2) it is outside the plume and receives a concentration of zero."?

SER p. 12-1

306. Please show by calculation and reference how .04 ± .03 mrem/hour represents background radiation in Los Angeles.

307. Is the assertion that levels of direction radiation in this uncontrolled area are not detectable above background by calibrated meters during full power reactor operation based on measurements by Staff or on Applicant's measurements alone? If measurements have been undertaken by Staff, please provide the readings and the records thereto.

308. Did Staff review the annual radiation surveys prior to making this assertion or merely accepted the statement by Applicant?

309. If Staff reviewed Applicant's data, did Staff note any readings above this "background" level in uncontrolled areas? If so, please identify said readings.

310. What is the maximum dose (beta, gamma, and neutron individually) to persons employed in the Engineering Building snack bar on the third floor of Boelter Hall above the reactor?

311. What is the maximum person-rem integrated figure for neutron, gamma, and beta exposure in that snack bar since it was built?

312. Provide all calculations, data, and references upon which answer 310 and 311 were based.

313. What is the maximum reading ("hot spot") on the fifth floor above the reactor.

314. What is the maximum person-rem exposure to the public from walking on walkways on 3rd floor surrounding the 3rd floor equipment room; provide all calculations, data, and references.

315. What facts, including all calculations, data, readings, and references, can Staff provide to demonstrate the adequacy of the reactor and reactor room shielding in protecting the public from direct and induced radiation around and above the reactor?

316. Does UCLA have HEPA filters in the rabbit room?

317. Does UCLA have HEPA filters anywhere in its facility?

318. If no HEPA filters are at the facility, what facts can Staff produce to demonstrate they are not needed to comply either with radiation protection standards or with ALARA?

319. What is the age of the hand-and-foot counters employed by UCLA at the reactor facility? Do they employ vacuum tubes or more advanced technology?

320. Do visitors routinely wear film badges when touring the facility? If not, are their names and addresses routinely recorded to contact them in case significant exposure was later determined to have occurred?

SER p. 12-2

321. Is Staff aware of incidents in which contamination was not detected by Applicant? If so, please identify each such incident by time period, nature of incident, and cause.

322. Please provide all data Staff possesses indicating that Cobalt-60 contamination is not present in the NEL high bay.

323. Please provide all facts Staff possesses indicating that Cobalt-60 contamination has occurred in the NEL high bay. Identify the particular and specific parts of the high bay where the contamination took place if such contamination has occurred.

SER p. 12-3

324. Please update the chart for 1980 and provide all data Staff possesses to fill in the period from 1960 to 1974.

325. On what basis is the visitor dose made when visitors are rarely badged? What is the visitor person-rem?

326. Please indicate all cases of over-exposure of workers at the UCLA reactor during the period 1960- present.

327. Intervenor finds no discussion of film badge program at UCLA.

a. What is Staff's assessment of UCLA's practice of monitoring its own film badges?

b. What is the minimum detectibility above background for gamma, soft gamma, beta, and neutron film badges? Please explain discrepancy between memo of March 4, 1980, Jack Hornor to Walter Wegst, stating hard gamma (greater than 150 KeV) minimum as 20 mR, and statements by UCLA in answer to Staff questions that minimum was 10 mR?

c. What accuracy does Staff believe the film badge readings have?

d. What total dose (beta, gamma, neutron, and X-ray) could an individual be receiving and still have the badges read zero because of their threshholds (for the monthly badges)?

e. What percent of actual dose fades in a three-month badge?

f. Where are UCLA's control film badges kept?

g. What has Staff done to determine whether the control badges may be picking up radiation other than "natural background" and thus skewing the other readings? Please be specific of efforts to make such a determination.

SER p. 13-1

328. SER indicates UCLA has submitted a draft emergency plan for review by Staff.

a) Does Staff refer here to the emergency plan contained in the application?

b) If not, please provide a copy of the draft referred to, and all written communication thereto. It is Intervenor's understanding that all such communication between Staff and Applicant is to be served on Intervenor as well.

SER p. 13-4

329. Did any of the violations of rules, guidelines, or technical specifications have potential safety significance? If so, please identify those that did?

SER p. 14-4

330. Please show, by reference and page, all facts to support the statement that for the metal-water reaction between aluminum and water to occur requires that the cladding be in the form of aluminum filings.

331. Please show, by page and paragraph, where in the Battelle study it indicates that the aluminimum must be in the form of filings to explosively react with water.

332. If the assertionis correct that aluminum filings are necessary for explosive metal-water reaction, please explain the existence of aluminum-water reaction at SPERT and SL-1.

SER p. 14-5

333. Please show, by page and paragraph precisely where in the Battelle report it is indicated that a chain of three events (failure of experimental apparatus, building fire, and the exposure of graphite blocks to free flow of air) is necessary for a graphite fire?

334. SER states that it considers "this scenario to be such a remote possibility that it poses virtually no risk at the UCLA reactor." (emphasis added). By "virtually no risk" and by reference to a particular scenario, does Staff intend to say that

a) a graphite fire at the UCLA reactor cannot be credibly initiated?

b) a graphite fire, were it to occur, cannot credibly cause fuel damage?

c) Please show all facts which Staff could produce, by calculation and reference, to support answers to a and b above.

335. Battelle, p. 26, concludes about mechanical rearrangementof the core and flooding: "Detailed analysis of this accident and its consequences are beyond the scope of this study." P. 25 refers to a "potentially credible" scenario with a secondary external water source causing a nuclear excursion. Please show, by page and paragraph, precisely on what Staff bases its assertion that the Battelle analysis "indicated that the most severe consequences from these events would be mechanical damage to the core."

SER p. 14-6

336. Does Battelle study assume "100% instantaneous release of noble and iodine gases" as SER states or rather 100% within the recoil distance or 2.7%?

337. Precisely what is the dose that an individual would receive at the reactor room outside wall or in the 3rd floor snack bar over an eight hour period from direct radiation from exposed fuel given the Battelle assumptions about prior history? Please show all calculations and references.

SER p. 14-8

338. Precisely where in the SER (page # and paragraph) does it show that the accidents mentioned "would not pose a threat to the health and safety of the workers..."?

339. Battelle study states (p. 26) that the "consequences from a core-crushing accident would be some multiple of the consequences of the fuel-handling accident." Yet Staff considers the maximum doses to the public from any credible accident to be <u>less</u> than what Battelle considers for the fuel handling accident. Furthermore, Staff claims its analysis is based on "extremely conservative assumptions." Please explain the apparent discrepancy between the Battelle study and the Staff's conclusions in the SER based on said study.

340. SER claims that a fire in the reactor room "would not pose a threat to the health and safety of the workers or the public." Earlier in the SER, Staff claimed merely that a graphite fire could not credibly occur. Does Staff claim that such a fire, should it occur, would not pose a threat to health and safety? If so, please provide all facts and references upon which such a statement is supported.

341. Staff also claims that "a severe fuel handling accident inside the reactor room would not pose a threat to health and safety." Has Staff analyzed such an accident occuring outside the reactor room; if so, what are the results of that analysis?

SER p. 14-9

342. On what basis does Staff conclude damage to fuel plates would occur as guillotine-type breaks? Would not greater surface be exposed by non-guillotine-type breaks, and are not guillotine-type breaks far less likely to occur than fractures, splintering, and rough edges? Present all facts and references upon which your answer is based.

SER p. 14-10

343. Battelle study assumes the result of dropping a shield block on the core would result in exposures "some multiple" of its dose estimates for a fuel handling accident. Staff assumes the worst credible earthquake, involving collapse of the superstructure onto the core, would result in doses <u>less</u> than the doses Battelle postulates for dropping one of 24 fuel elements on the floor in a fuel-handling accident. Please explain why Staff rejected the results of the Battelle study and provide all facts uponwhich that conclusion was based.

344. "Thus," says the SER, "the iodine releases for the severe earthquake damaged core are within 10 CFR Part 20 limits." The previous sentence refers to limits for workers. Is Staff considering visitors, students, and faculty at UCLA radiation workers for determining which 10 CFR 20 limits to apply?

345. Please explain why Staff uses 10 CFR Part 100 for comparison purposes.

SER p. 17-1

346. Please provide all facts and references to support the statement that "the operators of the UCLA reactor perform regular preventive maintenance in order to discover potential failures or to preclude the failure of components. At appropriate times, components with degraded performance are replaced before failure occurs."

347. Please provide all facts and references that indicate Applicant has failed to do appropriate maintenance at the required time.

348. Please indicate, for the fuel currently in the reactor core, and for operation for the next twenty years at the licensed limit of operation, at what point maximum fuel plate burn-up would occur; i.e. when, under those conditions, would fuel have to be replaced? If maximum burn-up would not have occurred by that time, please indicate what percent of maximum would have occurred by year 2000.

349. What would be the maximum dose at 3 feet unshielded from fuel at maximum burn-up a) immediately after shutdown, and b) 48 hours after shutdown?

General Matters

350. Please identify the NRC Staffperson(s) who principally answered these interrogatories or contributed to their answering. If specific interrogatories were primarily the work of one person and others the work of others, please identify which interrogatories were identified by whom.

351. If not elsewhere identified herein, please provide the qualifications of the individual(s) who answered said interrogatories.

352. Please indicate the Staffperson(s) who did the principal technical work on the SER and if not elsewhere provided, please provide a detailed description of technical qualifications, previous employment, educational background, and other relevant data by which to evaluate technical expertise.

353. If not identified in response to 352, please provide the information requested therein for Dr. Hal Bernard. Past employment unrelated to technical qualifications but which may be related to potential past associations with licensees in question should be included if relevant.

354. Please identify by name, address, and title, any expert witnesses whom NRC Staff intends to call at hearing, the subjects to which they will address themselves, the references and calculations they will use other than those contained in the 4 June reports, their qualifications

as experts and any information such as past employment or current associations other than regulatory functions.

355. Prior to the SER being released, the following statement was recorded in minutes of the Campus Radiation Safety Committee at UCLA (December 15, 1980):

> Reactor license renewal and Bridge the Gap. There will be a public hearing (precedent for a teaching reactor) on the nuclear reactor. State Board (sic) will tell parties what points will be heard at a hearing sometime in the spring. At that point NRC will shift from neutral to support of UCLA. Bridge the Gap has 23 items of issue, some of which will help us to do better.

Please indicate the nature of any communications between NRC Staff and staff of the licensee that may have resulted in licensee's belief that at a certain specified time "NRC will shift from neutral to support of UCLA." Please indicate the date of all such conversations or communications and who the individuals were who were involved in said communications.

INTERROGATORIES AS TO ENVIRONMENTAL IMPACT APPRAISAL

1. The EIA variously describes the UCLA reactor as water moderated (p.1) and as graphite moderated (p.2). Please clarify.

2. EIA indicates: "The roof of Boelter Hall houses the 14,000 CFM reactor stack and reactor room exhaust fan, and is a restricted area."

a. precisely what is meant by "a restricted area."
b. precisely what physical means restrict the area from public access?
c. are there other ventilation intake and exhaust fans for the reactor room; if so where are they located exactly?

3. EIA states that C-14 exists in very minute quantities. Please show by calculation and reference, and by producing available data as well, what quantities of C-14 are produced:

a) per year
b) per hour of operation at 100 kw
c) to date by the facility
d) total produced by year 2000 given past operating history and assuming future operation and licensed limit.

4. Please show total environmental impact of that amount of C-14, given its life-time. How many person-rem of exposure will that C-14 produce before it has decayed away? Show all calculations and references.

5. Are there any direct radiation readings on the Math-Science building which, if valid, would contradict Staff's calculation of 1.4 mr dose? If so, by what factor is there a discrepancy?

6. Application and annual radiation surveys indicate gamma doses in reactor room up to 200 mr/hour. Please explain quoted average film badge reading of 175 mr/yr. and 1200 mr/yr maximum.

7. What is the neutron dose to people in unexposed areas? Please present all data and calculations and references to support your answer.

8. Has UCLA experienced any contamination problems regarding high and low level wastes that may have resulted in public radiation exposures? If so, please identify each instance.

9. Is the low level liquid effluent radiation monitor capable of detecting concentrations at less than 10 CFR 20, Appendix B limits? Precisely what is its threshhold and what problems has it encountered that may shed light on its reliability.

10. SER states regarding the Los Alamos and Battelle studies: "In all cases the analyses made on a "worst case" basis, did not result in releases outside the reactor room of more than fractions of the guidelines in 10 CFR Part 100 for offsite doses, and ...would probably not exceed 10 CFR Part 20 limits." Intervenor can find only one dose estimate related to one accident scenario in either study. Please, by page number and paragraph, indicate where the two studies determined that the scenarios you cite would result in doses probably not in excess of 10 CFR 20.

11. Precisely what is the maximum credible accident, in Staff's determination, at the UCLA reactor?

12. At page 6 of EIA, Staff refers to educational and research objectives and activities performed by the UCLA reactor. Does Staff consider neutron activation services for commercial users part of those functions? If so, please specify in detail, and produce all facts you can provide to support you answer, precisely why such activity is research or education and not commercial activity.

13. Provide all evidence you can produce to show that the nuclear engineering/physics program at UCLA would be eliminated if the reactor were shutdown and its functions not transferred elsewhere.

14. Please provide results of all analyses Staff undertook to determine feasibility of not shutting down the facility but instead converting it into a simulator, with no fuel on site but the reactor otherwise present and performing its teaching functions.

15. UCLA indicated in answer to questions by Staff that in 1979 only 31 hours of reactor operation were devoted to instruction, with similar figures for other years. Precisely what is it that makes "commuting" necessary if only 10 hours per quarter of reactor use went to classroom instruction?

16. Do any nuclear engineering programs at other colleges travel to UCLA? What would prevent "field trips" to UC Irvine by the small instructional activity now taking place on site?

17. Precisely how many nuclear engineering students currently (during any quarter of last year) rely on the reactor for their credit-receiving studies or research? (We are not referring to total enrollment in the chemical, thermal and nuclear engineering program, nor to students whose class may visit the reactor for a demonstration). Please provide al facts, data, and references upon which this answer is based.

18. Staff refers (p. 6) to "activation of materials as part of the UCLA curricula." Precisely how does activation of gems for a commercial jeweler and activation of mining samples for a commercial assaying company represent part of the "UCLA curricula?"

19. Staff refers on page 6 to "beneficial uses of the reactor" among them "contributions to scientific knowledge." Please indicate all contributions to scientific knowledge by the reactor since 1970 of which Staff is aware and which forms the basis for said statement.

20. Please indicate all scholarly papers published since 1975 based on research in reactor physics done by the UCLA nuclear engineering department requiring use of the UCLA reactor.

21. As JPL and other non-UCLA users send their samples to UCLA for activation analysis, what would prevent UCLA users from sending their samples to UC Irvine should the UCLA facility cease to exist?

22. Staff states that "Inasmuch as the reactor has been constructed and in operation since 1960 there are virtually no additional capital resources required." Please indicate how much money is expended in maintaining, operating, and upkeep of the reactor per year and how much would need to be expended over the next twenty years if relicensed. Then please indicate what the reactor construction cost.

23. Please indicate all analysis included in your EIA as to the environmental impacts should the bomb-grade uranium be diverted and fall into violent hands.

24. Please indicate the environmental impacts should radiological sabotage take place at this facility.

25. Please indicate the adequacy of the protection measures against radiological sabotage.

26. How large an area of campus would be contaminated were 50% of the core fission products to escape? Please show all calculations and references.

27. What would be the effect on ground water should 50% of the soluble fission products contaminate water that reaches the water table?

28. Please specify, in detail, all alternatives considered by Staff to the continued operation of the UCLA reactor with fuel on site, all analyses conducted of those alternatives, and all data acquired thereto.

29. Precisely how did Staff go about determining what the alternatives to this reactor are?

30. As this reactor is only operated less than 18.8% of the week, and as the licensee has several other, newer reactors, more state-of-the art, precisely why is it not more cost-effective to consolidate users and have students who wish to major in nuclear engineering (the few who do so major at UCLA) go to a campus with a newer facility? Would not fewer resources be expended? Would not risks be reduced? Please provide all facts and references you canproduce to support your answers.

INTERROGATORIES TO S.C. HAWLEY, R.L. KATHREN, AND M.A. ROBKIN AS TO "ANALYSIS OF CREDIBLE ACCIDENTS FOR ARGONAUT REACTORS" NUREG/CR-2079 PNL-3691

TO: S.C. HAWLEY, R.L. KATHREN, AND M.A. ROBKIN:

1. Your report states that the UTR design was manufactured by American Radiator and Standard Sanitary Corporation and that "all five contemporary Argonauts in the United States...are the UTR model." It is our understanding that the UCLA Argonaut reactor was manufactured by AMF. Please clarify.

2. You state that the original Argonaut reactor had 20% fuel, relatively large negative void and temperature coefficients, and was only capable of continuous operation at 1 kw because sustained operation above about 1 kw would result in shutdown because of the negative temperature coefficient. Are these "fail-safe physics parameters" found in greater or lesser measure at the current UCLA Argonaut reactor?

3. You state (p. 1-3) that past Argonaut safety analyses have been based "almost exclusively on limited experimental data. Hence the scope of these analyses is quite narrow. To expand and update these original studies, particularly in the light of more than twenty years of operating experience and additional research, the Nuclear Regulatory Commission requested Battelle, Pacific Northwest Laboratory, to make a generic credible accident analysis of Argonaut-UTR reactors." Besides the SPERT destruct test and estimates of percent operating time at existing Argonaut reactors, specifically what aspects of the "more than twenty years of operating experience and additional research" were considered in making your analysis?

4. Are there any annular core Argonaut reactors in the United States? If so, please specify which.

5. Your study refers to the Argonaut's negative temperature coefficient. As the Argonaut is both water and graphite-moderated, as well as graphite-reflected, the coefficient for both becomes important. What are the various temperature coefficients at different Argonaut reactors for: a) water and b) graphite? Please provide references.

6. Does graphite, as used in the Argonaut reactor, have a positive temperature coefficient? Please provide all facts and references to support your answer.

7. If so, did you consider that positive coefficient in your analysis; if so, how?

8. If it does have a positive coefficient and you did not consider that fact in your analysis, please indicate how the analysis would be altered if that fact were considered.

9. You list a number of previous analyses related to excess reactivity insertions. Some of these analyses appear to contradict the conclusions made in your analysis. Please indicate, specifically and by reference, what is in error in each of these analyses that leads you to conclude your analysis is correct and theirs is not. In particular, the assumption you make that a 2.6% delta k/k insertion will produce a period of 7.2 msec, 12 MWs energy release, and maximum fuel temperatures of 590°C. Please show the flaws you believe exist in the a) ANL study, b) the 1959 ATL study, c) 1961 ATL study, d) GNEC study, e) URR study, f) JASON study,

and g) the UCLA 1960 Hazards Analysis, which differs slightly from the GNEC report. You need only address why you arrive at different figures for period, energy release, and maximum fuel temperatures, but should indicate why your estimates are believed to be the correct and most sufficiently conservative in contrast to these competing analyses.

10. You state on page 6 that the GNEC material postulated a 1000°F rise in fuel temperature. It is our understanding that what was postulated was an energy release capable of a 1000° temperature rise above the saturation temperature of the water. Please clarify.

11. It is our understanding that the GNEC material determined that melting would occur with an energy release capable of a 1000°F temperature rise in addition to the energy necessary to bring the water to saturation, that this was correlated to a energy release of 32 MWs, which was determined through certain relationships between Borax and different Argonaut reactors, to be resulted from a 2.4% insertion (2.3% in the UCLA case). You state that the GNEC material stated "that the reactor would tolerate this amount, rapidly inserted, <u>without</u> the fuel or cladding melting." (emphasis added). Please explain the apparent contradiction.

12. At page 8 you state: "An a priori calculation of the expected temperature rise from the largest possible pulse needs to be performed and the results compared with the data from the SPERT and BORAX experiments rather than relyingsolely on empirical extrapolations and interpolations of the same data." Your analysis, however, appears to be an extrapolation and interpolation of the SPERT destruct data without comparison with BORAX data or other data. Please explain.

13. Why was "deliberate destruction or similar events -- i.e. sabotage --" not considered in your study?

14. You make clear that shock wave phenomenon should be investigated in a future study. By that do you mean your study does not conclusively determine what is the maximum credible accident for Argonaut-type reactors because shock wave phenomenon may produce greater damage than that postulated in the accidents you did investigate? Please explain your answer in detail.

15. What prevents 20% fuel from being used in contemporary Argonaut reactors? What modifications would be necessary to permit use once again of 20% fuel?

16. Is the cadmium sheet used in control blades for current Argonaut reactors (UCLA inparticular) cladded with any other material, alloyed with other material, or is it simply a cadmium blade? Please give details and source of information.

17. Is the void coefficient for the UCLA Argonaut reactor smaller or larger than the void coefficient for the SPERT?

18. When you refer (p. 9) to large negative temperature coefficients, do you refer to the temperature coefficient of water?

19. How does the overall temperature coefficient of the core change during long-term operation during which the graphite warms up?

20. What is the temperature coefficient in the higher temperature ranges that could be expected in a power excursion?

21. You state (p. 9) that the long prompt neutron lifetime is largely a function of the graphite reflection. What other factors affect it?

22. Does the prompt neut. lifetime change with temperature? What specific changes take place in the range 30° C - 700°C; provide all facts on which you base your answer, including references.

23. Does prompt n... lifetime change during an excess reactivity insertion of 2.6% in an Argonaut reactor and if so, how does it change; provide all facts and references upon which you base your answer.

24. Is prompt neutron lifetime for Argonaut reactors calculated or measured; please indicate how the calculation or measurement is done, and what error bars should be given to the reported figures for prompt neutron lifetime.

25. P. 11 states that the earlier analyses identified maximum levels of reactivity and "implicity" those levels that would not cause severe disruption of the core. Please present all facts and references which demonstrate that severe core disruption <u>cannot</u> occur at an Argonaut reactor without melting of the cladding.

26. You state (p. 11-12) that the maximum power and total energy release are a function of the period. Are they not also a function of the total <u>number</u> of e-folding times prior to shutdown, and thus dependent upon the speed of particular shutdown mechanisms in particular reactors? Please explain your answer and produce all facts that support it.

27. You state (p. 12) that the required review system for experiments at research reactors would <u>preclude</u> a severe inadvertent chemical explosion. Please state explicitly what review you have conducted of the <u>adequacy</u> of said review systems at the UCLA reactor and the results of said analysis, and all facts upon which it is based.

28. Please, by reference and facts, show all supporting information you can produce that aluminum "has to be molted or finely divided before the exothermic reaction occurs." (p. 13)

29. You state onpage 13 that "the water used to extinguish a fire could lead to steam or other explosive reactions, including the Al-H_2O reaction. Even coolingof the fire, if sufficiently rapid, might lead to contraction and flexing of metallic components that might rupture the cladding and lead to fission product release." We see no analysis of hazards from graphite-fire-fighting included in the section on such fires; indeed, there appears to be an assertion that dangers from such fires are limited by the fact that fire departments may arrive in time to put out the fire.

Please indicate in detail what hazards may exist in the fighting of a graphite fire at a reactor, what training and procedures normal firedepartments near Argonaut reactors (particularly the UCLA case) have in fighting such fires, what the correct fire fighting technique would be and what incorrect techniques are possible. Please also discuss the potential for accidental criticality or reactivity insertion by water-flooding during fire-fighting.

30. At page 16 you refer to positive reactivity insertions. You assume 100 g of natural uranium; what would be the effect of adding 100 g of 93% enriched uranium in terms of reactivity addition? Please provide calculations and references where applicable.

31. Are you aware of any positive reactivity effect by partially draining the core? If so, please specify.

32. Precisely why is the "substitutionof heavy water" not credible? Give all facts and references to support your assertion.

33. You say that "although possible" partial or complete replacement of the moderator with a superior moderator is "not a credible or feasible accident scenario." Precisely what do you mean by the difference between something being possible but not feasible or credible? And show all data, calculations and references that demonstrate it is not feasible or credible.

34. Are there any other versions of the inhour equation that produce different results in terms of period for a 2.6% delta k/k insertion? If so, please describe and give the equations and the resulting period.

35. Your relationship of reciprocal period to total energy release is far less conservative than that assumed in several other hazards analysis. Please provide all facts and references that show your figure to be sufficiently conservative and the figure of choice.

36. If the BORAX data were used instead of the SPERT data, what total energy release would be associated with a 138 s^{-1} period?

37. If data from the SL-1 excursion were used instead of the SPERT data, what total energy release would be associated with a 138 s^{-1} period?

38. Precisely why is the SPERT data to be preferred over BORAX and SL-1 data; or is it preferred in your analysis?

39. Please show precisely, by calculation and reference, how 12 MWs is assumed to produce 4×10^{17} fissions.

40. Please show all facts, by calculation and reference, that support your claim that "this calculation maximum energy release...is not large enough to produce core disruption leading to cladding failure."

41. On what basis do you assume (p. 18) initial fuel temperature of 60°C.

42. Please explain the large difference (low) between your calculations on page 18 for temperature rise, based on models, and the estimate on page 19 based on the SPERT empirical data.

43. Please explain how you determine 586°C to be 74°C below the melting point of the fuel meat, when elsewhere you say melting occurs at 640°C?

44. NRC Staff in its calculations assumes an initial fuel temperature of 75°C. Given the melting point of the uranium-aluminum eutectic used in the UCLA reactor, how much below the melting point would your estimate based on SPERT's hot spot be, assuming the 75°C starting temperature?

45. What error bars should be given in transferring from the SPERT hot spot to a possible UCLA hot spot? Please provide all calculations and references to support your answer.

46. At what temperature below the melting point of the meat does the cladding become ductile and cladding failure due to internal pressure begin to occur with this kind of fuel? Please provide all facts and references to support your answer.

47. At what temperature does volumetric expansion begin to occur in this particular fuel?

48. At what level of energy release and period and excess reactivity insertion were cladding failures noted at Borax and SPERT?

49. At what temperature can cladding failures be conservatively expected at UCLA? Please show all calculations and references.

50. On page 19 you refer to the supposed 74°C margin "below the melting point of the fuel meat" as "certainly adequate" as a "margin of safety." In degrees C, what is the minimal margin of safety given conservative assumptions? Please provide all facts you can to support your answer.

51. If your estimate of 12 MWs were not correct, and the CBEC estimate of more than 32 MWs were indeed the correct value, what would be the actual temperature rise for the hottest part of the fuel? Please give all calculations and references.

52. If your estimate of less than 590°C maximum temperature from 12 MWs release were not the correct value, and the JASON estimate of 6-12 MWs for melting were correct, what would be the maximum fuel temperature given the UCLA fuel configuration with a 12 MWs excursion? Please show all calculations and references.

53. On page 21 you state that "core disruption, if any, would be minimal." Please show all facts that you can produce to demonstrate that that statement is correct for the UCLA reactor configuration.

54. Does the UCLA reactor have deflector plates designed to prevent repeated criticality from water falling back into core? Please detail answer.

55. What is the effect of repeated criticality on your analysis of reactivity accidents? Please be specific and provide supporting data if available.

56. Precisely where in the UCLA 1980 document referenced at page 22 have "the effects of catastrophic seismic phenomena" been "addressed in detail"? Give pages numbers and document title.

57. State precisely why "no significant effect would result from flooding unless structural rearrangement of the core also occurred or the control blades were somehow prevented from being inserted into the core."

58. Were tie bolts to fail in fuel elements during mechanical rearrangement precisely what would make increased fuel plate spacing non-credible?

59. Please show all facts you can produce to show that bowing of the fuel plates cannot credibly increase plate spacing.

60. You state on p. 24 that the decrease in reactivity from flooding the interstitial graphite spaces "would be more than offset by the increase from the other flooded voids." Later you assume that the flooding of the experimental facilities facilities would just offset the negative effect, giving a 2% plus reactivity. Please show all data that indicates an equal compensation leading to 2% plus reactivity.

61. You state minimal critical mass is 1.9 kg--is that given slabs together, increased fuel channel spacing, or both? If not both, what is the critical mass if fuel channel spacing is optimal and slabs are optimally together? Please show calculations.

62. You indicate (p. 25-6) that "an appreciable fraction of the fuel plates could be damaged and that fission product activity would get into the water. Detailed analysis of this accident and its consequences are beyond the scope of this study." By this do you mean that the fission product release and public exposure could not be greater than that postulated fo r the fuel handling incident, could be greater, or that you can make no determination given the scope of your study. Be specific and back up your answer with all facts you can produce.

63. Table 2 appears to indicate that 13.7% reactivity is the maximum possible with flooding and rearrangement; you state that it is not credible that perfect rearrangement and complete and instantaneous reactivity insertion isn't credible. But since around 3% delta k/k seems enough to produce fuel melting, less than 1/4 of the maximum available, perfection doesn't seem necessary to create a serious excursion. Please explain why an imperfect excursion is not credible. Provide all facts available to support your answer.

64. Given a graphite fire in which graphite in core region burns, causing fuel slabs to slump towards each other and requiring firefighters to flood core with water to prevent fuel melting, what is the potential reactivity available? If you believe this scenario to be non-credible, produce all facts to support your assertion.

65. You state (p. 25) "Only if there were a secondary external water source for the core could this accident be considered potentially credible." Given firefighting, or earthquake that causes ruptured piping above reactor or other floodingof reactor from secondary external water source, does not this statement mean that you consider this accident to be "potentially credible." Please explain in detail your answer, providing all supporting facts available.

66. P. 26 you analyze core-crushing accident based on dropping a shield block on core. What would be the effects of several stories of building above reactor crashing through reactor ceiling onto reactor in earthquake or plane crash induced accident? Please be specific--would that increase consequences over the scenario you analyzed, and by how much?

67. You state that the consequences of a core-crushing accident would be "some multiple of the consequences of the fuel-handling accident." On what basis do you then say in your abstract that "the only credible

accident involving offiste doses was determined to be a fuel-handling accident which, given highly conservative assumptions, would produce a whole-body dose equivalent of 2 rem from noble gas immersion and a lifetime dose equivalent commitment to the thyroid of 43 rem from radioiodines."? Please give all facts that can back up your explanation of the apparent contradiction.

68. Given the higher figures reported on p 27 for various scenarios (e.g. 5.6% for flooding the core air spaces with the blades out), precisely why do you conclude--at least as summarized in the abstract--that such an accident (or partial accident) is not credible?

69. Do you admit that your analysis of explosive chemical reactions is dependent upon the premise that cladding melting cannot occur in the Argonaut?

70. Were aluminum melting to occur, can you accurately predict that Aluminum-water reaction could not occur? Please explain your answer.

71. We notice no analysis of steam explosion. Is this the "shock wave" phenomenon mentioned earlier in the study as needing study elsewhere? Please explain.

72. Could a steam explosion caused during a reactivity insertion at the Argonaut reactor disperse hot aluminum with enough energy to cause metal-water reaction, even if the melting temperature of the aluminum was not reached? Please provide all calculations and references that indicate enough is known to predict that accurately.

73. Your analysis (p. 30) of the argon dilution air flow appears to indicate that that mechanism provides enough air flow to begin a graphite fire were an ignition source available. Is that correct? if not, please explain.

74. Were a graphite fire to start in a small part of the graphite where air or oxygen was available, is it not possible for the fire, as it progressed, to expose more and more graphite to air, feeding the fire? Please explain.

75. You say "if the reactor was otherwise normally sealed, the graphite temperature would not remain elevated." Please explain precisely what you mean by "otherwise normally sealed".

76. Is exhaust fan run only when the reactor is run, or is it run other times (at the UCLA reactor in particular).

77. Precisely where in Nightingale (or other source) do you find the figure .3 cal/g at 50°C cited on page 37 of your report?

78. Precisely why is it considered non-credible (p. 40) for a large excursion to occur coincident with a large enough spill of organic liquid inside the reactor? Are there no common-mode failures that can occur that would cause both events? Please provide all facts you can to support your answer.

79. You state that "the various events examined so far that could contribute to or initiate a graphite fire are all of low probability. However, insufficient data is available for quantifying the probabilities." By this do you mean to say a graphite fire which damages the fuel (a) is certainly credible, (b) is certainly not credible, (c) may be credible, or (d) may not be credible. Please explain your answer and give all facts you can to back it up.

80. You on pages 41-43 examine two common-mode scenarios in your discussion of a design basis accident. It is unclear whether you determine these to be design basis accidents or not, and what their consequences would be should they occur. Please clarify.

81. P. 42 you say that the glass would not soften and failure would be limited to mechanical causes. That is with an assumption of heating in one hour of irradiation. Could the glass soften if irradiation were longer than one hour? How long would be required for softening? Please show calculations and references where applicable.

82. You say that if the accident occurred while attended, "immediate response by the experimenters would limit the consequences."

a. what would be the appropriate response?

b. what procedures exist at UCLA delineating said response?

c. are student experimenters made familiar with said procedures, if the exist?

d. were water to be used to respond, what reactivity consequences could ensue?

e. what would be the effect if response were not immediate?

f. by limited consequences if response were immediate, what consequences do you mean?

g. if consequences were not limited by immediate response, what maximum consequences could ensue--be specific.

83. Your summary at page 43 does not make clear whether you think the graphite fire leading to release of fission products is completely non-credible or whether there are a number of scenarios with "some potential" for such events. Please clarify.

84. You say, unless the whole building were extensively involved, 'it again appears unlikely that enough time would elapse without detection of the fire to permit ignition of the graphite and subsequent fuel melting.'

a. Are you saying that to prevent fuel melting the building fire must be detected (and successfully kept from igniting the graphite)? Please explain.

b. If the reactor itself caught fire, how should the fire be fought?

c. What training do fire departments near reactors have for making such determination, and what radiation detection equipment and procedures?

d. What is the potential for the fire burning a considerable time because of indecision whether to enter the reactor room because of radiation (fire at night or on weekend when health physicist can't be located) or how to fight it?

e. What experience exists from other reactor fires as to how long they burn before being controlled? Please specify.

f. How long would an Argonaut reactor have to be involved in flames for the fu el to be damaged?

g. Could a fire from a ruptured gas line in the reactor vicinity, perhaps due to earthquake, ignite the graphite?

84. What is the certainty that a graphite fire would be detected by a smoke alarm?

85. On page 43 you say "the aluminum fuel boxes and fuel could be at risk for melting."

a. What would be the specific radiological consequences of such an event?

b. Are you saying such an event <u>could</u> or <u>could not</u> occur? Please explain and give all supporting data for your answer.

86. Regarding p. 44 and your assumption of a "worst case" situation regarding fuel handling, "involving two mutually independent events"--how many mutually independent events led to the TMI incident?

87. Please give the complete fission product inventory assumed, not just iodines, kryptons and xenons, for the primary isotopes. In particular, give for the whole core (not just one element) a maximum total core inventory, and the maximum inventory in the whole core of

a. the major cesiums
b. the major strontiums
c. I-131 through 135
d. Xe 133m, 133, 135m, 135
e. Kr 85m, 85, 87, 88
f. bromine, RB, Te, Se, Sb, Ba, Ru, Pd, Mo, Tc, Y, La, Ce, Pr, Nd, Pm, Sm, Eu, Np, Pu,
g. and the total core inventory

Please specify precisely the operating conditions assumed to bring about this maximum inventory. If you do not have figures for the categories requested, please provide all information you do have available as to maximum core inventory, and provide references.

88. You state that fission product release is strongly temperature-dependent in uranium-aluminum plate fuels.

Please provide all data available, and all references known to you, as to fission product release fractions for different isotopes at temperatures from ambient to above melting.

89. Is the UCLA, MTR-type fuel aluminum matrix with UAl_4 dispersed therein, or is the meat an aluminum-uranium eutectic? Please specific, and describe the particular characteristics as to melting and fission product release properties as to the UCLA fuel.

90. Please state with specificity why you think your 2.7% gaseous release estimate for a single fuel element in a fuel handling accident is a reasonable estimate (why it is neither too conservative nor too non-conservative.)

91. x/Q was determined for what distance for an observer downwind?

92. What would be the doses to people inside the building which houses the reactor? Please show all calculations and data and references.

93. What would a fuel element with that operation history be giving off in terms of direct radiation (at one foot, three feet, and the other side (outdoors) of the reactor room walls (or ceiling for classrooms, etc. above)? Please provide all data, calculations, and references.

94. Why wasn't SL-1 data included in your analysis?

95. At what temperature does uranium oxidation become exothermic?

96. At what temperature will metalic uranium ignite?

97. Why didn't your analysis consider uranium fire?

98. What reactivity insertion caused the destruction of
   a) the SPERT
   b) the BORAX
   c) the SL-1

99. Why in your reactivity analysis did you not, as GEC did, compensate for differences between SPERT and BORAX such as different void coefficients, ratio of heat flux to temperature difference, and so on?

100. What effect does the fact that the Argonaut is graphite and water moderated and SPERT and BORAX were merely water moderated have on extrapolations and interpolations of the destruct experiences?

101. What error bars should be put on the SPERT data itself?

102. What error bars should be put on your extrapolations and interpolations of the SPERT data; i.e. when you say fuel temperatures could reach 590°C, plus or minus what temperature range to produce a 95% confidence level? Please show all calculations, facts and references upon which you base your answer.

Section II

The following interrogatories are to be answered by G.C. Hawley alone:

A(1). Please provide a current c.v. or resume and indicate in addition any other technical qualifications upon which you base your expertise as to the matters addressed in the report in question.

A(2). Are you now, or have you been within the last five years, an employee of any of the five current licensees of Argonaut reactors? If so, please indicate which licensee, which period of employment, and what your role was at that licensee. By licensee we mean not merely on staff of a particular reactor facility, but being a faculty member, researcher, consultant or other employee of the University or University system (e.g. Regents of the University of California) which held the license for the facility.

A(3) Do you now, or have you within the last five years, received a paycheck from any of the five current Argonaut reactor licensees? If so, please explain.

A(4) Do you have personal acquaintance with any of the current or past staff of the reactor facilities at any of the five Argonaut facilities? If so, please identify each such individual and describe the nature of the acquaintance.

A(5) What personal knowledge do you have regarding Argonaut reactors? Please be specific.

A(6) Have you <u>ever</u> been employed at an Argonaut reactor? If so, please give details.

A(7) Have you ever operated an Argonaut reactor? If so, please give date and details and identify the specific reactor(s).

A(8) Do you endorse the full content of the report you co-authored? If not, please identify each specific portion, aspect or sentence which you do not fully endorse, and explain why.

A(9) Do you have reservations about any aspect of the report? If so, please identify each specific portion, aspect, or sentence about which you have reservations, and explain the reservations.

A(10) Do you take the abstract and summary of the report at its beginning to accurately reflect the content of the report?

A(11) Do you have any reservation about the abstract and summary completely accurately reflecting the content ofthe report? If yes, please identify each aspect of the abstract or summary with which you take some issue and indicate what you feel would be a more accurate way of summarizing or abstracting the report.

A(12) We note that language throughout the report could readily be interpreted as saying that certain accident scenarios (other than the fuel handling incident) are potentially credible. Is it your view that accident scenarios other than the fuel handling accident are credible? If yes, please specify which. If no, please explain why.

A(13) If A(12) above was affirmatively answered, please indicate whether any of the accidents potentially credible could result in doses in excess of those postulated for the fuel handling accident.

A(14) We note also that throughout the report there are indications of destruct events which were consciously not considered or which more study was recommended or which your team stated firm analysis was outside of the scope of the present study. Do you believe that your team analyzed all credible destruct modes for Argonaut facilities?

A(15) Are there some destruct or accident modes that you think demand greater attention than you have been able to give them to accurately assess their credibility and/or consequences?

Part B

These interrogatories are to be answered by R.L. Kathren:

Please answer questions A(1) through (15) above, numbering your answers B(1) through B (15).

Part C

These interrogatories are to be answered by R.A. Robkin:

Please answer questions A(1) through (15) above, numbering your answers (C)(1) through C(15).

Please in addition answer the following questions:

C(16) We note that the report indicates you are an employee of the University of Washington, a licensee of an Argonaut reactor. We also note that you are employed by the Department of Nuclear Engineering at the University of Washington. Is the U of W Argonaut part of the Department of Nuclear Engineering?

C(17) Do you teach any courses which utilize the U of W Argonaut? If so, please specify which classes, what use the reactor is put to, and how many hours per year roughly of reactor time you so use.

C(18) Have you in the past taught any classes that use the reactor? Please give details.

C(19) Do you now, or have you in the past, used the U of W reactor for any research, neutron activation, or other non-teaching activity? If so, please detail with specificity the uses to which you have put the reactor, the research you have conducted with it, and roughly the hours of reactor use so involved.

C(20) Do you personally know any of the staff of the U of W Argonaut? If so, please detail all such acquaintances.

C(21) Do you have colleagues at the University of Washington who use the reactor for teaching or research or other activities? If possible, please identify colleagues who are principal users and the use put.

C(22) Do you now, or have you in the past, sat on any supervisorial committee for the U of W reactor (reactor hazards committee, etc.)? If so, please detail said involvement.

C(23) Are you personally acquainted with any members of said supervisorial committees; if so, in what capacity?

C(24) Were the University of Washington reactor shut down, would any of your research or teaching activities have to be modified or curtailed? If so, please specify what activities would have to be altered and how. If not, please specify precisely why no alteration would be needed.

C(25) Is the University of Washington reactor currently up for relicensing or will it be in the next three years?

C(26) Is the NRC at this time reviewing any application from the University of Washington regarding its reactor facility? If so, please specify.

INTERROGATORIES TO G.E. CORP. AS TO NUREG/CR-2198 "FUEL TEMPERATURES IN AN ARGONAUT REACTOR CORE FOLLOWING A HYPOTHETICAL DESIGN BASIS ACCIDENT"

TO G.E. CORP:

1. Your February 5, 1981, report (WX-4-3692, is titled "Summary of Computer Model and Selected Results From Argonaut Design Basis Accident Evaluation." (emphasis added)

a. Please indicate precisely which results were selected for inclusion in your report and which were selected to not be included.

b. Did you at any time during your study, using different models or different assumptions, come up with peak temperatures, for a 100 kw Argonaut under any hypothetical condition considered, greater than the 631° K temperature reported in Table I of your report?

c. If the answer to b is affirmative, please indicate with specificity all numerical estimates higher than 631°K, the assumed conditions and model factors that produced that estimate, and why the estimate was rejected.

2. Who determined the particular accident scenario you considered (loss of water while at 100 kw, caused by earthquake potentially causing compaction of the fuel elements, successful insertion of control arms) to be a Design Basis Accident for the Argonaut reactor? How was that determination made?

3. You state in the first sentence of your report: "The hypothetical Design Basis Accident (DBA) for the Argonaut reactor is assumed to be a complete loss of water coolant/moderator while operating at full power (100 kw)."

a. Precisely define Design Basis Accident as used here.

b. Please indicate, by reference and page, the source for said definition.

c. Do you mean by the above-quoted statement that the accident scenario considered in your report is the Design Basis Accident for Argonaut reactors, or rather that it is a DBA, with others possible, and is merelt the DBA analyzed in your study?

d. Did you in your study make any analysis of, and any consequent determination of, whether any credible accident at Argonaut-type reactors could have greater public health and safety consequences than the DBA you analyzed?

e. If the answer to d above is affirmative, please provide said analysis.

4. Precisely why was this particular DBA chosen for analysis?

5. Why, of all the possible earthquake-induced transients and accidents possible at the Argonaut reactor, was a DBA chosen that represents the normal condition of the reactor after shutdown with only two exceptions--reduction in coolant channel width and cutting off of natural air convection?

6. Which specific earthquake-induced possible transients and DBAs did you consider before choosing this particular DBA for analysis. Please be specific as to the different scenarios considered and why they were not chosen for analysis.

7. Why, in the DBA you assumed, did you assume successful operation of the control blades in the earthquake situation?

a. On what basis did you assume the control blades would work?

b. What would have been the effect on your peak temperature estimates had the control blades been assumed to be stuck out-of-core?

c. Please provide all facts, by calculation and reference, on which you base your answer to 7b above.

8. What specific common-mode failures arising from the earthquake did you consider in your analysis beyond the change in coolant channel width and loss of air flow?

a. What was their effect on maximum fuel temperatures?

b. If no common mode failure elements were considered other than channel width and air flow loss, what facts can you produce to indicate that no other failures would accompany a major earthquake at an Argonaut reactor like UCLA's?

9. You say in your study (p. 2): "The core might also be crushed in the vertical direction by falling lead bricks, access plugs, fuel box shielding plugs, or the massive removable concrete shield blocks. These components are interlocked and supported by the reinforced concrete shield. Even though the concrete in the shield may crack and spall, it is difficult to imagine that large displacements could occur that would allow these interlocked components to fall."

a. Did you consider in your analysis the core crushing effects of an earthquake which causes several stories of building above a reactor to fall onto the reactor structure itself?

b. If so, please provide detailed results of such analysis.

10. You say in your study (p. 2): "Any crushing that takes place will tend to 'squeeze the air out' from between the fuel plates so that heat conduction to the surrounding graphite will be improved relative to the uncrushed state."

a. Please state precisely why you believe "any crushing that takes place" will increase conduction.

b. Please state precisely why squeezing the air out from between the fuel plates <u>will</u> improve heat conduction to the surrounding graphite.

c. Please produce all facts, by calculation and reference, including all empirical evidence, that supports your claim.

11. On page 3 you state: "The calculations reported herein include cases with the core crushed laterally so that the coolant gap between adjacent fuel plates is reduced to 50 per cent and 25 per cent of its nominal value."

a. Precisely why are calculations not reported in the study of complete closing of the coolant gap?

b. Would not the temperature in the center-most plates be higher if all the plates were in direct contact? If so, please indicate how much higher temperature, by calculation and reference; if not, please indicate, with all facts and references you can produce to support your answer, why not.

c. Were calculations made but not reported in the study of coolant gap reduction to other than 50% and 25% of nominal? If so, please indicate the coolant gap considered and the calculations and their results.

12. Please describe how the air between fuel plates in coolant channels was included in your homogenized model.

13. What figure for thermal conductivity of graphite did you use, and from what source?

14. In determining thermal conductivity of graphite, did you take into account changes in that conductivity due to radiation damage in graphite? If so, precisely how was that factor taken into account?

15. In determining thermal conductivity of graphite, were changes in that conductivity at different temperatures assumed; if so, precisely how and with what result?

16. You state (p.3): "The fuel plates and coolant channels are not modeled individually in the code because of limitations on computer time and memory. Instead, the core is 'homogenized' bycombining the fuel, structure, and coolant channels, according to their respective volume fractions, into two composite materials."

a. Aside from the question of two versus three dimensionality, which you addressed in the study, how would your results have been altered, had you not been limited on computer time and memory and could individually model plates and channels?

17. On page 8 you state an equilibrium inventory of fission products was assumed. Please give total curies of said inventory, and curie total of the major isotopes.

18. Please indicate the total energy output in terms of heat assumed from decay heat right after shutdown.

19. What percent of operating power is assumed for decay heat at shutdown--give source by reference for said assumption.

20. Show by calculation and reference how you determined that the "fuel plate could be a maximum of 12 K hotter than calculated by the model." (p.9).

21. What temperature diffeerence with the model would there be for the fuel meat of the centermost fuel plate? Please show by calculation and reference.

22. By calculation and reference, please show precisely on what basis you assume the reactor to be at a uniform temperature of 311 K at 100-kw.

23. Was the assumption referred to in 22 above based on operation of 8 hours or so--precisely how long was reactor assumed to have been operating, or does that make a difference in your assumption of 311 K starting temperature? Please explain.

24. What was the fuel meat temperature assumed to be at the start of your assumed DBA, and on what basis?

25. How was the lead radiation shielding worked into your model?

26. Does your homogenized model assume uniform graphite temperature throughout core, uniform fuel temperature, and so on? If so, on what basis is that assumption made?

27. Please explain footnotes a and b in Table I--explain the relationship between coolant gap ½ nominal and void fraction being 75% of nominal.

28. What error bars should be given to your calculated peak temperatures?

29. Please indicate why temperature is lower with smaller coolant channel. Give all empirical data and sources you can to support your argument.

30. Provide all facts, empirical data, and sources you can to support claim at page 11 that crushing the core causes "a decrease in temperature when air flow is not present (because conduction heat transfer is improved)."

31. Is the assumption mentioned in 30 above based on an assumptionthat core crushing sufficient to reduce coolant channels would also bring graphitecloser into contact with the fuel boxes and fuel?

a. If so, please produce all evidence you can to show that vibratory oscillations consequent to earthquakes could not produce an "accordian-type" effect in which one part of the initial oscilation causes compaction of the fuel, but that the graphite comes to rest at some distance from the fuel, reducing conduction.

32. Is the statement that in the typical isotherm shown in Figure 2, the graphite temperature does not exceed 340 K true merely for that isotherm; with other isotherms are isolated portions of graphite at higher terperatures than 340 K?

33. P. 14 states: "It is reasonable to conclude that fuel melting is precluded for the 100-kw reactor under the DBA scenario."

Does your study preclude fuel melting for all credible accident scenarios in 100 kw Argonaut reactors, or merely for the particular DBA you analyzed?

34. You state at the end of your summary, "It is quite possible that refinement of some of the conservative assumptions, such as a three-dimensional rather than two-dimensional model and including the latent heat of fusion, would show that melting would not occur at 500 kw."

a. Are there any non-conservative assumptions whose refinement would show increased melting at 500 kw? If so, please identify them.

b. Are there any non-conservative assumptions about your 100 kw analysis that would show, upon refinement, increased maximum fuel temperatures? If so, please identify them and what their likely effect would be if refined, and the basis for that assessment.

35. You state in your February 11, 1981 letter to Millard Wohl that, "As you know, the release of fission products from the aluminum-uranium alloy plates can occur only after the fuel has melted."

a. Please provide all facts and references you can produce that support this assertion.

36. Why does your analysis assume intact fuel plates after the maximum core crushing possible in a maximum earthquake? What would be the effect (in terms of thermodynamics and in terms of fission product release) if there were significant fuel damage?

37. Did you consider in your model Wigner energy being released by the graphite as it was heated by the fuel's decay heat?

a. If so, please give all calculations and references that indicate the effect on conduction from the fuel by changes in the graphite's heat sink capabilities and conduction to the fuel by the heat given off by the Wigner energy.

b. If not, please give all calculations and references that would indicate the effect on conduction from the fuel by changes in the graphite's heat sink capabilities and conduction to to the fuel by the heat given off by the Wigner energy.

c. In either case, give a numerical value for peak temperature of the hottest part of the hottest fuel plate given a Wigner energy release. To be conservative, consider the Wigner release assuming the maximum operating history permitted under the proposed UCLA license (18.7 MWd to date, plus 36.4 MWd through the year 2000 if license is renewed with current operating limit). If you do not have information given these assumptions, please provide what information you do have available and specify what assumptions were used. Please detail your answer by calculation and reference.

38. Given the hottest fuel plate temperatures you estimate for 100 kw, could:

a. the cadmium control blades melt?

b. the uranium metal--assuming splintering of the fuel--undergo exothermic oxidation?

c. a flammable irradiation sample or sample container in core at time for sample irradiation ignite?

d. the graphite undergo Wigner release?

Please provide, by calculation and reference, all facts you can produce to substantiate your answer to a through d above.

39. Is the uranium fuel for the UCLA reactor an alloy, matrix, or some other combination of Uranium-Aluminum? Please provide what information you have as to the fuel nature and its capacity at various temperatures for fission product release.

40. Were the DBA you considered to occur in conjunction with an earthquake-induced building fire, what would be the maximum fuel temperatures at 100 kw history and would melting occur? Please, by calculation and reference, show all facts upon which answer is based.

41. Were the DBA you considered to occur in conjunction with an earthquake-induced graphite fire of the reactor itself, what would be the maximum fuel temperatures (for a 100 kw reactor) and would melting occur? Please, by calculation and reference, show all facts upon which your answer is based.

42. Were an earthquake-induced reactivity insertion to occur followed by the DBA you analyzed, could melting occur? What would be the minimum reactivity insertion necessary in such a scenario to cause melting in conjunction with the DBA you analyzed. Please, by calculation and reference, show all facts upon which your answer is based.

43. Are you now, or have you been within the last five years, an employee of the Regents of the University of California? Please explain.

44. Do you now, or have you in the past five years, received a paycheck from the Regents of the University of California? Please explain.

45. Do you have personal acquaintance with any of the current or past staff of the UCLA Nuclear Energy Laboratory? If so, please identify each such individual and describe the nature of the acquaintance.

46. What personal knowledge do you have regarding Argonaut reactors?

47. Have you ever been employed at an Argonaut reactor? If so, please give details.

48. Have you ever operated an Argonaut reactor? If so, please give details.

49. Have you ever visited an Argonaut reactor? If so, please give date and details and identify the specific reactor.

50. Please provide a current c.v. or resume and any additional information as to your particular technical qualifications to make the assessments you have in your report.

REQUEST TO NRC STAFF FOR PRODUCTION

Intervenor hereby requests the following documents be produced. These documents can be produced by having copies sent to Intervenor; or they can be made available for inspection and copying at the LPDR. These requests are made pursuant to the Freedom of Information Act as well as the discovery procedures established in this proceeding. Intervenor requests waiving of any copying and search fees, as per the Freedom of Information Act, as the use to which the documents will be put is provision of information to the Atomic Safety and Licensing Board in a matter of reactor safety. Provision of a full evidentiary record for the Board is obviously in the public interest. Furthermore, Intervenor notes that NRC Staff has not charged the other party in this proceeding for documents provided.

The following documents are hereby requested for production:

all licensee event reports for the University of Washington and the University of Florida Argonaut reactors for the period 1970 to the present.

all abnormal occurrence reports from U of F and U of W Argonaut reactors 1970 to present not included in item above.

annual reports for the last three years from both reactors

initial hazard analysis from University of Washington

drawings provided NRC Staff by UCLA in response to NRC Question #1, 4-17-80.

reactor core drawings provided by NRC Staff to G.E. Cort for his study.

AEC letter, Price to Boelter, regarding Argon 41, September 9, 1960

p. 2, inspection report 1963

application for relicensing, University of Washington and University of Florida

inspection reports, 1975 to present, University of Washington and University of Florida reactors

probabilistic risk assessments for research reactors performed by NRC

compilations of statistical data regarding operating performance (# of unintentional scrams, abnormal occurrences, violations) comparing research reactor performance.

current statement of NRC policy regarding consideration of Class 9 accidents in SERs, EIAs, and licensing hearings.

Reg. Guide 1.60

documents detailing results of or status of review of total safeguards requirements at research reactors mentioned in 12 NRC 528, CLI-80-37.

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 SERVICE

I hereby declare that copies of "Intervenor's Discovery Requests as to SER, EIA, NUREG/CR-2079, and NUREG/CR-2198" in the above-captioned proceeding have been served by me on the following by deposit in the United States mail, first class, this 31st day of July , 1981:

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