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16 to 17 pages 55

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DC 58-1-55

RADIATION TESTING OF SHIELD

SPECIMEN: TEST LTH_x-4

SPECIAL REREVIEW FINAL DETERMINATION	Reviewers	Class.	Date
	BBM	U	12-10-81
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TID- 6249

R. C. Lee

GE-ANPD - ORNL
Oak Ridge, Tennessee

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GENERAL ELECTRIC-AIRCRAFT NUCLEAR PROPULSION DEPARTMENT-CINCINNATI 15, OHIO

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THE RADIATION TESTING OF A LITHIUM
HYDRIDE SPECIMEN: TEST LTH_x-4
CLASSIFIED TITLE

ABSTRACT OF REPORT NO. DC 58-1-55

On September 9, 1957, the Radiation Testing Unit began a 740-hour irradiation of a lithium hydride specimen at 400°F. The sample was enclosed in an evacuated, pressure-tight can; the pressure build-up due to H₂ evolution caused by irradiation was to be measured during the test. However, leaks in the vacuum lines to the lithium hydride capsule admitted air to the specimen, making these measurements impossible. On October 17, 1957, after six weeks in the reactor and a dose of $\sim 2.1 \times 10^{19}$ nvt, the test was terminated and the specimen removed from the reactor. The capsule was disassembled and the LiH sample will be shipped to GE-ANPD, Evendale, for analysis.

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IRRADIATION REQUEST

GEIT NO. _____

TASK NO. 7703

I. GENERAL

A. Title of Test: Code OS-4

B. Purpose of Test: To measure damage of material (powder pressed) at temperatures of (a) 400°F, (b) 600°F, and (c) 800°F

C. Reference: GEIT 465

1. Engineer: Frank H. Welch or Paul Bauer

2. Phone: VA 1-7400, Ext. 542

D. Description and composition of material to be irradiated:

Powder pressed Code OS material with 1/16" void around outside, O.D. 0.940" - 0.125" = 0.815" $\pm$ 0.005" Normal Code OS (Virgin) material

E. Dosage Desired

1. Flux: Flux to achieve equilibrium temperature (a) 400°F (b) 600°F, (c) 800°F

a. Thermal neutrons: 10^{17} nvt

b. Fast neutrons: Time 100 hours or more

c. Gamma: Code Mi flux monitor at interior of and along outside of Code OS material.

2. Facility or Reactor Position: LITR

F. Schedule

1. Date submitted: April 17, 1957

2. Desired insertion date: May 15, 1957

If not possible, use earliest available date

G. Data desired at given test conditions:

Temperature and pressure monitoring over specimen desired. Time and integrated flux.

H. Temperature

1. Continuous monitor or recorder: Yes, Rwf. GEIT 465

2. Operating limits: a) 400°F $\pm$ 5°F
b) 600°F $\pm$ 5°F
c) 800°F $\pm$ 5°F

II. SUPPLEMENTAL

A. Drawing or sketch of in-pile assembly, showing dimensions:

Ref. GEIT Sketch. Primary capsule only unless double capsule needed for cooling or other reasons.

B. Location of all thermocouples attached to the in-pile assembly:

(1) At center

(1) On outer shell

C. Two copies of bench test data taken before reactor insertion:

Bench test required to outgas specimen

Reference: GEIT 465

D. Schematic diagram of circuits both internal and external to the test reactor:

See GEIT 465

E. Schematic diagram of any commercial equipment that may be provided with the test assembly:

None used

F. Identification for any coded test leads or tubes:

All thermocouple leads

III. OPERATING PROCEDURE:

A. Insertion: Normal insertion

B. Operation: Adjust LITR position to obtain correct operating temperature.

C. Removal: Normal removal procedure

- (1) Pull out of flux area for approximately 15 hours
- (2) Pull into cask for storage
- (3) Sever capsule in hot cell
- (4) Remove Code Mi wire for activation
- (5) Post-irradiation examination same as GEIT 465

D. Disposal: Deliver to Hot Cell, Evendale

IV. EXTERNAL FACILITIES:

A. Air: None

B. Water: None

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C. Electrical Power:

1. Volts: 110 volts, 60 cycles

D. Gas: No cooling gas needed

V. A. Possible damage to test Reactor: Negligible if operated within temperature limitation

B. Possible danger to operating personnel: None, if operated according to normal reactor operating precautions

C. List any unsafe operating limits: Temperature of test material should not exceed control temperature of GEIT 465

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TEST LTH_x-4Background

Test LTH_x-4 was the first of a series of three tests to determine the stability of lithium hydride (LiH) under irradiation at moderate temperatures. Because of the highly reactive nature of LiH, it was necessary to design a special capsule to prevent air from coming in contact with the sample during the test. A lithium hydride sample was prepared in an inert atmosphere and placed in a sealed, evacuated container. This can, called the primary capsule, was surrounded by a helium jacket. A positive helium pressure was maintained between the walls of the two capsules during the test. Thus, if the primary capsule started to leak during the test it would be filled with helium from the helium jacket.

Surrounding the helium jacket was a third, perforated metal can through which cooling air passed over the helium jacket. The completed capsule then consisted of three concentric cans, the first two of which were pressure tight. The primary capsule had a small tube attached to it which led to a vacuum pump; the helium jacket had a tube attached to it which led to the helium pressure system, and the cooling air jacket had a tube attached to it through which the exit air traveled. All three of these tubes had to be brought outside the reactor and then extended further, down to the midriff level of the LITR, to where they were connected to the vacuum, helium, and off-gas systems.

The GEIT for the lithium hydride tests called for separate samples to be operated at 400°F, 600°F and 800°F; each sample was to be irradiated for 6 weeks in hole C-48 of the LITR to achieve the desired dosage. Originally, it was planned to incorporate all three of these tests in a single three-stage capsule,

and operate them simultaneously, which would result in a saving of 12 weeks of irradiation time. The LiH samples for the three-stage capsule were prepared and encapsulated; helium-containing jackets and air jackets were heliarc-welded in place around the primary capsules, and the LITR test system was modified to accept the three-sample test. However, during the final stages of completing the triple capsule, which had become quite complex (involving 6 pressure-tight cans and 9 tubes coming from the top of the capsule), leaks were discovered which could not be repaired. The plan to run a three-sample test had to be abandoned as too liable to component failure for a successful in-pile test, and the single capsule for LTH_x-4 was fabricated.

The Test Specimen

The lithium hydride sample used in test LTH_x-4 was prepared in the Y-12 area of the Oak Ridge National Laboratories. The sample was .765" in diameter, 4.0001" long, and had a concentric hole .129" in diameter and 3 1/4" deep drilled in one end. This hole served as a thermocouple well for thermocouple No. 1. A chemical analysis of the sample, also made at Y-12, is shown in Table 1. The sample was slightly contaminated (about 1% each) with hydroxide and carbonate, presumably from reaction with the water vapor and CO₂ of the atmosphere.

The LiH sample was encapsulated at Y-12 in a stainless steel can and weld-sealed. A single access tube was connected to the sample can; then the sample can was evacuated and the access line sealed off. The primary capsule was transferred to the Radiation Testing Unit for further fabrication.

Capsule Fabrication

The primary capsule as received from Y-12 was 1" in diameter and 5" long. The helium and air jackets were added by the Radiation Testing Unit, using type

CHEMICAL ANALYSIS OF THE LITHIUM HYDRIDE

Li (%)	86.14	Cu (ppm)	14
H (%)	12.37	Fe (ppm)	430
C (%)	0.15	K (ppm)	< 40
Cl (%)	0.01	Mg (ppm)	< 60
CO ₃ (%)	0.96	Mn (ppm)	2
OH (%)	0.98	Mo (ppm)	65
Ag (ppm)	3	Na (ppm)	560
Al (ppm)	180	Ni (ppm)	120
B (ppm)	< 100	Pb (ppm)	30
Ba (ppm)	150	Si (ppm)	410
Be (ppm)	< 2	Sn (ppm)	< 20
Ca (ppm)	< 40	Sr (ppm)	< 20
Cd (ppm)	< 20	V (ppm)	< 10
Co (ppm)	< 40	Zn (ppm)	< 1000
Cr (ppm)	19	Nb (ppm)	< 400

TABLE I

Test LTH_X-4

347 and 304 stainless steels, approximately .032" thick. Silver solder was used for all joints and connections because of the trouble experienced with heliarc-welded joints in the three-stage capsule. The helium jacket was 1 1/4" in diameter and 6" long; an access tube, 1/8" in diameter, was attached to the top of the helium jacket. Thermocouple No. 1 was placed in the well of the primary capsule, and the thermocouple leads brought out through the access tube; at the end of the tube, which was about 30' long, the thermocouple was attached to a pair of Kovar seals in a stuffing box. Thermocouples 2 and 3 were also brought out the helium pressure tube. From the outside of the stuffing box, compensated leads were run down to the instruments on the ground level of the LITR.

The air jacket of the capsule was a can 2 1/4" in diameter and 7" long. The bottom of the can was perforated to allow cooling air to pass into the can from the bottom, up along the outside of the helium jacket, and out the exit air line at the top. The exit air line was a 3/8" stainless steel tube, connected to a 3/8" stainless steel hose a foot or so from the capsule. Cooling for the sample was relatively inefficient, since heat had to be transferred from the sample through a vacuum to the primary capsule wall, then through the helium to the helium jacket wall, and finally into the cooling air.

Ten thermocouples were attached to the capsule. Figure 1 shows a diagrammatic view of the capsule, with the three cans and the thermocouple locations. Thermocouples 4 to 10 were taped to the exit air bellows and brought out to the stuffing box in the top flange in the usual way.

The LITR Test System

To accommodate the lithium hydride tests, the LITR test system was modified extensively. Test LTH_x-4 utilized only part of the triplicate system set up for the three-stage capsule, however. Figure 2 shows a schematic of the various piping systems used with LTH_x-4. This system may be compared with the fuel

element test system, shown in Figure 3 in the report on LTL-6 (ORNL 57-2-111).

The primary capsule was connected to a vacuum pump by a 1/8" stainless steel tube. An off-on manual valve was inserted in the line between the pump and the top flange; this valve was closed during most of the test. A Microsyn pressure transmitter was inserted in the system between the valve and the top flange, as shown in Figure 2. The output from the Microsyn was fed into a Brown strip-chart recorder so that a continuous record of the primary capsule vacuum was obtained. For the first week of the test, the wrong Borden tube was used in the Microsyn, and only pressures of about one-half atmosphere and above were registered on the Brown. After the first week of testing, the Borden tube was changed and the complete pressure range, from 0 lbs/sq. inch to 60 lbs/sq. inch (absolute) was shown on the Brown.

An atmosphere of helium was provided surrounding the primary capsule, so that if the primary capsule leaked during the test, helium would be in contact with the lithium hydride specimen instead of air. This was to prevent interaction of the sample with moisture or CO₂ which might be present in the air.

The helium pressure system (Figure 2) maintained a static pressure of helium in the helium capsule; the helium was supplied by a cylinder at a pressure of 38 psig. Helium entered the helium pressure control panel through a manual off-on valve and normally-open solenoid valve #1. Solenoid valve #1 was actuated by pressuretrol #1; if the pressure dropped below 20 psi, the valve opened and admitted He from the cylinder; when the the pressure reached about 30 lbs. the valve closed again. Solenoid valve #2 was normally open straight through. When the pressure became greater than 35 psi in the system for any reason, pressuretrol #2 activated the valve, closed the straight-through path and opened the valve to the off-gas line. After the pressure had bled down to 30 lbs again, the valve returned to its original position. This combination of pressuretrols and valves kept the helium pressure on the system at about 30 psig during the test.

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The cooling air system was quite simple; air from a 100-lb. tank fed by the plant air supply was passed through a dryer, then to a pressure-reducing control panel which governed the inlet air pressure. The air then flowed up to the top level of the LITR and into the large access bellows for hole C-48, down the bellows, up over the test, and out the stainless steel exit air hose. From the exit air hose it entered the off-gas system through a pneumatically-operated flow control valve on the midriff level. The air flow over the test was adjusted, using a pneumatic air valve on the main instrument control panel, to keep the temperature of the test at the desired level.

Reactor Safety

Because of the potential fire hazard presented by LiH, stringent safety requirements were placed on the operation of the test. Reactor alarms were connected to the primary capsule vacuum, the helium pressure (both high and low pressure) and the various thermocouples attached to the capsules. Setbacks were also connected to the thermocouples, the primary capsule vacuum, and low helium pressure (utilizing pressuretrol #3). The test was to be terminated if a major leak occurred in the primary capsule or the helium jacket, or if there were frequent high-pressure alarms or any non-correctable dangerous condition.

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Operating History

Test LTH_x-4 was inserted in the LITR on September 9, 1957. The vacuum pump was connected to the primary capsule and started at 1400 so that the LiH sample would have adequate time to completely de-gas before reactor startup. All other connections were made, and the system tested for leaks and electrical continuity. All the Brown Recorders connected to thermocouples, even the multi-point Brown, were set to give the reactor an alarm at 425° and setback at 450°F.

The reactor began its startup at 1630, but instrument trouble involving the instrument to which T. C. #10 was connected caused the startup to be delayed. At 1800 the trouble had been corrected and the reactor reached 1000 KW. The vacuum pump was turned off and the primary capsule sealed. At this point it became apparent that the test could not be operated in the maximum flux zone of the reactor because the γ -ray and neutron heating in this region generated more heat than could be carried away by the cooling air. To remedy this, the test was pulled up from the maximum flux zone. At 1845 the reactor advanced to 2000 KW; at 1950 the reactor reached full power. During this time the position of the capsule in the flux was adjusted several times; by 2230, a suitable position had been found, with the capsule about 11" above the maximum flux position.

At 0030 the primary capsule vacuum began to show signs of failure; at 0120 there was an alarm on primary capsule vacuum, indicating atmospheric pressure in the capsule. At 0125 the vacuum pump was again connected to the primary capsule and the capsule evacuated. Then the pump was turned off. For the next nine days pressure continued to build up in a regular fashion in the primary capsule and the primary capsule was pumped down each time an alarm occurred, which was about once every eleven hours. The pressure buildup in the primary capsule was at first attributed to a buildup of H₂ pressure caused by radiation, but the magnitude of the effect seemed to indicate that a leak must be responsible.

Also, the pressure continued to build up smoothly regardless of whether the reactor was operating or not, and whether the sample was hot or cold. However, the possibility of H_2 buildup as a contributing factor should not be excluded. During the reactor shut-down periods for the next nine days, various methods were employed to halt the leak which was admitting air to the primary capsule system. On September 19, after tests had shown that the leak was not outside the top flange, the top flange was taken loose from the access bellows and the test pulled part-way out of the reactor. All joints in the vacuum line that could be reached were painted with Glyptol to halt the leak, and the test reinserted. This apparently stopped the main source of air leaking into the capsule, since the next vacuum alarm did not occur until September 28.

There were also bothersome leaks in the helium pressure system during the test. While these leaks did not prejudice the operation of the test, since the helium system refilled each time the pressure fell too low, the numerous alarms which occurred each time the helium system refilled (about 30-minute intervals) were a source of annoyance to the reactor operators. On September 17, an automatic clear mechanism was placed on the helium low-pressure alarm, so that G.E. personnel would not be required to man the test 24 hours a day to clear helium alarms. Later, the helium low-pressure alarm was taken from the reactor safety circuits entirely.

The trouble experienced on startup from T.C. #10 was repaired the next day, September 11, and all thermocouples placed back in use. On September 12 and 13, there was more instrument trouble involving the multi-point Brown and the single-point Brown with T.C. #3 attached. This was repaired September 13, and the alarm taken from the multi-point Brown. Instrument trouble during the remainder of the test was relatively minor.

The effect of the vacuum surrounding the LiH specimen on the cooling effectiveness of the air flow was shown by the reaction of T.C.'s 1, 2 & 3. As the pressure inside the primary capsule built up, the heat transfer from the LiH sample improved and the temperature of T.C. #1 dropped. When the vacuum pump was connected to the primary capsule, and the capsule evacuated, the heat transfer from the sample was spoiled and T.C. #1 increased in temperature; since there was less heat reaching the helium jacket, T.C. #3 dropped. T.C. #2, located on the primary capsule nearest the LiH, usually did not change much. As soon as the vacuum pump was turned off, T.C. #1 began to drop at once, then settled down to a gradual temperature decrease as the pressure slowly built up. This effect is mentioned in the log sheets, p. 5 & 6, but the pressure buildup is known to be a leak instead of H_2 accumulation and the effect on helium pressure was not consistently observed and can probably be discounted.

The most significant period of the test is the time from September 19 to 28, during the period of small leak rate into the primary capsule. This rate of pressure buildup is the maximum which can be attributed to gases given off by the sample, either as a direct result of radiation damage or as a result of reactions induced by the presence of air in the primary capsule.

On October 17, 1957, at 1345 the reactor went down and the test was terminated. The test had operated for 743.7 hours at full reactor power. The capsule was pulled from the reactor and stored until it can be opened and the contents shipped to GE-ANPD, Evendale, Ohio.

A cobalt flux monitor was included with the test and will be counted after the test is disassembled to give an accurate dose measurement. The flux on the test is difficult to estimate since the capsule was not in the maximum flux zone; also the reactor loading was changed during the test with an accompanying

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change in flux. However, assuming a perturbed flux of 8×10^{12} neutrons/cm²/sec, the dose received by the test was 2.1×10^{19} nvt.

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TEST LTH_x-4

Log Sheets

Please note that several of the conclusions reached in the log sheets were modified by later events--for example, the deductions concerning the location of the primary capsule system leak at the top of page 8.

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TASK 7123FACILITY LITR

C-48

EXPERIMENT NAME LT-HX-4PERSON RESPONSIBLE R.C. Lee

9-10 1200 Modified LITR system to accept LH test.
1400 Inserted test and made connections. Attached vacuum pump and started to evacuate primary capsule. Attached helium system and set Pressuretrols for control and safety. Leak tested entire system. Alarms and setbacks as follows:
All thermocouples - Alarm 425° setback 450°
Pressuretrol 1 - Alarm below 20 psi He
Pressuretrol 2 - Alarm above 35 psi He
Pressuretrol 3 - Setback below 4 psi He
Primary Capsule Pressure - Alarm - Opsig Setback - 5 psi g
T.C. #1 on Circular Brown controller; T.C. #2, 3 & 10 on single-point recorders; all others on multi-point.
1625 Alarm & safety panel checked with control room.
1630 Reactor starting up 1635 T.C. #10 opened up, giving reactor (at N₆) a setback.
1740 Thermocouples changed; reactor going up. T.C. #10 removed from circuit due to mal-function of recorder; T.C. #9 in use on single-point as metal shell thermocouple; T.C. #3 on multi-point.
1800 Holding at 1000 K.W. reactor power to stabilize temperatures. Vacuum pump cut off.
1830 Pulled capsule up about 6" to reduce temperature.
1845 Reactor went up to 2000 KW and held there.
1946 Pulled capsule up about 5 more inches; reactor started up again.
1950 Reactor at full power - 3000 K.W.
2015 position of capsule adjusted downward to bring temperature near 400°. Estimated position of capsule = about 10" from maximum flux zone.
2230 Capsule again adjusted upward about 1".

TASK 7123FACILITY LITR C-48EXPERIMENT NAME LT-Hx-4PERSON RESPONSIBLE R. C. Lea

- 9-11 0030 Pri. capsule vacuum reads 1.5 mv & increasing
0120 Alarm on pri. capsule vacuum.
0125 - primary capsule vacuum reached 1.6 mv. Opened valve between pump & pri. capsule system for approx. 30 sec. Test could not continue to operate with pri. capsule pressure increasing. Pressure buildup could be caused by:
1. Release of H_2 from sample
 2. Sample not completely degassed at startup
 3. Leak from helium system into primary system
 4. Leak from atmosphere into primary system
- (1) is improbable - no change indicated in sample cooling rate.
(2) or (3) are most likely.
- 0140 Reactor power fluctuating
0735 Switched air dryers. Helium supply = 1400 psi.
- 9-11 0940 - Primary capsule vacuum reached 1.5 mv. Opened valve started pump same as before. When pump started, alarm was received and was cleared. Temp. of #2 T.C. dropped 10°. A change in temp. in T.C. #1 & 2 were noted. Vacuum valve closed at 1005. (Pump was left running continuously).
1115 Thermocouples traced and all thermocouples placed back in use (recorder repaired). T.C. #10 had been mislabelled #9; T.C. #9 had been mislabelled #8; however, there should be little difference in the temperatures of these three thermocouples.
- 9-11 1900 Primary capsule vac. alarm at 1.4 mv. (14 on scale).
Opened valve to vacuum pump - alarm clear.
1915 Primary capsule vac. valve closed - He supply 1400 psi.
T.C. #1 & 2 Temp increased about 10°F during primary capsule evacuation. Dropped back to normal after valve between vacuum pump & pri. cap. was closed.

TASK 7123FACILITY LITR C-48EXPERIMENT NAME LT HX - 4

PERSON RESPONSIBLE

9-12 0010 - Helium supply pressure 1400 psi - switched air dryer
marked charts

0613 - Primary capsule vacuum alarm

0618 - pumped out for 30 sec. alarm cleared

0630 - Reactor going down for 5th hour - scheduled - 11B-5

9-12 1037 Reactor started up - 1049 Reactor at N₂
Reactor Full Power at 1110.

1020 Primary Capsule vacuum reached 1.4
gauge valve to vacuum pump

Helium Supply 1400 psi

1825 - High Temp (425°F) Alarm TC #1 - Shut off
vacuum pump valve - Alarm Cleared 1828

TC #2 Temp jumped from 230°F before opening
vacuum valve, to 250°F after opening it.

TC #1 showed a 20°F increase, TC #3 about 10°F.
2300 - Misc. Temperature alarm all points to
max scale. Alarm Cleared when instrument
dial was opened.

2305 - Set back - Misc temp instrument

2330 - Reactor at full power - Misc Temp still in
Alarm Condition.

9-13 0030 moved alarm point on misc temp recorder to full scale

0120 received setback (warning) from TC-3 - it indicated on TC-10
on safety panel

0445 - switched air dryer - Helium supply - 1395 psi
pri capsule vacuum - 0.5 mv

* 0505 - set back from TC-3 * Appear to be instrument trouble

0512 - three setbacks from TC-3 - turned off chart drive

0540 - pumped pri capsule for 30 sec. Temp on TC1 & TC2
increased

TASK 7123FACILITY LITR C-48EXPERIMENT NAME LT-HK-4PERSON RESPONSIBLE R. C. Lee

9-13 0900 Reactor down; instruments being worked on.
 Miscellaneous temp. Alarm inactivated.
 0950 Reactor starting up. 1000 Reactor at N.
 1015 Reactor at full power 1450 He low pressure
 alarms are becoming more frequent; from more than
 1 hour between alarms to about 40 minutes.
 1530 Primary capsule vacuum building up
 1625 Primary capsule vacuum at 0.4 mv. Pumped 30 sec.

9-14 0220 switched air dryer
 0327 Primary capsule vacuum alarm
 0333 pumped pri. caps. for 30 sec. alarm cleared
 helium supply pressure 1390 psi
 0715 Helium supply pressure 1390 psi * there is a slight leak
 at the point where the valve enters the helium cylinder

9-14 1330 primary capsule vacuum building up.
 1443 Primary capsule vacuum alarm
 1445 Pumped primary capsule for 30 sec. alarm clear
 TC#1 increased 10°F and TC#2 increased ~20°F while
 capsule was being pumped

9-14 2148 Reactor Down, N.
 2200 Adjusted air flow to bring TC#1 up to temperature
 2209 Reactor Power 800 Kw
 2210 Reactor Power 1200 Kw
 2220 Reactor at Full Power
 2232 TC#1 at 390° - after much juggling
 2245 TC#1 at 400° - after dipping to 380°
 2250 TC#1 increased to 410° - now going down
 2315 TC#1 at 390° - steady with flow (manual)
 at 4 on the gage.
 2355 Air gage for TC#1 increased to 5

9-15 0047 primary capsule vacuum building up.
 0154 PRIMARY CAPSULE VACUUM ALARM
 0156 Pumped primary capsule for 1 min. Alarm clear.
 T.C.'s #1, 2, 3 INCREASED SLIGHTLY AS BEFORE BUT CAME BACK TO ORIGINAL POSITION.

TASK 7123FACILITY LIFRC-48EXPERIMENT NAME LT-H-4PERSON RESPONSIBLE J. LEE

9-15 When primary capsule was pumped down alarm was received on low He. Press. This indicated small hole or leak in primary capsule. Alarm on low He. Press. was 20 minutes too soon. Next alarm was regular, 31 minutes. This happening should be watched closely.

9-15 0220 Temp started to drop slowly decreased main valve position 5%.

0231 Temp started to increase slowly.

1200 Primary capsule vacuum building up.

1218 Low He pressure alarm. Started vacuum pump before primary capsule alarm. Temperatures of T.C. #1 & 2 went up about 20° each. Primary capsule vacuum = 1.2 mu at starting of pump.

1225 Increased air flow over sample to full flow.

1228 Alarm from T.C. #1 (425°)

1237 Cleared alarm. Vacuum pump still running low He pressure Alarm.

1245 All T.C.'s below previous readings except T.C. #1, which is 20° higher (420°).

1256 Alarm from T.C. #1 (425°). Temperature on this T.C. did not decrease appreciably when more air was added, and has been creeping up ever since.

1309 He Low pressure Alarm - now back to normal interval.

1311 Vacuum pump turned off. Temp. on T.C. #1 began to drop almost at once.

1314 Alarm on T.C. #1 cleared. Temp = 415° F. falling.

The following explanation of the test actions is proposed: The LiH sample, under the influence of heat and radiation, slowly releases H₂ into the vacuum between the LiH sample and the primary capsule. The sample is heated by X-ray and neutrons, and this heat is transferred to the wall of the primary capsule by the rarefied gas surrounding the sample. There will be little transfer of heat by radiation, since the LiH specimen is only

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TASK 7123FACILITY LITRC-48EXPERIMENT NAME LT-Hx-4PERSON RESPONSIBLE R.C. Lee

9-15 slightly warmer than its surroundings. As the pressure builds up, approaching 1 atm. and the alarm point, heat transfer gets better and the amount of cooling air over the sample may decrease. The cooling air removes heat from the He jacket, which removes heat from the primary capsule wall.

When the primary capsule is connected to the vacuum pump, the vacuum increases and the heat transfer from the LiH to the capsule wall is spoiled; the LiH sample should get hotter (as indicated by T.C. #1). At the same time, the amount of heat being transferred to the helium decreases, so the He temperature should decrease (as indicated by T.C. #2, 3, & 4). Since the He system is at constant volume, this means that the He pressure will also decrease. This causes the low-pressure He alarm to sound early (an interval of 10-15 minutes instead of 30 minutes). If a leak caused the early He alarm, continued operation of the vacuum pump should produce other short-interval alarms, and this is not the case.

When the vacuum pump is disconnected, there is a buildup of H₂ pressure, initially rapid, which permits T.C. #1 to drop in temperature. Then as the pressure continues a slow buildup, the temperature of all T.C.'s will creep downward.

9-15 1925 - Adjusted Cooling air to 10% of Max.
2335 - Primary Capsule Vacuum started up scale. Air Control opened to maximum, (16% flow)
2345 - T.C. #1, 2 & 3 are about 20° lower. Primary Capsule Vacuum = 0.15 mv. (20° Rise in #2 Noted)

9-16 0110 Primary Capsule Vacuum alarm - opened valve to pumps. Alarm Cleared - T.C. #1 went up, #2 + 3 went down. - Closed ^{Vacuum} valve at 0143. - T.C. #3 went up, then #2 began to rise. - #1 leveled out 385° and then at 0145 it began to drop.

9-16 0157 Adjusted Air to bring #1 to 400° (to 12%) at 0212 adjusted to 10% - adjusted air at 0237 to 9.5% 0244

TASK 7123

FACILITY

LITR C-48

EXPERIMENT NAME

LT-H_x-4

PERSON RESPONSIBLE

R.C. Lee

- 9-16 1210 Primary Capsule vacuum building up; air flow increased.
 1300 Temperature of T.C. #1 has dropped 30°. Sample cooling appears to be getting more efficient.
 1330 Primary capsule vacuum alarm. Started pump; He pressure on gauges undisturbed.
 1332 Pushed alarm reset button to clear vacuum alarm; low He pressure alarm resulted; pushed button again to clear He alarm.
 1335 T.C. #1 & 2 have gone up; T.C. #3 has gone down.
 1345 T.C. #2 has returned to previous value. T.C. #1 still high.
 1402 He low pressure alarm after normal interval (30 min.) vacuum pump shut off.
 1415 T.C. #1 temp. has dropped.
- 9-16 1645 - ~~In~~ Decreased flow to TC #1 to bring up to 390°
 1655 - As a result of the decreased flow, the temperatures of TC # 2, 3, 5, 6 & 7 have also increased. The flow is at 7 on the dial - (Completely closed is at 17 on the dial.)
 2230 - Marked Charts
- 9-17 0045 Primary Capsule vacuum building up - air flow increased to 10%. T.C. #13 dropped 20° - #2 dropped 15°. Primary capsule ^{vacuum} alarm at 0133. Opened valve - He pressure undisturbed - cleared vacuum alarm TC #1 went up, #3 went down #2 went up and then gradually went down to approximately its original position before valve was opened.
- 9-17 Adjusted air flow to about 7% at 0145.
 Temp. On T.C. #1 continued to rise until vacuum valve was ~~was~~ closed then dropped off. - 39 min. between He Pressure Alarms at 0125 to 204.
- 9-17 0600 Reactor Going Down For 8 hrs.

TASK 7123FACILITY LITR C-48EXPERIMENT NAME LT-Hx-4PERSON RESPONSIBLE R.C. Lee

9-17 1100 Completed minor changes in apparatus: Set Microsyn pressure transmitter & Brown to read entire pressure scale (0-20 lbs absolute); provided automatic clear for He low pressure alarm.

1400 Primary capsule vacuum building up; air admitted to 1 atm. pressure; cooling air pressure back to 0.

1430 No pressure buildup beyond 1 atm., which means that there is no leak from the helium system.

Air pressure built up to 50 lbs; still no increase in pressure, meaning that there is no leak into the LiH capsule system inside the access bellows.

1510 Reactor starting up to N_2

1520 Reactor at N_2 - starting pump on pri. capsule reactor going up - switched air dryers

1530 Reactor at 2000 Kw - will remain at this level for 1 hr

9-17 1744 Reactor going down to N_2 from 2000 Kw level

1810 Painted connections on midriff with that red GOOP!

1841 - Primary Capsule vacuum reading 9 on scale or 4 psia from the chart.

2056 - Reactor at N_2 & going to 200 Kw.

2058 - 200 Kw 2102 - 600 Kw 2104 1000 Kw

2100 - 400 Kw 2103 - 800 Kw

2109 - 2000 Kw

2114 - 3000 Kw - full power

2126 - Alarm on TC^{#1}, Cleared at 2130 after increasing flow to 56[#] and 20% and opening valve below TC^{#1} recorder wide open.

2230 - Set flow to 6 on the gage to try to adjust TC^{#1} to 390°

9-18 0145 Adjusted air to 8% to maintain air 400° T.C.^{#1} topping. 0155 adjusted to 8.5% Temp. Overshooting. - 0217 adjusted air flow to 9%

0222 Primary capsule vacuum reading 24.5 set air flow to take care of about 20° rise (14%)

T.C. dropped from 390° to 380°

TASK 7123FACILITY L I T RC-48EXPERIMENT NAME LT-HA-4PERSON RESPONSIBLE R.C. Lee

9-18 Primary Capsule vacuum alarm at 0240 -
 Opened vacuum pump valve - Helium pressure
 not affected - T.C. #1 rose about 20°, #2 rose
 about 20° quickly then dropped about 25° slower, #3
 dropped about 5°
 0300 Vacuum went to negative pressure according
 to graph ^{long low pressure alarm 0311} - Valve open at 0318. Pressure in
 primary capsule rose immediately and the Temp. in
 TC #1 dropped. #2+3 began to rise. ^{flow} Discharge
 adjusted to 10%.
 0509 Low Pressure alarm at long interval (2.9 min.)
 0744 Low Pressure alarm at short interval (1.5 min.)
 0918 Heard a short Buzzer alarm but no alarm lights were
 out.
 0932 Heard short Buzzer alarm but saw no visual alarm
 0956 Another short Buzzer alarm everything else normal
 1020 " " " " " " " " " " " "
 1044 " " " " " " " " " " " "
 1109 " " " " " " " " " " " "
 1133 " " " " " " " " " " " "
 1152 Reactor going down.
 1405 Primary vacuum alarm
 1425 Opened Primary Vacuum Valve
 1445 Closed
 9-18 1613 - Reactor at 1000 Kw
 1618 - 2000 Kw
 1623 - Reactor at full power
 1630 - Went to X-pile to change wire on oscillator
 1830 - Finally got oscillator ☐ed away
 2045 - Painted with that GOOD on the midriff.
 8-19 ~~1122~~ ²⁰²⁴ - Primary Capsule Alarm - opened valve
 T.C. #1+2 began to rise - #3 dropped - 0026
 adjusted air flow from 9% to 13% to compensate
 for the rise in Temp. TC #1+2 began to drop
 quickly - #1 leveled out & continued to drop. - Long Low Pressure alarm
 at 0051.

TASK 7123FACILITY LITRC-48EXPERIMENT NAME LT-Hx-4PERSON RESPONSIBLE R.C. Lee

9-19 0056 Adjusted Air Flow to 11% - 0100 negative ^{absolute} pressure reading according to graph. 0109 - Valve Evacuated closed.
0114 Air flow adjusted to 10% - Painted ^{vacuum} tubing with Glyptol

0131 Reactor setback to N_h by HB-3
0139 Reactor starting up.
200 KW - 0145
Time
0146 - 400 KW
0148 - 600 KW
0149 - 800 KW
0152 - 1000 KW
0153 - 1200 KW
0154 - 1400 KW
0155 - 1600 KW
0156 - 1800 KW
0157 - 2000 KW
0158 - 2200 KW
0159 - ~~2000~~ KW 2400 KW
0200 - 2600 KW
0201 - 2800 KW
0203 - 3000 KW Full Power

0243 Adjusted Air to about 8% flow
0645 Short Low Pressure alarm interval

0700 Reactor going down for 2 hours for experiment to be installed in C-44

0800-1200 Attempted to find leak in primary capsule vacuum system. Eventually, pulled off top flange and put glyptol on inside joints which could be reached.

1220 Reactor starting up.
1234 Reactor at full power; vacuum pump on.
1303 Turned off vacuum pump.

TASK 7123FACILITY LITRC-48EXPERIMENT NAME LT-HX-4PERSON RESPONSIBLE R.C. LEE9-19 1825 - Adjusted air pressure from 48[#] to 50[#] on panel1827 - Adjusted flow below TC[#]1 Brown to 7 in order to increase Temp on TC[#]1 to 400°1902 - Alarm on HB-3 reactor set back to N₂

2118 - Reactor starting up

2146 - 200 Kw { had to wait on HB-6 pump }

2155 - 1000 Kw

2205 - 2000 Kw

2216 - 3000 Kw full power

Reactor down 2 hrs. & 42 min approx.

9-20 0517 changed chart on TC [#]100726 changed chart on TC [#]3

0735 changed chart on Reactor Power

1300 Reactor going down

1440 Switched to small flow reactor.

1450 Switched back to big flow reactor.

1608 - Reactor starting up.

1625 - 2000 Kw

1636 - 3000 Kw - full power

2340 - pen on prim. cap. vac. jumping around on about 0.5 range on the scale.

9-20 2345 - Low He pressure alarm about same as before - 25 min. (more or less). I caught it two times, 1645 - 1711 = 26 min and 1846 - 1910 = 24 min. Bad

9-21 0330 adjusted air flow to 8.5%

0722 The time interval between Low Helium Alarms was checked each reading on every 2 hr approx and averaged 23 min between alarms.

9-22 0030 Operation is normal.

0230 Operation is normal.

720 029

TASK 7123FACILITY C-48 LITREXPERIMENT NAME LT-Hx-4PERSON RESPONSIBLE R.C. Lee

9-22	2100 - Changed dryers, Adjusted Mainline air flow to increase temperature of TC#1.
	2230 - Standardized circular Brown recorder.
	2300 - Operation is normal.
9-23	0100 - " " "
	0300 - " " "
9-24	Purged dryers & standardized circular Brown recorder
	0600 - Reactor down (Later) Reactor up
9-25	0000 - Changed dryers & Standardized circular Brown
9-26	0930 - Reactor down
	1412 Reactor started up 1426 Reactor at full power.
9-28	0923 Pumped primary capsule vacuum down; reading at start = 21.8
10-1	0300 Reactor down.
10-2	0830 Reactor still down.
10-3	1300 Reactor still down
	1645 Reactor starting up
	1730 Alarm from T.C.#1; Reactor at 2000 KW.
	1800 Air flow over capsule increased. Cooling does not appear to be as efficient as formerly.
	2010 ADJUSTED REOS
10-4	0515 Adjusted Air Flow to about 9.5% from 18% Power level is 307 ^{HAS BEEN} 20 ^{HAS BEEN} ACCONST most of this shift.
	0534 Adjusted Air Flow to ~6.5% of MAX
	Power adjusted - cut ~100 KW @ about 0550 adj air flow to ~5%
	0710 adjusted air flow to ~4.5%
	0900 Reactor loading was changed during long shutdown, increasing flux and making sample hotter.
	0935 Reactor down
	1100 Reactor starting up 1140 Reactor at full power.
	2030 REOS ADJUSTED, FOLLOWED BY AN INCREASE IN TEMP. ON ALL THERMOCOUPLES.
	2045 ADJUSTED MAIN VALVE POSITION TO 41 FROM 50.

7123

FACILITY C-48

L T T R

PERSON RESPONSIBLE R.C. Lee

10-6	1130 Turned on vacuum pump & pumped down primary capsule.
	1135 Turned pump off. T.C. #1 has gone up, T.C. #2 & 3 down
	1140 T.C. #3 jumped up-scale and gave an alarm; cleared almost immediately. Also, short (140KW) setback.
10-8	Reactor Down at 0730 (Later) Reactor up
10-10	1240 Turned on vacuum pump & pumped down primary capsule, Reading at maximum = 24.
	1245 Turned pump off. Rdg. = 2.5
10-11	1515 Turned on vacuum pump, rdg. = 12.0 at start.
10-11	Pumped primary capsule down. Rdg. = 2.4 at finish.
10-14	1230 Pumped primary capsule down. Rdg at start = 23.0 Rdg at finish = 2.3
10-15	0600 Reactor down 1500 Reactor going up.
10-17	1343 Reactor starting down. 1355 Reactor down.
	1400 Test pulled out of flux zone; vacuum pump connected to primary capsule and left on. Helium pressure reduced to 0. Total running time = 743.7

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED

03 1204 1030

1249

020

TEST LTH_x- 4DATA SHEETS

Running Time: Represents time with reactor power above 500 KW

Reactor Power: Measured in kilowatts; full power is 3000 KW

Thermocouples: All temperatures in degrees Fahrenheit

Primary Capsule Vacuum: The reading directly from scale of Brown Instrument; converted to pressure by use of calibration graph.

Before installing an instrument to read absolute pressure (p. 9), the Brown gave a reading only when the pressure approached atmospheric; hence, there are a number of single entries in this row at times just prior to pumping down the primary capsule.

The Microsyn was uncalibrated during this part of the test.

Primary Capsule Pressure: Reading from the calibration graph for Primary Capsule Vacuum to give lbs/sq. inch (absolute)

Main Line Pressure: Reading in pounds per square inch (gauge)

Main Line Flow: Reading in percent of Flowrator capacity, using large Flowrator

Temperature: Reading in degrees Fahrenheit of inlet air temperature

SCFM: Reading is standard cubic feet per minute, using main line flow (%) and main line pressure (psig) with a conversion graph.

Experiment LT-HA-4 Task No. 7123

Date In 9-10-57

Operator	DBS	DBS	DBS	RCL	RCL	AHH	AHC	AHC	AHC	AHC	DBS
Date	9-12	9-12	9-12	9-12	9-12	9-12	9-12	9-12	9-12	9-12	9-13
Time	0130	0330	0630	1215	1340	1500	1730	1845	2030	2230	0130
Running time	31.6	33.6	36.6	37.9	39.3	40.7	43.2	44.4	46.2	48.2	51.2
Reactor Power	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
T.C. #	1	405	405	325	395	400	400	390	395	400	400
	2	272	270	200	240	245	240	235	238	238	238
	3	290	290	245	290	300	295	295	290	290	290
	4	115	115	102	115	120	110	105	105	100	*
	5	165	165	148	165	165	165	162	160	160	-
	6	185	185	158	185	190	190	185	180	178	-
	7	185	185	158	185	190	190	185	180	178	-
	8	100	100	100	100	105	100	100	100	100	-
	9	100	100	100	100	105	100	100	100	100	-
	10	105	105	105	110	110	105	105	100	100	100
Pri. Cap. Vac.	0.0	0.0		0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Main Line Press.	50	50		50	50	50	50	50	50	50	50
" " Flow	13.5	13.5		13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
Temp.	63	61		67	65	64	64	64	64	64	65
SCFM	14	14		14	14	14	14	14	14	14	14
* Multi-Point Brown Recorder out											

Experiment LT-H₂-4

Task No. 7123

Date In 9-10-57

Operator	DBS	DBS	DBS	RCL	RCL
Date	9-13	9-13	9-13	9-13	9-13
Time	0300	0530	0700	1100	1320
Running time	52.7	55.2	56.7	59.6	61.9
Reactor Power	3000	3000	3000	3000	3000
T.C. #	1	400	395	380	380
	2	238	234	233	235
	3	290	*	-	285
	4	-	-	100	100
	5	-	-	160	160
	6	-	-	180	180
	7	-	-	180	180
	8	-	-	100	100
	9	-	-	100	100
	10	100	100	100	105
Pri. Capsule Vac.	0.0	1.36	0.0	0.0	0.0
Main line Press.	50	50	50	50	50
" " Flow	13.5	13.5	13.5	13.5	13.5
Temp.	61	65	61	65	63
SCFM	14	14	14	14	14

*T.C. # 3 out while Brown being repaired.

Experiment LT-HX-4

Task No. 7123

Date In 9-14-57

[illegible]

Experiment LT-HX-4

Task No. 7123

Date In 9-10-57

~~SECRET~~

Operator	RCL	RCL	RCL	RCL	RCL	HHH	HHH	HHH	HHH	HHH	HHH	HHH	
Date	9-15	9-15	9-15	9-15	9-15	9-15	9-15	9-15	9-15	9-15	9-16	9-16	9-16
Time	1000	1200	1250	1430	1600	1800	2000	2200	2330	0030	0230	0400	
Running time	106.3	108.3	109.1	110.7	112.3	114.2	116.3	118.3	119.8	120.8	122.8	124.3	
Reactor Power	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	
T.C. #	1	390	400	420	390	385	390	400	400	400	370	385	390
	2	250	260	240	240	235	255	258	255	258	225	245	250
	3	310	315	300	300	300	310	320	320	320	285	300	305
	4	120	130	120	120	120	120	120	120	120	100	115	115
	5	180	190	170	175	170	180	190	190	190	155	180	185
	6	200	205	185	185	185	195	210	210	210	170	190	200
	7	200	205	185	190	185	200	210	210	210	170	195	200
	8	100	110	110	110	100	100	100	100	100	95	95	95
	9	100	110	110	110	100	100	100	100	100	95	95	95
	10	105	110	110	110	105	105	105	105	105	100	100	100
PRIMARY CAPSULE VACUUM		0.0	.85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
MAIN LINE PRESS.		50	50	50	50	50	50	50	50	50	50	50	50
" " FLOW		10.0	10.0	14	14	14	12	10	10	10	16	10	9.5
TEMP.		61	62	62	63	63	63	61	60	59	60	61	59
SCFM		11	11	15	15	15	11.5	10.5	10.5	10.5	18.5	10.5	10.0
				</									

[illegible]

649 C40

Experiment LT-H_x-4Task No. 7123Date In 9-10-57

Operator	HXX	HXX	HXX	RCL	RCL	RCL	BG	BG	BG	BG	HXX	HXX
Date	9-16	9-16	9-16	9-16	9-16	9-16	9-16	9-16	9-16	9-16	9-16	9-16
Time	0500	0700	0910	1100	1300	1510	1700	1900	2100	2300	0030	0100
Running time	125.3	127.3	129.5	131.3	133.3	135.4	137.3	139.3	141.3	143.3	144.8	145.3
Reactor Power	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
T.C. #	1	2	3	4	5	6	7	8	9	10	11	12
	390	385	410	400	370	390	392	388	388	390	390	375
	250	250	264	260	230	250	257	256	254	260	260	245
	305	305	325	320	285	310	310	308	318	321	320	300
	115	115	125	120	110	115	118	118	118	122	120	115
	185	185	200	190	160	185	192	192	193	197	195	175
	200	205	215	210	180	200	210	209	210	212	215	190
	200	205	215	210	180	200	210	209	210	210	210	195
	95	95	100	100	100	100	98	98	98	98	100	100
	95	95	100	100	100	100	98	98	98	98	100	100
	100	100	105	100	100	100	102	103	103	103	103	100
Primary Capsule Vacuum	0.0	0.0	0.0	0.0	.9	0.0	0.0	0.0	0.0	0.0	0.0	0.9
Mainline Press.	50	50	50	51	50	50	52	50	50	51	50	50
Mainline Flow	9.5	9.5	9.5	~7	12	10	7	7.5	7	7	7	10
Temp.	59	57	78	64	62	67	64	64	64	64	64	64
SCFM	10.0	10.0	10.0	~8	13	11	~8	8	~8	~8	7.5	10.5

SECRET

Experiment 4T-H_x-4 Task No. 7123 Date In 9-10-57

COPY

Operator	HXX	HXX	HXX	BG	BG	BG	HXX	HXX	HXX	HXX	MPR	MPR
Date	9-17	9-17	9-17	9-17	9-17	9-17	9-18	9-18	9-18	9-18	9-18	9-18
Time	0300	0500	0555	1700	2200	2400	0130	0300	0500	0700	0900	1100
Running time	147.3	149.3	150.2	151.8	153.5	155.5	157.0	158.5	160.5	162.5	164.5	166.5
Reactor Power	3000	3000	3000	2000	3000	3000	3000	3000	3000	3000	3000	3000
T.C. #	1	2	3	4	5	6	7	8	9	10	11	12
	390	385	385	340	390	388	400	400	400	400	400	400
	260	257.5	257.5	238	258	250	260	237	265	265	265	267
	320	315	315	295	318	305	315	295	325	320	320	325
	120	115	115	130	128	115	115	100	120	120	120	125
	195	195	195	230	198	180	190	165	195	195	195	195
	215	215	210	215	212	195	205	180	210	210	210	215
	210	215	210	210	212	195	205	180	210	210	210	215
	95	95	98	105	110	98	100	98	100	100	100	100
	95	95	98	104	110	98	95	98	95	98	100	100
	102	102	102	115	114	103	105	100	105	105	105	108
Primary Capsule Vacuum	0.0	0.0	0.0	*4.5	17.5	20.4	23.0	2.0	6.5	10.7	15.0	19.2
Mainline Press.	50	51	51	52	52	50	51	50	51	51	51	51
Main Line Flow	7	7	7	3	8	11	10	14	10	10	10	10
Temp.	75	64	64	68	66	66	66	66	75	67	66	67
SCFM	7.5	7.5	7.5	~4	~9	10.5	10.5	15.0	10.5	10.5	10.5	10.5
Pri. Cap. Pres. ^{psia}	-	-	-	1.2	9.3	11.1	11.7	0.00	4.9	5.05	7.7	10.3
* At this point a Borden tube reading from Ops (absolute) up was installed in the Microsyn pressure transmitter, allowing the primary capsule vacuum to be observed at all times.												

Experiment LT-H₂-4 Task No. 7123Date In 9-10-57

Operator	BG	BG	BG	HHH	HHH	HHH	HHH	HHH	RCH	R.M.	HHH
Date	9-18	9-18	9-18	9-18	9-18	9-18	9-19	9-19	9-19	9-19	9-19
Time	1838	2010	1838	2300	0100	0300	0500	0658	1330	1430	1550
Running time	169.8	171.3	173.2	174.2	176.2	177.8	179.8	181.7	182.9	183.9	185.2
Reactor Power	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
TC #	1	373	390	390	395	395	400	400	400	390	395
2	248	265	267	267.5	245	270	276	275	265	273	275
3	308	323	326	328	305	330	335	335	330	335	340
4	188	121	122	122	115	125	125	125	125	125	125
5	188	195	198	198	185	210	210	210	210	215	215
6	192	212	215	215	195	225	230	228	230	230	230
7	142	212	215	215	195	225	225	222	220	225	225
8	100	101	101	100	100	100	100	100	100	105	110
9	100	101	101	100	98	98	100	100	100	105	110
10	106	107	107	107	105	107	107	107	110	110	112
Primary Capsule Vacuum	11.6	15	18.7	20.5	2.0	7.2	11.6	15.5	3.0	3.0	4.0
Main line Press	50	51	51	51	50	51	51	51	49	49	49
Main line flow	10	8	8	9	11	8	8	8	8	8	8
Temp.	72	71	70	70	70	70	75	70	68	64	74
SCFM	~11	~8.5	~8.5	9.5	11.5	8.5	8.5	8.5	8.5	8.5	8.5
Pri. Cap. Press ^{PSIA}	5.6	7.7	10.0	11.1	0.0	2.9	5.6	8.0	0.3	0.3	0.9

Experiment LT-HX-4 Task No. 7123 Date In 9-10-57

Operator	BG	BG	BG	HXH	HXH	HXH	HXH	J.D.E.	J.D.E.	MAR	MAR
Date	9-20	9-20	9-20	9-21	9-21	9-21	9-21	9-22	9-22	9-22	9-22
Time	1844	2110	2340	0100	0300	0500	0700	0030	0230	0430	1415
Running time	206.0	208.4	210.9	212.3	214.3	216.3	218.3	235.8	237.6	243.7	249.5
Reactor Power	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
TC #	1	400	400	400	405	405	400	400	395	393	388
	2	274	270	270	270	273	270	270	270	268	267
	3	338	337	338	340	340	338	338	335	330	330
	4	124	125	124	125	125	125	125	125	120	125
	5	215	212	212	212	212	115	215	215	215	212
	6	228	228	228	228	228	225	228	225	220	218
	7	220	218	218	218	218	215	215	215	215	215
	8	105	100	98	100	100	98	102	100	100	100
	9	105	100	98	98	100	98	100	100	100	100
	10	110	108	107	107.5	107	107	107	110	110	106
PRIMARY CAPSULE VACUUM	6.1	6.2	6.5	6.7	6.8	7.0	7.3	9.0	9.0	9.6	10
PRIM. CAP. PRES.	2.2	2.2	2.5	2.6	2.65	2.75	2.95	4.0	4.0	4.3	4.6
MAIN LINE PRES.	49	51	51	51	51	51	51	51	51	51	51
MAIN LINE FLOW	7.5	7.5	7.5	8	8	8.5	8.5	8	8	8	8
TEMP.	64	62	69	64	62	61	63	62	62	68	65
SCFM	8	8	8	8.5	8.5	9	9	8.5	8.5		

Experiment LT-Hx-4 Task No. 7123 Date In 9-10-57

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Operator	J.D.E.	J.D.E.	J.D.E.	J.D.E.	RCL	RCL	REB	J.D.E.	J.D.E.	J.D.E.	J.D.E.	RCL
Date	9-22	9-22	9-23	9-23	9-23	9-23	9-23	9-24	9-24	9-25	9-25	9-25
Time	2100	2200	0100	0300	0935	1230	1700	0100	0300	0000	0430	0830
Running time	256.2	258.2	260.2	262.2	268.8	271.7	276.2	284.2	286.2	293.5	298.1	302.1
Reactor Power	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
TC # 1	387	400	400	395	395	400	400	385	377	375	377	380
2	265	275	275	275	275	275	277	268	272	273	273	275
3	330	345	343	340	340	345	345	335	340	335	340	340
4	122	130	120	125	125	130	130	117	130	125	125	135
5	205	230	230	230	230	235	235	230	230	220	230	240
6	218	230	230	230	230	235	235	230	230	230	230	240
7	218	225	225	225	225	225	228	215	220	220	215	230
8	100	100	100	100	100	100	105	100	110	100	100	100
9	100	100	100	100	100	100	105	100	100	100	100	100
10	105	108	105	108	105	105	107	100	110	107	105	110
Primary Capsule Vacuum	8.2	8.0	8.0	7.8	11.9	12.2	12.6	6.3*	7.0*	15	15	15
Primary Capsule Press	3.5	3.4	3.4	3.2	5.8	6.0	6.2	3.2*	2.8	6.7*	6.7*	7.6
Mainline Press	51	51	51	51	51	51	51	51	51	51	51	52
Mainline Flow	8	~5	~5	~5	~6	~6	10	5	~5	~5	~5	~5
Temp.	63	70	70	71	62	63	66	65	67	58	59	58
SCFM	8.5	5	5	5	7	7	11	5	5	~5	~5	~5

* Incorrect readings

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Experiment LT-H_x-4

Task No. 7123

Date In 9-10-57

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Operator	HH	RCL	RCL	RCL	HH	RCL	RCL	RCL	RCL	ACE
Date	10-7	10-9	10-9	10-10	10-10	10-11	10-14	10-16	10-17	10-17
Time	1430	0840	1545	0835	1625	1245	0830	0830	1120	1330
Running time	521.7	555.8	562.9	579.7	587.5	607.6	675.4	714.0	740.8	743.0
Reactor Power	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
T.C. #	1	400	400	410	400	395	380	375	395	390
	2	297	290	300	285	287	275	280	285	285
	3	365	355	370	350	350	340	340	350	350
	4	255	130	135	130	132	130	120	130	130
	5	255	250	255	245	240	230	240	250	250
	6	255	250	255	245	240	230	240	250	250
	7	245	240	245	235	235	230	230	240	240
	8	112	100	120	100	110	100	100	100	100
	9	115	100	115	100	115	100	100	100	100
	10	117	110	120	105	115	105	100	105	105
Primary Capsule Vacuum	10.2	18.5	20.0	22.7	4.3	11.5	21.2	14.5	21.6	22.2
Primary Capsule Pressure in PSTA	4.7	9.8	10.8	12.4	1.1	5.6	11.5	7.4	12.8	12.0
Mainline Pressure	49	48	48	48	49	48	48	48	48	48
Mainline Flow	~7	~7	~7	~7	~7	~7	~7	~7	~7	~7
Temperature	60	70	66	66	65	61	65	64	60	61
SCFM	~7.5	~7.5	~7.5	~7.5	~7.5	~7.5	~2.5	~7.5	~7.5	~7.5

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FIGURE 1

Diagrammatic View of Test Capsule Showing Thermocouple Locations

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