NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Sequoyah, Unit 1	0 5 0 0 0 3 2 7	1 OF 0 7

TITLE (4): Thimble Tube Ejection

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 4	1 9	8 4	8 4	— 0 3 0 —	0 0	0 5	1 8	8 4		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): 1
POWER LEVEL (10): 0 3 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

[ ] 20.402(b)	[ ] 20.405(c)	[X] 50.73(a)(2)(iv)	[ ] 73.71(b)
[ ] 20.405(a)(1)(i)	[ ] 50.36(c)(1)	[ ] 50.73(a)(2)(v)	[ ] 73.71(c)
[ ] 20.405(a)(1)(ii)	[ ] 50.36(c)(2)	[ ] 50.73(a)(2)(vii)	[ ] OTHER (Specify in Abstract below and in Text, NRC Form 366A)
[ ] 20.405(a)(1)(iii)	[X] 50.73(a)(2)(i)	[ ] 50.73(a)(2)(viii)(A)	
[ ] 20.405(a)(1)(iv)	[ ] 50.73(a)(2)(ii)	[ ] 50.73(a)(2)(viii)(B)	
[ ] 20.405(a)(1)(v)	[ ] 50.73(a)(2)(iii)	[ ] 50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER	
	AREA CODE	
Glenn Kirk, Compliance Section Engineer	6 1 5	8 7 0 - 6 1 4 6

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

[ ] YES (If yes, complete EXPECTED SUBMISSION DATE) [X] NO

EXPECTED SUBMISSION DATE (15): MONTH | DAY | YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On 04/19/84, unit 1 was in mode 1 (2235 psig, 558 degrees F) at 30% reactor power with maintenance personnel cleaning incore detector thimble tubes. A high pressure connection on the thimble tube at the seal table failed resulting in a reactor coolant system pressure boundary leak of approximately 25-35 gpm and ejection of one incore detector thimble tube at 2100 CST.

8405220459 840518
PDR ADOCK 05000327
S PDR

IE22

NRC Form 366 (9-83)

Background Information Leading to Event

The Reactor Engineering Unit (REU) had submitted various maintenance requests (MR) during late 1983 whenever a plugged incore detector thimble tube was encountered. In December 1983, REU submitted an MR requesting all unit 1 thimble tubes be cleaned (MR A098022). Due to manpower, time restrictions, and low priority, only 9 thimble tubes were cleaned during the unit 1 refueling outage. Prior to startup following the outage, REU functionally tested the incore detector system (April 11-13) and identified 23 thimble tubes which were blocked. Research was done by REU to obtain information on the possibility of cleaning the tubes at temperature and pressure. It was determined that both Trojan Nuclear Plant and Beaver Valley Nuclear Plant had cleaned thimble tubes at reactor power operation with no problems being encountered. Westinghouse representatives were consulted, and they raised no objection to cleaning the tubes at pressure. Following management discussions, a decision was made to proceed with startup operations while cleaning the tubes in a similar technique as Trojan had used. This method would require removal of the 10 path selector and directly attaching a hand crank assembly which inserts a brush into the tube. Unit 1 entered mode 1 on 04/18/84 at 1118 CST and reached 30% reactor power on 04/18/84 at 1700 CST with thimble tube cleaning in progress.

The Event

On 04/19/84 after cleaning five thimble tubes, the job foreman was unsure if the brush was being inserted completely to the end of the tubes. A decision was made to insert the brush into an unblocked tube to obtain information on brush travel in a clean tube. The cleaning assembly was installed at tube D-12 and was inserted to approximately 15 feet prior to shift change. The second shift cleaning crew took over and began inserting the brush. Each turn of the cleaning tool crank resulted in inserting the brush 10 inches further into the tube. Personnel stopped at the fiftieth (50th) crank to ensure the number of turns had been properly counted. At the seventy-eighth (78th) turn, the tool handler noted that more pressure was being required to turn the crank. At approximately 2100 CST during the seventy-ninth (79th) turn (brush would be approximately 80.8 feet into the tube), water was noticed on the seal table. The work crew immediately evacuated the area. After exiting from the personnel containment airlock, the foreman requested the public safety officer stationed outside the airlock to notify the shift engineer (SE) of the situation. Since the public safety officer was unable to reach the SE by phone, the foreman proceeded directly to the control room following removal of his anti-C clothing.

At 2110 CST, the pressurizer level was decreasing and the charging flow was increased by 45 gpm (from 85 gpm to 130 gpm). At 2116 CST, the pressurizer level decrease stopped and began to increase, indicating the reactor coolant system (RCS) leakage was less than 45 gpm. Later estimates showed the leakage was approximately 30 gpm. At 2117 CST, power reduction at 1% per minute was initiated. At 2120 CST, Radiological Emergency Plan Procedure IP-2, "RCS Leakage Greater Than 10 gpm Identified," was initiated, and the Operations Supervisor and Assistant Plant Superintendent-Operations and Engineering were notified. At 2125 CST with reactor power at 18% (525 degrees F and 2235 psig), the TVA duty specialist was notified.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Sequoyah, Unit 1	0 5 0 0 0 3 2 7	8 4	— 0 3 0	— 0 0	0 3 OF 0 7

TEXT (If more space is required, use additional NRC Form 366A's) (17)

At 2133 CST with steam generator level controls in manual at 12% reactor power, unit 1 tripped on low-low level in the number 1 steam generator. At 2152 CST, the NRC was notified of the event pursuant to 10 CFR 50.72.a.1.i (initiation of REP) and 10 CFR 50.72.b.1.i.A (plant shutdown). At 2205 CST, RCS pressure and temperature were at 1900 psig and 500 degrees F respectively, and a controlled shutdown to mode 5 was in progress. During the event, an ice condenser ice bed temperature recorder, an area radiation monitor, a particulate radiation monitor, two pressurizer level transmitters, two pressurizer pressure transmitters, and six non-qualified instruments failed apparently due to the high temperature and humidity. A containment sump level transmitter was also found inoperable. The failure of the containment sump level transmitter has been determined as coincidental and not due to the environment.

Information and Events Leading to Recovery

At 0932 CST on 04/20/84, unit 1 entered mode 5 and depressurization of the RCS was initiated. At 1114 CST with RCS pressure at 210 psig, the leakage rate was estimated at 18 gpm. At 1400 CST with RCS pressure at 40 psig, the leakage rate was estimated at 5.4 psig.

At approximately 0715 CST on 04/21/84, the vessel water level had been lowered to about 701 feet. Since the top of the seal table is at 702 feet, the only leakage would be due to the pressure of the nitrogen cover blanket in the pressurizer. Later calculations indicated approximately 16000 gallons of water was lost from the RCS during the event.

At approximately 0900 CST, four personnel entered the seal table area to observe the general condition of the area. Personnel reported the thimble tube to be completely ejected from the guide tube and twisted throughout the room. A small, steady stream of water was flowing from the guide tube at the seal table as a result of the pressure from the nitrogen blanket in the pressurizer. Radiation surveys indicated levels of 2-3 rem at the entrance to the seal table area, 200-300 rem at the end of the tube closest to the seal table, and greater than 1000 rem in the center of the ejected tube. The radiation reading of a smear taken from the floor was 60 millirem per hour. Personnel reported the temperature and humidity in the area was very high making working conditions difficult. The team took several pictures of the area, but only remained in the area for approximately two minutes. All four individuals received a total combined dose of 3.036 rem with a maximum individual exposure of 1.219 rem.

At approximately 1800 CST on 04/21/84, two individuals made a second entry into the seal table area to take additional, detailed photographs of the area. The two individuals were in the seal table area approximately seven minutes and received doses of 1.966 rem and 1.939 rem. The photographs that were taken during this entry became an extremely valuable asset. They were used to identify the best removal process which included a configuration mock-up to practice the removal techniques.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Sequoyah, Unit 1	0 5 0 0 0 3 2 7	8 4	— 0 3 0 —	0 0	0 4 OF 0 7

TEXT (If more space is required, use additional NRC Form 366A's) (17)

On 04/21/84 and again on 04/22/84, the following eight alternatives for removal of the ejected tube were discussed:

1. The thimble tube could be fed into the incore detector storage location inside the polar crane wall. This method would reduce radiation exposures due to the close accessibility of the storage location. But disadvantages such as possible interference with incore probes in storage, unknown interferences while inserting the tube into the storage location, future disposal of the tube, and whether the polar crane wall would provide adequate shielding were also pointed out.

2. The thimble tube could be reinserted into the guide tube. This would allow disposing of the tube by normal means during the next refueling outage (removal via the vessel), but would also cause loss of one incore detector location for the next cycle. Other disadvantages included unknown difficulties in starting the tube in the guide tube and problems caused by kinks and sharp bends in the ejected tube.

3. The tube could be moved into the keyway by inserting the tube through the seal table drain or spares. A shielded pipe could be installed in the keyway to store the tube, but additional radiation exposure would be obtained to fabricate the storage piping in the keyway. Additional difficulties included unknown hanger interference during transfer and problems with later access to keyway.

4. The thimble tube could be cut into pieces and stored in a pig. Using video monitors, long-handled tools would be operated from behind shielding to cut the tube and drop the pieces into a funnel-pipe arrangement which would transfer the pieces into a shielded pig in the raceway. This method would reduce personnel exposure and simplify disposal since disposal could be planned at a later date. This method could also be easily mocked up at Watts Bar Nuclear Plant for simulated practice. Disadvantages such as the required weight of the pig, unforeseen problems with the funnel-pipe transfer assembly, and unforeseen problems with cutting tools were pointed out.

5. The thimble tube could be wound onto a spool in a water cask. This method could also be easily mocked-up at Watts Bar, but difficulty of connecting the tube to the spool, keeping the tube untangled as it was turned onto the spool, and the size and weight of the cask were pointed out as disadvantages.

6. The thimble tube could be pulled through a PVC pipe from the seal table to the refuel floor. This method was mentioned and immediately withdrawn as impractical.

7. Use of a mechanical robot to perform the work. This would greatly reduce personnel exposure and could be used in conjunction with one of the other methods. Disadvantages pointed out were the size and weight of the robot and unknown difficulties in set up.

8. An outside contractor could be hired to remove the tube. This method would reduce exposure to plant personnel, but the reduction in plant management control of the work would not be acceptable.

Following discussion of these eight items, management concluded to use option 4 above. On 04/23/84, the condition of the tubing in the seal table area was mocked-up at Watts Bar using the detailed pictures obtained during the second entry of 04/21/84. A work team then simulated the actions they would take during the actual work at Sequoyah. In conjunction with the practice sessions at Watts Bar, shielding was being installed at Sequoyah.

Following difficulties encountered during the practice sessions and exposure levels being received from shielding installation, management reevaluated the options on 04/24/84 and concluded to use a combination of options 4 and 7 above. The portion of the tube with the highest radiation level (approximately 20 feet) would be cut free and dragged into the raceway. Once in the raceway, the work of cutting this section into smaller pieces and placing the pieces in the pig could be performed by the robot. The lower radiation levels of the remainder of the tube would allow personnel to cut it up and dispose of it. A work team then simulated these actions on the Watts Bar mock-up. Following the practice session, additional meetings were held to finalize the plans of the operation. The plan was as follows:

1. On the first entry, one individual would enter and cut the tube near a designated point and immediately exit.

2. On the second entry, two individuals would then enter and coordinate attaching a cable to the section of tubing using a special clamp.

3. Another individual stationed in the raceway would then pull the section of the tube into the raceway using the cable attached in step 2 above.

Using this plan, the 20-foot section of the tube with the highest radiation levels was successfully transferred into the raceway on 04/25/84 with no problems being encountered and only 700 mr exposure. Personnel then entered the seal table area and cut the remaining portion of the tube into smaller pieces. The tube was completely removed from the seal table area by 1900 CST on 04/25/84, and actions to decontaminate the seal table area were initiated. During the activity of decontamination and removing the remaining section from the seal table area, 1 man-rem of total exposure occurred.

The low radiation level section of the tube was delivered to the waste packaging area and prepared for shipment to an offsite burial facility. A new thimble tube was installed in the D-12 guide tube on 04/28/84 with no problems encountered. Cleaning of the remaining thimble tubes was contracted to NUS who started the cleaning operation on 04/26/84 and completed on 04/30/84 with no problems encountered. Of the instrumentation which failed, the area radiation monitor was replaced and all other instrumentation repaired and/or recalibrated.

An evaluation of all Class 1E equipment in the incore instrument room was made to determine if the environmental conditions experienced during this event could be detrimental to their present qualified life. The evaluation determined that no deterioration of qualified life was experienced based on temperature and radiation readings during and after the event.

On 04/26/84, the robot was lowered into the raceway for a mock-up test of the actual cutting operation. The robot would lift the tube and carry it to a table with two hydraulic cutters. Using video cameras, personnel would remotely operate the cutter when the robot had the tube in place. The robot would then carry the smaller (cut off) piece and place it in the storage cask. When all of the tube had been cut and placed in the cask, the robot would fill the remainder of the cask with lead shot and close the cask. The actual operation was started on 04/27/84 and completed on 04/28/84. An approximate six-foot section of the tube was found to have a low radiation level and sent to waste packaging to be added to the other low level tubing for shipping.

Evaluation of the Cause of Failure

Five possible modes of failure of the fitting were identified and evaluated. Evaluation of each possible failure was accomplished by inspection of the failed part and tests performed on a mock-up of the cleaning tool and seal table assembly. The possible failures and their dispositions are as follows:

1. Improper assembly of fitting (such as ferrule upside down or in wrong order).

   The ferrule and tubing were inspected and assembly found correct.

2. Improper expansion of the end of the tube.

   Inspection and comparison of the mock-up specimens to the ejected tube indicate the tube end was properly expanded prior to ejection of the tube.

3. Cracking of Ferrule

   Although the ferrule was found cracked circumferentially approximately 180^{o} on the inside diameter, the relative motion by the ejected tube and fitting would have caused the crack to close if it existed prior to the event.

4. Nut not tightened or had become loosened from other operations.

   The nut was found tight following the event. Destructive tensile tests performed on similar fittings confirmed that the nut remained tight.

5. The fitting being a combination of Gyrolok and Swagelok parts.

   Subsequent evaluation and discussions with vendors has determined that this configuration would not have caused the failure.

NRC Form 366A
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Sequoyah, Unit 1	0 5 0 0 0 3 2 7	8 4	— 0 3 0	— 0 0	0 7 OF 0 7

TEXT (If more space is required, use additional NRC Form 366A's) (17)

6. Cleaning fixture imposed unusual forces on the assembly. This appears to be the most probable cause of the failure from the tests performed on the mock-up. Three fittings were failed by a person pushing on the handle of the cleaning fixture mock-up. The failed mock-up tubes were similar in appearance to the actual failed tube and fitting. Strain gauges were installed on the mock-up tube and a measured force was applied to the mock-up handle. A plot was made using applied force versus strain. Tube strains of approximately 1000 strain units were noted just due to installation of the cleaning tool. Evaluation of the plot showed some slippage at 30 lbs. applied force. Some leakage appeared at 140 lbs. force and separation occurred at 250 lbs. force.

Corrective Actions

All short-term corrective action taken has been described in the above text. Per vendor recommendations, the seal table and associated fittings were inspected. This inspection determined that no additional corrective action was required. For long-term corrective action, management has made the decision that future thimble tube cleaning will not be performed during power operations.

TENNESSEE VALLEY AUTHORITY
Sequoyah Nuclear Plant
Post Office Box 2000
Soddy Daisy, Tennessee 37379

May 18, 1984

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Gentlemen:

TENNESSEE VALLEY AUTHORITY - SEQUOYAH NUCLEAR PLANT UNIT 1 - DOCKET NO. 50-327 - FACILITY OPERATING LICENSE DPR-77 - REPORTABLE OCCURRENCE REPORT SQRO-50-327/84030

The enclosed licensee event report provides details concerning ejection of one incore detector thimble tube. This event is reported in accordance with 10 CFR 50.73, paragraph a.2.i and a.2.iv.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

for O.R. Wallace

C. C. Mason
Power Plant Superintendent

Enclosure
cc (Enclosure):

James P. O'Reilly, Director
U.S. Nuclear Regulatory Commission
Suite 2900
101 Marietta Street, NW
Atlanta, Georgia 30303

Records Center
Institute of Nuclear Power Operations
Suite 1500
1100 Circle 75 Parkway
Atlanta, Georgia 30339

NRC Inspector, NUC PR, Sequoyah

IE22
1/1