PANEL III

CORE DISRUPTION AND RELATED ACCIDENTS

Seismic Damage

1. The Hawley study states that the consequences of a core-crushing accident "would be some multiple of the consequences of the fuel-handling accident" analyzed in the study. (p.26). The damage to a single bundle in a severe core-crushing accident induced by collapse of the building above onto the core in a major earthquake would be substantially greater than the damage induced in a fuel-handling accident to a single bundle. Furthermore, one must presume most, if not all of the fuel bundles in a core-crushing accident would be similarly affected. At minimum, then, the consequences would be twenty times as great for a core-crushing incident as for Hawley's assumed fuel-handling incident. *

2. Earthquake-induced structural damage is often accompanied by fire. In this case, the structural damage could expose the core interior to more air than might be availalbe were the core intact, making propagation of fire even easier.

3. The history of tie-bolt failures for the fuel and the unreported finding from the vibration tests of reactivity oscillations due to the severely undermoderated current configuration, particularly with regards coolant channels that are half the optimum width, creates potential for reactivity surges due to bowing or other plate and bundle spacing changes induced by the seismic shock. An earthquake could also readily cause a large negative worth sample to be removed from the core region rapidly, without time for intervention of the control blades to compensate, resulting in a power excursion. (One particularly worrisome scenario would be a large negative worth sample in an irradiation port, the sample being in liquid form in a container which is squeezed or shattered by the compressive forces in the earthquake, rapidly expelling the contents from the core region. In addition to effecting a positive reactivity insertion, if the liquid were a solvent, the reactivity-induced temperature rise could ignite the material.) A seismic jolt could jerk a control blade out of the core, or cause a large object to impact the drive mechanism outside the core, perhaps initiating an excursion.

4. The Argonaut reactor is severely undermoderated. The University of Washington's Argonaut reactor reports that just a small change in the gap betwsen fuel bundles can cause a significant change in reactivity. (see Exhibit C-III-1). At UCLA, it has been determined in addition that the narrow plate spacing within the bundles creates an "extremely undermoderated" situation so that any incident which caused an increase in that plate

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* The Staff attempts to make some comparison to guillotine-type breaks in the fuel. First of all, the fuel is unlikely to shatter in clean, guillotine-type cuts. The jagged exposed surfaces will have substantially more surface area exposed, and therefore result in greater fission product release, than the theorized clean cuts. The fission product release rate from jagged surfaces will not be substantially slower. But more importantly, the assumption of a mere three clean cuts per plate in a severe seismically-induced core-crushing incident is questionable. It is unrealistic to assert that the damage that a severe core-crushing accident, as from a major earthquake which collapsed the building above the reactor onto the reactor core, would produce the same or even less damage than that which could result from a fuel-handling accident to a single bundle.

spacing could create a positive reactivity affect. (see Exhibit C-III-2). Earthquake vibration tests revealed power oscillations caused by the fact that an increase inplate spacing can amount to a positive reactivity insertion. (see Exhibit C-III-3). (The misleading nature of the reference in the Application to the vibration tests is especially serious, not only because it obscures this potential positive reactivity effect, but because the information, if not so obscured, makes clear that the assertion elsewhere in the Application that the reactor is optimally moderated so that any seismically-induced or other rearrangement of the core or fuel would decrease reactivity is simply not correct.)

5. As a result of vibration tests on the reactor, it was determined that reactivity oscillations were detected, traced to the fact that the reactor is substantially undermoderated with its present plate spacing. This would be significant because core distortions, for example, those created in an earthquake or an otherwise non-destructive power excursion involving rapid steam formation and water expulsion, could potentially have the equivalent of increasing plate spacing and thus amount to positive reactivity insertion. Furthermore, an undermoderated core presents the possibility of power excursion through increased moderation being introduced. The Hawley review indicated that up to 18.5%$\Delta k/k$ extra reactivity could result from catastrophic mechanical rearrangement and/or flooding of the core (p.27), but concluded that such perfect rearrangement or complete flooding was not credible. However, with 18.5% available, far less than perfect rearrangement or complete flooding is necessary for a disastrous power excursion, which all the analyses would appear to accept as occurring at least with a 3% insertion, if not considerably less. Thus, flooding from the shield tank, a heavy water tank, broken pipes above the reactor, or the failure of a nearby upstream reservoir could result in a substantial positive reactivity insertion, as could the use of water to fight a reactor fire.

6. The machine room above the reactor contains numerous water sources and piping systems. These pose the potential of leaking directly onto the reactor below, creating an avenue for flooding of the reactor from a pipe break above. These pipes have leaked in the past, flooding the reactor facility and damaging the control panel and related reactor instrumentation. (see UCLA Daily Bruin article, Exhibit C-III-4). Placement of plumbing systems above the reactor seems a poor choice from a safety standpoint. (see p.233 of 1965 operating log, attached, for heavy water leak incident.)

7. The history of control blade difficulties also presents problems. The vibration tests indicate that seismically-induced core-shifting can pin the drive mechanisms. The results were delayed from the vibration tests, but those tests simulated very small accelerations compared to what can be expected in a realistic earthquake. Pinning of control blades, jamming of the dump valve can make reactor shutdown impossible, perhaps with operation at a power level far in excess of the design level which can result in enough decay heat, once the water is boiled off, to result in fuel melting. (Note that Cort concluded that melting could occur simply from seismically-induced blockage of cooling for a 500 kw Argonaut. Note also that the temperature rise for a 100 kw Argonaut could produce fuel ignition and/or trigger Wigner energy release.)

8. Severe core disruption could occur from initiating events other than an earthquake. For example, the means of shutdown in a power excursion,

rapid expulsion of water, generates substantial pressure pulses capable of substantial alterations to the core configuration, even in a power excursion that does not reach the melting temperature of the fuel. If the excursion were very severe, shield blocks weighing several tons could be thrown in the air; the many-ton SL-1 reactor vessel itself was lifted to the ceiling during that excursion, shearing piping as it went.

Fuel Handling Accidents

9. Hawley assumes a 2.7% release of gaseous fission products from a fuel bundle involved in a handling accident. Other than inadequate demonstration that only those fission products one recoil-distance from the exposed surface could be released, the estimate seems reasonable.

10. The Staff appears to assert that its consultant is in error in his estimate and that the true amount of damage to a bundle in a fuel handling accident would be 1/24 of what their consultant calculated. In the absence of empirical data from actual crushing tests on fuel like UCLA's, that assertion is unsupportable and non-conservative. We have commented above on the problems in assuming three guillotine cuts rather than extensive fracturing, splintering, gouging, or shattering of the thin plates.

11. UCLA asserts that only the outer surface of the two outer plates (the equivalent of damage to one of the eleven plates in the bundle) could be damaged in a severe fuel handling accident. That seems unreasonable, particularly for an incident, for example, in which a ten-ton shield block was dropped on the bundle, which is composed of thin plates rigidly bolted. In its design basis fuel handling accident, UCLA further assumes that the fuel has cooled down 21 days before the accident, an unreasonable assumption. Review of UCLA's operating records indicates occasions when fuel was removed from the core only a few days after shutdown (e.g., see p. 215 of the 1965 Operating Log for 4/1-5/65; also, p.455-6, 1963 Operating Log; p. 144-5, 1964 Operating Log; p.446-8, 1964 Log; all attached).

12. UCLA, in addition to assuming only one of the eleven plates is damaged and that its inventory has decayed for three weeks first, also assumes that the fission product release is diluted by 14,000 cubic feet per minute of air as the release is exhausted out the ventilation stack. However, the exhaust system is tied in with radiation monitors to shut down upon a high radiation reading (Application III/4-7), so the dilution assumption is incorrect.

13. Only one form of fuel handling accident has been analyzed in each case, moreover, that of mechanical damage to the fuel plates. Other kinds of fuel handling accidents that need to be assessed include direct radiation exposure, criticality accidents, and contamination incidents during preparation for shipment.

14. Radiation Use Committee minutes for December 22, 1977, at page 2, (Exhibit C-I-5) assert that a mere four seconds of exposure to a person near a fuel cask would result in a reportable incident, and a few minutes for a lethal dose, should the shielding slip. The result of a fuel-handling accident, be it in the reactor room or in unrestricted areas during

transfer for shipment could thus be more significant in terms of direct exposure than release of fission products. (See photos of fuel transfer location in public area, attached to D. Hirsch testimony to the California Highway Patrol about the June 1980 shipment incident. Further, note the unanalyzed potential for public exposure in a fuel handling incident in which fuel prepared for transfer has been accidentally contaminated by a leaking radiation source.)

15. In addition to in-reactor reactivity accidents, possession of the requested amounts of HEU pose potentials for out-of-reactor criticality accidents. This is particularly true in connection with a facility that additionally has had two subcritical facilities, with fuel (in addition to the HEU in the reactor and in storage) and a large quantity (many barrels) of heavy water and graphite for experimental uses. Experiments have already been performed at the facility with fuel bundles in water pools outside the reactor; extensive experiments were performed changing spacing for fuel bundles and determining reactivity effects. More creative experiments can be assumed as the basic reactor physics experiments that can be done with such a reactor have been exhausted. With poor administrative controls, experiments by students involving the fuel without proper prior review or supervision could be dangerous.

Other Fuel Failures

16. The analyses done to date have not addressed the potential for localized fuel melting during operation should some coolant channel(s) be blocked, due to bowing of fuel plates or other blockage of the channel. Nor has there been an analysis of the history of fuel failures for this kind of fuel. UCLA has had such "leaky" fuel (see operating log entry for 4/29/63). MTR-type fuel has had problems related to distortion of plates and subsequent blocking of flow channels, due in part to the tendency of the thin plates to cause an unbalanced hydrostatic pressure in the coolant channels. (See The Technology of Nuclear Reactor Safety, vol. 2, p. 87). Other similar plates have failed due to poor process control in assembly, or melted as a result of restriction of coolant flow by debris from a gasket (ibid., p. 94).

Conclusion

17. As indicated by Mr Hawley in his report, the effects of a core-crushing incident would be some multiple of the effects he has estimated for a fuel handling accident. In our view that multiple is approximately twenty, for severe mechanical damage without large fire, Wigner energy release, or power excursion being triggered. However, there are numerous mechanisms whereby such core disruption could lead to those additional events, in which case the fission product release would be substantially larger.

18. Various fuel handling accidents not addressed in the current analyses--involving direct exposure, criticality accident, or external contamination, for example, during preparation for shipping-- could produce substantial

exposures. And the potential for other fuel failures needs to be reviewed, particularly through examination of experience with similar fuel elsewhere.

19. The UCLA reactor is not inherently protected against mechanical damage. If its fuel is damaged, a radiologically significant portion of the gaseous fission products can escape. If fire or power excursion or Wigner release or some combination is initiated by core disruption, considerably more of the inventory could be released.

CORE DISRUPTION AND RELATED ACCIDENTS

Exhibit List

Exhibit Number	Description
C-III-1	letter, 11/2/81, Univ. of Washington to NRC
C-III-2	abstract of thesis by J.A.Vitti
C-III-3	excerpts from thesis by R.L. Rudman on Earthquake-Induced Vibrations
C-III-4	UCLA Daily Bruin article on water leak, 11/21/79
C-III-5	1963 Operating Log excerpts
C-III-6	1964 Operating Log excerpts
C-III-7	1965 Operating Log excerpts
C-III-8	Testimony of D. Hirsch before California Highway Patrol

UNIVERSITY OF WASHINGTON
SEATTLE, WASHINGTON 98195

College of Engineering
Department of Nuclear Engineering
Nuclear Reactor Laboratory, FD-10

2 November 1981

Director
Division of Reactor Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

RECEIVED
NOV 09 1981
U.S. NUCLEAR REGULATORY COMMISSION

Dear Sir:

Re: Docket No. 50-139
License R-73

In accordance with Section K:1 of the Technical Specifications for the University of Washington Nuclear Reactor this letter is being transmitted. Section K:1 requires a telephone call within one working day to Region V office and a written report in ten days to the Director of Reactor Licensing. This item is for abnormal occurrences as defined in Section J:3 and specifically J:3:b, an uncontrolled or unanticipated change in reactivity.

As defined in J:3:b we may have an unanticipated reactivity change although the explanation seems logical.

In summary, during September and October of this year we changed the fuel-box gaskets. This required removal of the fuel, core graphite and the fuel boxes. During reassembly the fuel elements were returned to the same boxes and positions they occupied originally.

On October 23, 1981 the reactor was taken critical and the excess reactivity was calculated to be 1.052% Δk/k. On October 27 and 29 the calculated excess reactivities were 1.046% Δk/k and 1.055% Δk/k. These values were then compared with original measurements and conditions (no samples). On August 18 and 21 the excess reactivity was 1.182% Δk/k and 1.64% Δk/k. The net change as a result of the unloading and reloading the fuel is therefore approximately -0.12% Δk/k.

Earlier experiments show that a change in the small gap between fuel bundles can cause a change in reactivity. Data taken during the original start-up of the reactor in April 1961 shows a reactivity difference between, 1. all fuel bundles wedged toward the central graphite island (minimum spacing between bundles) and 2. the maximum gap between fuel bundles to be 0.54% Δk/k. In the U. of W. reactor, fuel bundles are separated at the top by an aluminum wedge which maintains maximum separation in one direction at the top of the fuel box. However, there is no positive separation at the bottom except the bolts in the bundles which give a minimum separation of 0.25 inch between

A020
s
1/0

Benson Hall, BF-10 / Telephone: (206) 543-2754

plates on adjacent bundles. The maximum separation between outside plates from adjacent bundles could be 0.55 inch. In the other direction the fuel bundles are separated by a plate support at the bottom of the bundles.

With the wedges in place at the top of the bundles, the bundles are forced to the edge of the box and maintained there. This prevents the bundles from movement within the boxes. From prior operating experience there is no evidence to indicate any movement of the bundles once the wedges at the top are in place.

There are other possibilities to explain this reactivity change. One is that there could be some water in the graphite, which we do not believe is the case. The second is a neutron absorber in the primary water and we do not think this is the case either. The primary water was retained in the dump tank and the specific resistivity is about 10^6 ohm-cm (same as prior operating condition).

The change in reactivity can be accounted for by the possible difference in the positioning of the fuel bundles at the bottom in that they may be closer together in some cases than before. We believe that this is the reason for the unanticipated reactivity change and feel that our operations will be essentially unaffected by the small change.

Another observation should be mentioned. As a result of the water spill in December 1979 we found some corrosion on the outside of the fuel boxes between the aluminum boxes and graphite moderator interfaces where water made contact. This corrosion is the result of a water-graphite-aluminum reaction. Some minor pitting was observed on the outside of the boxes during cleaning; however, none of the boxes showed any evidence of leaking during a static-head leak-test prior to re-installation.

We called Region V on October 23, 1981 and will be meeting soon with the University of Washington Safety Advisory Committee.

Sincerely yours,

W.S. Chalk
Director

WSC:mt

cc: Region V
Safety Advisory Committee

ABSTRACT

OPTIMIZATION OF CRITICAL MASS IN THE URANIUM WATER CLOSE-PACKED LATTICE IN THE ENGINEERING NUCLEAR REACTOR

BY

JOSEPH A. VITTI

The primary objective of this thesis is to find the plate spacing of the fuel elements of the uranium water close-packed lattice in the Engineering Nuclear Reactor that would optimize the critical mass.

The analysis is made in two ways; experimentally, utilizing the Engineering Nuclear Reactor, and with Aim-5, a multiregion, multigroup diffusion equation nuclear reactor code programmed in Fortran for the IBM 709.

The experimental analysis consists of two phases. The first phase involves the variation of spacing of the fuel plates of a particular fuel bundle in the reactor. The second is the calibration of the regulating rod so that changes in its position, resulting from variation of the spacing, could be interpreted in terms of reactivity. Using this information, the maximum reactivity change is evaluated and that plate spacing is determined that would result in minimum critical mass.

CONCLUSIONS

After consideration of the results of the experimental and computer analyses, it is concluded:

1. The present 0.137" spacing of the fuel plates in the Engineering Nuclear Reactor places the uranium water close-packed lattice in an extremely undermoderated condition.

2. A plate spacing of approximately 0.290" would yield the minimum critical mass for the uranium water close-packed lattice in the Engineering Nuclear Reactor.

UNIVERSITY OF CALIFORNIA

Los Angeles

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

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

by

Richard Lee Rudman

Committee in charge:

Professor Craig B. Smith, Chairman

Professor Ralph B. Matthiesen

Professor Robert B. Andrews

1968

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

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

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

1.2 The Approach

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

1.3 Fuel Plate and Bundle Description

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

Reactor shut down by water damage

By Mary Astadourian
Staff Writer

A water leak developed in the control room of the Boelter Hall nuclear reactor over the weekend, causing extensive damage to the main control panel, and rendering the reactor inoperable for a week or more.

An anonymous phone caller told the Bruin about the leak, which started Friday in the de-ionized water tank, and rapidly incapacitated the control room but did not release any radioactive water.

Reactor supervisor Chuck Ashbaugh confirmed the report Tuesday. Ashbaugh explained that two weeks ago the main water pipe in the School of Engineering broke. A temporary pipe was installed but not depressurized.

"This increase in pressure caused the machine that makes purified water for the reactor to leak," Ashbaugh said. He also explained that this water is used for experiments and "doesn't belong to the reactor."

The damage, according to Ashbaugh, is not serious. "Some of the instruments got wet and we're drying them out," he said, adding, "We don't think that anything got burned out, just wet."

Ashbaugh believes it will cost about $500, primarily for labor, to get the reactor operating again.

The anonymous caller blamed the damage on Ashbaugh's carelessness. The caller reported that Ashbaugh discovered

(Continued on Page 11)

Daily Bruin 11/21/79

Reactor . . .

(Continued from Page 1)

the leak on Friday afternoon but called the Physical Plant Office and told them to do it, shut off the water valve, because he did not know how. But he forgot to check and see if they did, the caller said.

Ashbaugh denies this. "Two people from Physical Plant came Friday morning and said that they would take care of the leak — it was just a few drops at the time," he said. Ashbaugh believes the major leak began over the weekend when the reactor was not in operation and when none of the reactor personnel was present. "The custodian found it and told the custodian supervisor, who called Physical Plant," Ashbaugh said.

Ashbaugh said he would allow the Bruin to take pictures of the damage in the Nuclear Energy Laboratory. However, Dean Tom Collins of the School of Engineering refused to allow a Bruin photographer to do so. "You can clarify the incident," said Collins, "but I don't think you need any pictures."

4

4/29/63

#382

0845 Check list satisfied. Loaded Manganese sample in center vertical beam tube for irradiation @ 200 Watts for 10 minutes. (Dr. Pecsok of UCLA Chem Dept

Eo

RUN NO. 382	TIME 0845	SHIM 1 100%
DATE 4/29/63	ROD NO. 1 0903	SHIM 2 100%
OPER. PSJ	AUTO. 0917	SHIM 3 100%
LIC. OPER. JWH	SCRAM 0927	REG. ROD 8%
SAFETY 1 27%	TYPE SCRAM manual	LOG. N 1.7×10⁻⁷
SAFETY 2 27%	FLOW 10 gpm	LINEAR 2.05×10⁻⁷
TEMP. IN 74°F	TEMP. OUT 74°F	HX. TEMP 72°F

Pow Dem 10.9

0917 Executed manual scram.

0930 Removed Mn sample from reactor

1000

During Run No 380, the primary loop deionizers were observed to be reading 110 mr/hr. A spectrometer check of the primary water showed I-132. We are now attempting to isolate the fuel bundle with the leaking plate or plates. After identifying the bundle we will remove it and store it in the fuel storage area. A fresh bundle will then be loaded into the reactor in the position occupied by the old one.

1015

Replace thermal column shield plugs. Remove Rosenfeld cell from south beam port and replace beam port plugs.

[redacted]

4-29-63

1430
Located leaky fuel element (I-A-1); removed element to fuel farm; replaced with fresh element. Fuel loading remains 253 plates.
Deionizers are now down to 0.5 mr/hr. During fuel transfer staff members received the following doses.

Horner : 20 mr
Jones : 10 mr
Jordan : 9 mr

as indicated by pocket dosimeters. Will go critical after replacing top blocks & check reg rod position

1500- This run to check criticality after fuel bundle exchange.
The reactor will be leveled at 1 watt power and standard readings check. This is also an operator training operation.

RUN NO.	363	TIME	1500	SHIM 1	100%
DATE	4-29-63	ROD NO. 1	1548	SHIM 2	100%
OPER	[illegible]	AUTO	1558	SHIM 3	100%
LIC. OPER.	[illegible]	SCRAM	1608	REG. ROD	8%
SAFETY 1	off low	TYPE SCRAM	Manual	LOG. N	0.009%
SAFETY 2	off low	FLOW	10 gpm	LINEAR	1.05×10^{-9}
TEMP. IN	80°F	TEMP. OUT	79°F	HX. TEMP	76°F

Power Dem 10.9

1608 Executed manual scram Standard shutdown.

KWH's to date: 7009.18
KWH's to day: ———
Total KWH's 7009.18

144

3-19-64

1641 Increase oscillator to 50%
reactor level on manual @ 500 watts

1648
Reduce oscillator to 20%

1654
Increase oscillator speed to 60%

1656
Drive Rods Shutdown
Standard Shutdown JLH.

KWH's to date 9681.30
" " day NONE

1700

Noticed that Shim #2 was slow driving down. Raised this rod and pressed "drop rods" switch. The rod stuck at 80% withdrawn. Took shield off rod shaft and twisted shaft with pipe wrench. Rod felt very stiff. Will investigate tomorrow. RJW

3-20-64

Removed top shield blocks. Removed thermal column. Unstacked lead and graphite around #2 blade shroud. Removed shroud cover and observed blade scraping east side of shroud. Bent blade to free it. Blade is no longer touching shroud but still sticks. Conclusion: blade shaft is bound. Will unstack more lead to bare shaft on Monday.

RJW

[redacted]

3.23.64 thru
3.25.64

Partially unstacked lead and graphite and removed blade shroud cover on #2 shim. No binding of any consequence in the shroud.

Unloaded and stored all fuel elements. Unstacked lead and graphite down to level of blade shafts. One brick, which forms part of the shaft alley for #2 shaft, was found to be binding shaft. This has been corrected and #2 shaft is now free. Checking three remaining shafts.

[signature]

3.26.64

No 2 shim and reg rod shaft alleys rebuilt with larger clearances for shafts. NW quadrant of lead shield and external reflector restacked. NW quad lead "roof" now being stacked. Lead now coming out over #'s 1 and 3 ~~blade~~ shafts (10:25 A.M.) Blake

1530

#1 and 3 shim blade shaft alleys rebuilt. SW quadrant of graphite and lead stack rebuilt. Lead walls now going in in NE and SE quads.

[redacted]

446

11-3-64 (Be Sure to Vote)

0800

Console checkout OK

Unload Frasil and Spruny Libby Samples.

#590 Load Nashita soil sample in South horizontal beam port.

Leave Exp. CIC in place

TIME	0800	POWER	10Kw	SHIM 1	100 %
DATE	11-3-64	LOGN	%	SHIM 2	100 %
RUN NO.	#590	LIN	x10^-5	SHIM 3	100 %
TC 1	°F	SAFETY 1	%	REG ROD	%
TC 2	°F	SAFETY 2	%	ION 41	mV
TC 3	°F	POW DEM	40.7	FLU	NA
TC 4	°F	AUTO TIME		SCRAM TIME	
TC 5	°F	PRI FLOW	10gpm	SUPV.	JWH
TC 7	°F	SEC FLOW	5gpm	OPERATOR	T. Zane

0920 unable to go critical - DRD to find out why

0930 Nashita's sample removed from So beam port - attempting start up again

0935 - trying again but reactor will not go critical

0938 - drop rods - #2 indicates still up - Rod drive #2 inspected + coupling link found to be broken - attempting repairs + reloading Nashita's sample in So beam port.

0945 - Unable to operate - all samples removed reactor to standard shutdown.

Tony Zane

[redacted]

0950

Shim Rod # 2 found to be stuck on its down limit. Unable to move shaft with wrench. Run 59 cancelled. Will unload top shield blocks to check Rod #2 visually.

1010

Phoned AEC Compliance - Berkeley Alex Johnson to advise of stuck rod. Will write Dr. Doan DL&R within 30 days.

11.4.64

Allowing reactor to "cool down". Will pull top blocks on Friday.

11.6.64

Unloaded and stored all fuel elements.

11.9.64

Unstacked graphite pedestal. Removed lead from around No. 2 shim shroud. Removed shroud cover. Previous examinat. showed that the coupling connecting #2 shim blade drive shaft to its right angle drive had parted allowing the blade to fall beyond its normal stop position. Examination of the blade showed that this had happened and the blade had jammed in the

shroud. Freed blade using die jack. Reassembled out-of-pile coupling. Re-zeroed position indicating pot. Installing additional steel pin in coupling to prevent recurrence of this problem. Blade and drive now function properly. Restacking north lead wall.

11.10.64

Finished restacking lead. Restacked graphite pedestal.

11.11.64

Preparing to examine 2000 R/hr fuel elements using closed circuit TV system.

11.12.64

Began inspection of fuel and reloading of reactor. Doing standard "approach to critical" experiment. YM vs fuel load plot in supervisor's notebook.

11.13.64

Continue loading. Elements 5-C and 6-B each have one broken bolt.

4.1.65

Rod drop tests on 3/30 @ 2200 showed Rod # 3 dropping slowly compared to other rods (550 msec vs. 330 msec avg. for other three). Suspect inner shaft bearing grease may be congealing due to radiation damage. Reactor will stay down for next three weeks while we look at this.

4-2-65

No Runs. Waiting for short lived fission products to decay before unloading reactor core. Requires approximately 72 hours.

4-5-65

Unstack core shield blocks and unload fuel.

During the fuel handling and core unstacking operations which are now beginning, staff members will necessarily receive more than 100 mrem/week. This will authorize each reactor staff member to accumulate up to 1000 mrem in the next 3 weeks - <u>except D. V. Jones</u>

Jones' exposures will be kept to a minimum by utilizing him in a supervisory capacity.

R[illegible]

[redacted]

4-29-65

1230

A check was made of the surge tank attached to the D_2O tank in the thermal column. A leak was visually detected with about a cup of D_2O on the high bay floor. The leak was cleaned up and resealed. The D_2O on the floor was picked up with absorbent paper and disposed of in Radioactive Waste because of possible tritium contamination. The tank was then removed for inspection, pressure checked and returned to position for tomorrow operation.

1500

Standard Shutdown was executed and all equipment power turned off because of University power being turned off for 4 hrs this evening between 4PM and 19PM to enable the electricians to tie in the new Memorial Activities Center power system.

to date	Kwh	55474.6 Kwh
	Kwh today	300.0 Kwh
	TOTAL	55,774.6 Kwh

JW Horner

[redacted]