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DUN-5302 RD
Hanford Category C-65
Copy No. 1

D. L. Hirschel
1/10/69

DUN RECORDS DISPOSITION

Indefinite Retention _____
Destruction Date Until Reactor is abandoned
Authority B-5-2

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REACTOR INCIDENT FILE

GENERAL INFORMATION

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HCR TEMPERATURE LIMITS EXCEEDED

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AUTHOR

L. R. Monson

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#1-KL Hladek
#2-LR Monson

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DATE August 14, 1967

TO K. L. Hladek

FROM L. R. Monson

SUBJECT HCR TEMPERATURE LIMITS EXCEEDED

On July 26, 1967, it became necessary to reduce the reactor power level at KW Reactor in order to maintain the outlet temperatures on HCR #10 and HCR #18 below the 60°C limit as specified in Process Standard A-060. A power reduction of 200mw was necessary to accomplish this. For a period of approximately four hours, the above mentioned rods intermittently exceeded the 60°C limit. According to the "operations" log, no temperature on either rod exceeded the 60° limit for more than the one-half hour allowed by Standards. The data below were taken from the hourly data sheet and indicates the nature of the problem.

Time	Rod No.	Reactor Power	Rod Temp.
8:30	10	4200	56.6
9:30	10	4200	61.7
10:30	18	4100	60.0
11:30	18	4000	60.2
12:30	18	4000	60.8
13:30	18	4000	60.0

During this same time period, much difficulty was encountered with graphite temperatures. The graphite temperatures in general were higher than normal. The highest temperature recorded was 953C on stringer 5355-Pt. 4 at 11:30. A survey of the graphite temperature data available in the vicinity of HCR #10 and #18 also indicated higher than normal temperatures.

A review of the "Weekly HCR Water Check" data (A-5900-067) was made to determine if any trends or problems were developing with any of the twenty rods. Data from the period beginning 4-8-67 and ending 7-30-67 was used. The review indicated very little change in operating characteristics of any of the rods during this time interval. This information is plotted on page 3 and shows supply press, HCR #10 press, and HCR #18 press. The fluctuations shown on the plot could be a result of the readings taken by the operators rather than actual changes. The gauges are mounted on the panel such that a short person could read a higher press than a taller person.

Coolant outlet temperatures for HCR #10 and #18 are, and have normally been higher than the remaining rods with the exception of #2 which is a flat rod.

From the data available, I conclude that the temperatures experienced were a result of the increased graphite temperatures and not due to any HCR coolant problem.

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Related Problems

One improvement that could be made to the present system would be to replace the bourdon-tube gauges with Δ P cells. During a recent updating of Standard A-060, it was found that the limits, as applied to the present system, would be very difficult to administer. This difficulty is present because each rod is degenerating at its own rate, thus requiring individual limit administration. With a Δ P cell indication system, definite limits could be established and easily administered. This new system would indicate Δ P and flow and would allow the operator a much more complete indication of each rod's performance.

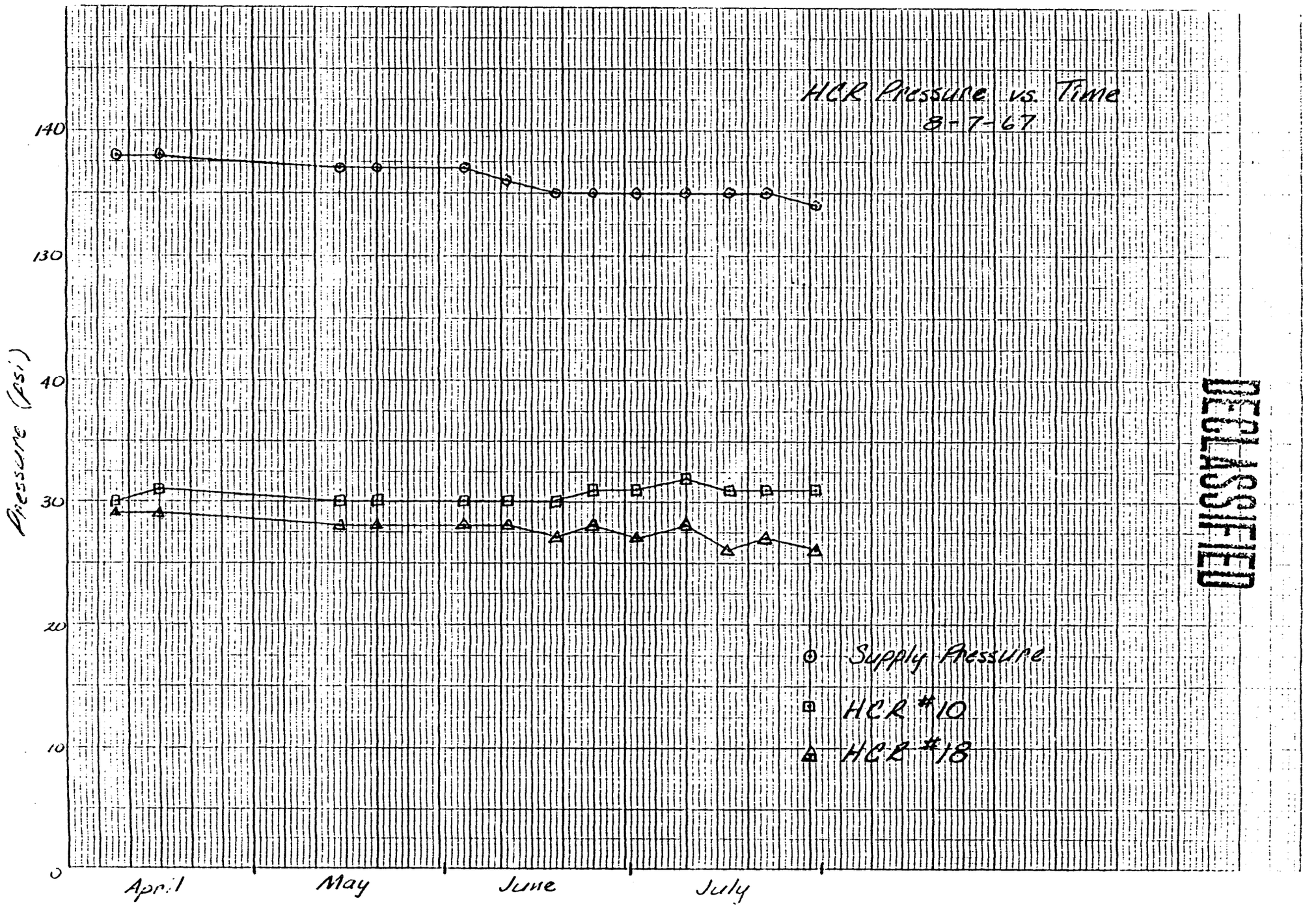
A cost review of this change has been requested by K. R. Ellison.

LRM / LRE
KW Process Engineer
Research and Engineering

LRM:cs

[redacted]

10 X 10 TO 1/2 INCH 46 1320
KEUFFEL & ESSER CO.



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54-7000-101 (9-59)

VIII

DON'T SAY IT --- *Write It!*

TO #1 HCR

this

1 not now in scram circuit

make total of 6 ~~5½'s~~ + #1

DATE

FROM 6/1/64

8:55 AM 221 inches @: 1860 rod scrammed in by itself

operator observed selsyn went in to 5" ~ Full in

Level 1350 — G_T reduced 30 units 13:30 1800 units

series SNM + 1XX

Coil 1 SR relay burned out causes fail safe scram of individual

Rod in ~ 5 minutes 1SR opened removed from SC

when removed from scram circuit 10 to 15 units / minute

highest tube Temp 119 Eqb 118

Now 273" out.

Heat at time coming to near + rod completed flow. Heat now near bottom.

"SAFETY IS NO ACCIDENT"

54-3000-101 (9-59)

DON'T SAY IT --- *Write It!*

DATE

TO

FROM

25% over file

#1 HCR ~ 9 00 Am. 6/1

By 9 30 on way up 35/36

1740

8 30/ 1360

1860

#1 Rear

#2 ½

#3 front

Equiv to full scram in this area

HSU in this area

f 4 as far as severity of transients

"SAFETY IS NO ACCIDENT"

54—3000—002

IRRADIATION PROCESSING DEPARTMENT
GENERAL ELECTRIC
RICHLAND, WASHINGTON

File
Incident Failure

July 26, 1962

R. W. Reid, Manager
Process Technology Operation
Research & Engineering Operation

REACTOR SAFETY

Recent loss of horizontal rod cooling water incidents at C Reactor have me concerned from a safety standpoint. On the first occasion after losing water to HCR No. 14 (center rod, lower bank), we experienced an estimated 30 per cent increase in local flux. On the second occasion, the flux monitors showed a 7 per cent increase. If water had been lost to an upper rod it is probable, in my mind, that we would have exceeded boiling limits on numerous tubes. The reactivity affect we experienced was greater than I or the Reactor Physicist anticipated. A thorough review of the problem appears to be in order. In addition, the requirement that horizontal rods except half rods be in the scram circuit is questioned. Had No. 14 HCR been in the circuit, it would have taken us approximately five minutes to remove it from the unit. We were fortunate in that No. 14 is a half rod.

Roy E. Dunn
Manager
C Processing Operation
B-C Reactor Operation

RE Dunn:mhm

cc: WJ Ferguson
SM Graves - SA Wood
GF Owsley - DW Constable
JR Pierce
Processing Managers (8)
File
LB

54—5000—002

IRRADIATION PROCESSING DEPARTMENT
GENERAL ELECTRIC
RICHLAND, WASHINGTON

July 19, 1962

W. J. Ferguson, Manager
B-C Reactor Operation

COOLING WATER LOSS TO NO. 14 HCR - C REACTOR

Introduction

On July 8, the cooling water inlet supply hose separated from No. 14 horizontal rod resulting in a complete loss of cooling water to that rod. The loss of the hose permitted the water in the rod to drain which resulted in sufficient localized power increase in the lower portion of the reactor to cause a high level trip on all four flux monitors.

Approximately 24 hours following startup, the hose again became separated from the rod. The reactor was scrammed manually on this occasion.

Operational and visual checks made on the rod following both incidents indicated that the rod had not suffered any damage.

Discussion

At 0919 on July 8, the flux monitors shut the reactor down within approximately 6 to 8 seconds after the annunciator system indicated an abnormal pressure on No. 14 HCR. A horizontal rod can normally be removed from the reactor in 45 to 50 seconds. However, the fact that the loss of water to a rod would result in a flux monitor trip was not expected and there was some delay in pulling the rod. Also, initial efforts to pull the rod were hampered by the dead-man switch. As soon as this was bypassed, the rod was pulled without further delay. Total time to remove the rod from the time water pressure was lost to the time the rod was full out was approximately 2 1/2 minutes. No. 14 rod is a half rod and is not in the scram circuit. It should be noted, that if the rod had been in the scram circuit, at least 5 minutes would have elapsed before the safety circuit could be reset in order to pull the rod.

The 20-tube average recorder and the flux monitor recorders indicated that the localized power increase in the vicinity of the rod was approximately 30 per cent. Maximum tube powers in this vicinity probably reached 1700 which would have resulted in temperatures over the boiling limits. However, since the reactor scrammed within 6 to 8 seconds it is doubtful if any boiling did occur.*

---

* Personal communication with D. W. Constable and S. A. Wood.

Prior to placing the rod back into service, the rod was pressure tested to 250 psi for 15 minutes, visually inspected for evidence of having overheated, operated under power in and out of the reactor for evidence of binding, and finally was connected to the scram circuit and scrammed several times. The checks indicated the rod had suffered no damage. In addition, smears from the floor were sent to Physical Analysis Lab to check that the boron carbide powder compartments had not been damaged permitting the boron to flush out of the rod. Results were negative.

Water draining from the rod onto the outer rod room floor resulted in high levels of contamination as follows:

1. Immediately after the failure, direct readings 6 inches from the floor showed 6,000 mrad, including 4,000 gamma.

2. Smears taken approximately 24 hours later showed 16,000 mrad, including 450 mr.

At 2316 on July 11, low pressure on the rod water supply sounded an annunciator warning. Within a few seconds, an alarm was sounded on No. 14 rod. The Supervisor stepped into the outer rod room, saw considerable water spraying, and requested that the reactor be scrammed. Approximately 10 seconds had elapsed between the time No. 14 rod annunciator sounded and the time that the reactor scrammed. The rod was pulled out of the reactor within approximately 50 seconds. The flux monitor showed an increase of approximately 7 per cent. The reactor had been operating only 24 hours, so several startup splines were still in the lower portion of the reactor below the rod bank. This probably accounted for the fact that the increase on the flux monitor was not sufficient to cause a trip.

Extensive checks were again made on the rod. Cause of the failure was not detected. A new inlet hose and hose reel were installed and tested.

Recommendations resulting from the incidents will be forwarded in a separate letter.

Roy E. Dunn
Manager
C Processing Operation

RE Dunn:JRP:mhm

cc: DW Constable
SM Graves
GF Owsley
JR Pierce
RW Reid
SA Wood
Processing Managers (8)
File
LB

54—5000—002

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File

August 5, 1958

R. W. Reid, Supervisor
Process Engineering Operation
Research and Engineering Operation
IRRADIATION PROCESSING DEPARTMENT

INSERTION OF UNCOOLED HCR IN KE REACTOR, 12-13-57

Background:

Half rods are being changed from center to fringe positions at the KE Reactor to improve flattening efficiency, control effectiveness, and to reduce enrichment costs. As a part of this program, #4 HCR half-rod was being exchanged with #3 HCR full-rod. It has been the practice in the past to make the change during an outage up to the point where the long rod is ready to be installed where the half rod was. This installation has been done during operation in order to save outage time since the long rod is not usually needed for control during operation.

Sequence of Events:

In this case, #4 half rod had been removed and put in the #3 position, and work was in progress to put the #3 long rod back into #4 position. The actual installation was scheduled for Friday, December 13, while the reactor was operating. This job takes about 8 hrs. and was started at about 10:00 a.m. At shift change the rod was left with the tip two inches inside the biological shield and with four jobs remaining to be done: 1) Make up the gas seal, 2) Attach the center and rack sections to the tip section of the rod, 3) Connect the cooling water system to the rod, and 4) Connect the motor drive to the rod. At 5:30 p.m. the reactor operator at the control room console noticed that the reactor power level had dropped about 80 units in the region of #4 HCR. The operating supervisor immediately went to the outer rod room. He found that a few minutes before the radiation monitor had pointed out to the craftsmen working on the rod that the radiation level where they were working was about 300 mr/hr. and that the level about 4 feet nearer the reactor was only about 100 mr/hr. Apparently, without further thought, the craftsmen had moved the rod toward the reactor about 5 feet and continued to work on the rod assembly. The operating supervisor asked that the rod be pulled back one foot at a time to avoid further power level bumps. No change in level occurred, and the rod was pulled back as far as it would come - 30 inches from

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The normal out position. At this time (about 5:45 p.m.) it was requested that cooling water be turned on slightly to see if the rod was damaged. Although the valve was only cracked for a few seconds, the dew points immediately went up and gas pressure increased slightly.

The operating supervisor then (5:50) conferred with the Processing Analyst and Manager. It was felt that the rod motor should be connected and an attempt made to get the rod out before the reactor was shut down. The basis for this was that the damage had already been done and that it would be easier to pull the rod when the reactor was hot. The graphite temperature in this general vicinity was estimated to be about 300° C. At the point where the rod had been in the farthest, graphite temperatures were just under 500° C. During this time Process Technology personnel were contacted and they advised that if the rod could not be pulled out, the reactor should be shut down. At about 9:00 p.m. the rod was pulled out to about 10 inches from normal out position with the rod motor. Removal attempts continued unsuccessfully with a pry-bar and come-along, and the reactor was shut down by 11:00 p.m. The rod was pulled on out of the active zone with a come-along and two hydraulic jacks during the outage. Since there would have been so much overtime involved in removing the rod from the reactor completely that weekend due to the high radiation level, the reactor was started up after the minimum outage with the intention of removing the rod on Monday. Operations personnel felt, because of the way the rod pulled back, that all of the tip was there, or that any portion detached would be stuck in the step plug out of the active portion of the reactor.

When the rod was removed on Monday, December 16, some of the tip section was missing. This consisted of about 5 inches of the tip and about another 13 inch wedge -- shaped piece out of the top or bottom of the rod such that the cooling tubes were exposed. Since the location of the rod tip was not certain, the decision was made to hold the pile power level where it was (well below normal) and shut down the following day at 6 a.m. so that maximum manpower could be utilized for the repair job. Graphite temperatures in the region where the rod had been were below the point they were when the rod was originally inserted in the reactor.

The rod channel was borescoped early on the following day, December 17, 2'-5" into the graphite stack. At 5" a piece of molten metal was encountered, and at 2½' more pieces were observed. Just beyond

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GENERAL ELECTRIC
RICHLAND, WASHINGTON

2½' a large piece believed to be the rod tip was encountered. Further examination was not possible because of the pieces piling up in front of the scope. The pieces were removed but the tip piece, about 5" long, fell into the plenum between the thermal shield and graphite stack as it was being removed. A quick borescoping of the channel after the pieces were removed revealed that it was clean except for a small piece of molten metal about 3/8" high and 1/2" long 7' from the outer skin or about 4" inside the graphite stack. The reactor was then started up after an outage of 30 hrs.

A later borescope inspection on a subsequent outage on December 26 showed that:

1. The bearing blocks in the inner rod room thimble were scored, but the thimble was in good condition.

2. Although the graphite rod bearing blocks in the biological shield step plug were scored, the plug was in good condition.

3. About 6" of the first rod support block in the graphite stack was broken off at the keyway and the key was missing.

4. The channel was in good condition except for a loose piece of molten metal about 1/8" X 1/2" X 2" at about 25' in the unit.

During a subsequent outage, a piece of graphite was wedged in between the first support block and the gas plenum skin in order to keep the support block in place, and the loose piece of metal was removed. The rod was installed later and the operation of this rod since then has been normal.

Investigations:

The rod tip section was removed to the burial trench and covered over immediately since the section had a high radiation level. As a result, no good views of the damaged section were obtained. It was noted from a distance during the removal work that the edges of the break were jagged and uneven, however. Although the 5" tip was in one piece, the rest of the material was in small pieces or "gunk" which were vacuumed out of the channel and buried. Several of the smaller pieces (flattened about 4" by 2") were removed and stored in a double garbage can arrangement full of water. These pieces were

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inspected about a month later when radiation levels had dropped, and their appearance was that of softened, twisted, jagged, metal with the boron carbide fused into the aluminum. Because of the high contamination level, the pieces had to be buried.

J L Benson

J. L. Benson
PROCESS ENGINEERING OPERATION

JLB:bam

cc: GJ Rogers
JL Benson - 2

DATE
FILMED
5/20/94

END