NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
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EXPIRES 8/31/85

# LICENSEE EVENT REPORT (LER)

| FACILITY NAME (1) | DOCKET NUMBER (2) | PAGE (3) |
|---|---|---|
| Catawba Nuclear Station, Unit | 0 5 0 0 0 4 1 3 | 1 OF 1 4 |

TITLE (4) Degraded Performance of Unit 1 Auxiliary Feedwater System and Required Hot Shutdown of both Units Due to Asiatic Clam Infestation In The Nuclear Service Water System.

| 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 3 | 0 9 | 8 8 | 8 8 | 0 1 5 | 0 1 | 0 9 | 0 6 | 8 8 | Catawba, Unit 2 | 0 5 0 0 0 4 1 4 |
| | | | | | | | | | | 0 5 0 0 0 |

OPERATING MODE (9): 1

POWER LEVEL (10): 0 9 7

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) | 50.73(a)(2)(iv) | 73.71(b) |
| 20.405(a)(1)(i) | 50.36(c)(1) | X 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 |
|---|---|
| Julio G. Torre, Associate Engineer - Licensing | AREA CODE 7 0 4   3 7 3 - 8 0 2 9 |

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 |
|---|---|---|---|---|---|---|---|---|---|
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SUPPLEMENTAL REPORT EXPECTED (14)

| | | EXPECTED SUBMISSION DATE (15) | MONTH | DAY | YEAR |
|---|---|---|---|---|---|
| YES (If yes, complete EXPECTED SUBMISSION DATE) | X NO | | | | |

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


On March 9, 1988, at approximately 1825 hours, Unit 2 tripped from approximately 20% full power (see LER 414/88-12). During the transient, all three Auxiliary Feedwater (CA) pumps started automatically as designed. However, Motor Driven CA Pump (MDCAP) 2A swapped suction automatically to the Nuclear Service Water (RN) System when a sustained low suction pressure condition was sensed, and raw water from Lake Wylie entered two Steam Generators (S/Gs). After the initial trip recovery, it was noted that CA flow to S/Gs 2A and 2B had degraded following the suction swap. Two work requests were written to inspect the internals of the CA Pump 2A to S/G 2A and 2B flow control valves. The inspections revealed that the Cavitrol cages for these valves were clogged with shredded Asiatic Clam shells. Following discovery, all CA pumps for both Units were declared inoperable. This resulted in both Units being taken to Mode 4, Hot Shutdown. At the time this incident occurred, Unit 1 was in Mode 1, Power Operation, at 97% power and Unit 2 was in Mode 3, Hot Standby. This incident has been attributed to Asiatic Clam larvae from Lake Wylie entering the RN System and growing to maturity in normally stagnant or low flow lines which provide assured water supplies to various safety related systems (including the CA System). All appropriate stagnant lines in the RN System were examined and flushed if necessary. The Unit 2 Train A CA System was flushed and the flow control valves' Cavitrol cages were cleaned. Stagnant instrumentation lines in the RN System were also examined. Any blockages were removed and samples taken for analysis. A task force has been formed to study long term solutions in order to prevent recurrence of this event. A Safety Analysis will be provided in an upcoming revision to this report.


IE22 1/1

BACKGROUND:

The Auxiliary Feedwater (EIIS:BA) (CA) System ensures a sufficient feedwater supply to the Steam Generators (EIIS:SG) (S/Gs) in the event of loss of Main Feedwater (EIIS:SJ) (CF) System, to remove stored and residual core energy from the Reactor Coolant (EIIS:AB) (NC) System. Each Unit is provided with a separate CA System which is designed to be capable of cooling down the NC System to the temperature at which the Residual Heat Removal (EIIS:BP) (ND) System may be operated. There are two motor (EIIS:MO) driven CA pumps (EIIS:P) (MDCAPs) and one steam turbine (EIIS:TRB) driven CA pump (TDCAP) per Unit. Each MDCAP is capable of supplying two S/Gs while the TDCAP is capable of supplying all four S/Gs. Figure 1 shows a simplified flow diagram for the CA System.

CA flow to each S/G is modulated by air operated control valves (EIIS:V) (CA36, CA40, CA44, CA48, CA52, CA56, CA60, and CA64). These valves fail open to predetermined positions on a CA autostart signal. The travel stops on these valves are set to optimize the system flow rates for various accident scenarios. The valves can be remotely operated from the Control Room within the preset limits after the CA autostart signal has been reset. The Catawba Final Safety Analysis Report (FSAR) accident analyses assume degraded operation of the CA System such that a total of 491 gpm of CA flow is delivered to only two intact S/Gs.

There are several sources of water available to the CA pumps. The preferred sources are non-safety related condensate quality sources located in the Turbine and Service Buildings (CA Condensate Storage Tank (EIIS:TK) (CACST), Upper Surge Tank (UST), and Condenser Hotwell). The assured source of water to the CA pumps is the safety related portion of the Nuclear Service Water (EIIS:BI) (RN) System. During a CA autostart, each pump's suction is designed to automatically swap to the RN System if a sustained low pressure is detected by its associated suction pressure switches. If the autostart signal has been cleared, or the pumps started manually, the pumps will be tripped on low suction pressure rather than be aligned to RN. An additional source of raw water is available from the Condenser Circulating Water (RC) System. However, this source is only intended for use during security or fire events when operations have been transferred to the Standby Shutdown Facility or the Auxiliary Shutdown Panel.

Technical Specification 3.7.1.2 requires that all of the CA pumps and their associated flow paths be operable in Mode 3, Hot Standby, or above. The operability of the CA System is dependent on the availability of the assured source of water from the RN System and the capability of delivering the minimum required flow rate to the entrance of at least two S/Gs under all postulated service conditions.

The RN System serves as the ultimate heat sink for all heat loads in the Auxiliary and Reactor Buildings of both Units (other than the secondary (steam) side of the station). Most RN heat exchangers (EIIS:HX) are cooled directly by heat transfer to the once-through lake water pumped by the RN pumps. The RN System also serves as the assured source of makeup water for several safety related systems. During normal operation, the RN pumps take suction from Lake

Wylie. Should Lake Wylie be lost for any reason, suction will automatically be swapped to the Standby Nuclear Service Water Pond. The outlets of each RN pump utilize strainers with a 1/32 inch mesh to prevent debris and aquatic wildlife from entering the system. Figure 2 shows a simplified diagram of the RN System.

The Containment Valve Injection Water (NW) System is designed to inject water between the two seating surfaces of gate valves used for Containment isolation. The injection pressure is higher than the peak Containment pressure expected during a loss of coolant accident (LOCA). This is intended to prevent leakage of the Containment atmosphere through the gate valves, thereby reducing the potential offsite dose consequences during an accident. There are two trains of NW per Unit. Each train contains a surge tank which is filled with water and pressurized with nitrogen. Normal makeup to the tanks is from the Demineralized Water Storage Tank. Assured water is provided from the essential header of the RN System.

The Component Cooling (EIIS:CC) (KC) System is designed to remove residual core decay heat from the NC System via the ND System, and transfer the heat to the RN System. It also supplies cooling water to various other essential and non-essential loads in the Reactor and Auxiliary Buildings. The system serves as an intermediate system between potentially radioactive coolant systems and the RN System. This reduces the probability of leakage of radioactivity to the environment. Normal makeup to the KC System is from the Makeup Demineralized Water System. However, an assured source of makeup water is available from the RN System.

Asiatic Clams are a non-native species of fresh water bivalve mollusk. They were first found in the United States in 1938 in the Columbia River near Knappton, Washington. Since then, they have spread across the country and are now found in at least 33 states. They first appeared in the Duke Power Company service area in the mid 1960's. Adult clams measure approximately 1 inch in diameter. However, the clam larvae measure approximately 1/125 inch in diameter.

DESCRIPTION OF INCIDENT:

On March 9, 1988, at 1825:36 hours, MDCAPs 2A and 2B started automatically following a Turbine Trip/ Feedwater Isolation (P-14) signal caused by a high high S/G level. At the time, Unit 2 was in Mode 1, Power Operation, at 20% full power. Following the Feedwater Isolation, the Reactor (EIIS:RCT) tripped automatically on low low S/G level at 1825:44 hours. At the same time, an automatic suction swap to the RN System occurred for MDCAP 2A due to a sustained low suction pressure signal. After the suction swap, flow from MDCAP 2A to S/Gs 2A and 2B decreased to approximately 220 gpm and 100 gpm, respectively. Normal flow rates were expected to be approximately 320 gpm. CA flow rates to S/Gs 2C and 2D from MDCAP 2B were within normal bounds. For more details on this transient, see LER 414/88-12.

On March 10, 1988, at approximately 0100 hours, testing of the MDCAPs confirmed that CA flow rates from MDCAP 2A to S/Gs 2A and 2B were seriously degraded. Work

Requests 39792 OPS and 39793 OPS were originated to inspect and clean 2CA60 (CA Pump 2A to S/G 2A) and 2CA56 (CA Pump 2A to S/G 2B), respectively. The Unit 2 CA System Train A was declared inoperable at 0200 hours. The inspection of 2CA60 and 2CA56 revealed that the Cavitrol cages for these valves had become clogged with shredded Asiatic Clam shells measuring approximately 0.15 to 0.25 inches in diameter. The cages were cleaned and the valves reassembled. At 1000 hours, the NRC dispatched an Augmented Inspection Team to Catawba Nuclear Station (CNS) to investigate the transient of the previous day. At 1130 hours, it was decided to declare all CA Pumps on both Units inoperable, because of the potential for degraded system performance in the event of a suction swap to the RN System. A Unit 1 shutdown was commenced at 1157 hours, from 97% full power. At 1230 hours, a Unit 2 cooldown to Mode 4, Hot Shutdown, was initiated. Technical Specifications required that Unit 1 be in Mode 3 by 1730 hours, and Mode 4 by 2330 hours. Unit 2 was required to be in Mode 4 by 1730 hours. An Unusual Event was declared for Unit 1 at 1250 hours, due to the loss of the CA System while at power. At 1645 hours, Unit 2 entered Mode 4. Unit 1 entered Mode 3, Hot Standby, at 1650 hours. In order to restore the Unit 1 CA System to operability, a program was initiated at approximately 2100 hours, to flush the stagnant RN lines leading to the CA Pumps back through the RC System (see Figure 1). The RC System is maintained at a lower pressure than the RN System. The flushing was accomplished by removing the internals of check valve 1CA173 and aligning the valves such that both trains of RN were flushed for approximately 15 minutes. During the flush, all available RN Pumps were operated to maximize the differential pressure between the two systems. Following the flush, the lines were verified to be free of clams by sampling the flow at 1CA173 and performing a visual inspection of the RN Train A lines (gaining access by removing the internals of check valve 1CA172). The final phase of the operation was to remove all raw water from the CA Pump suction lines. This was done by aligning the condensate grade sources for the CA System to backflush into the RC System. At 2312 hours, Unit 1 entered Mode 4, and the Unusual Event was terminated.

On March 11, 1988, the RN lines supplying an assured source of makeup to the NW Surge Chambers on both Units were tested to verify adequate flow rates. The tests were performed by allowing RN to flow through the supply lines and out a vent located between the two valves which isolate RN from the NW Surge Chamber. Design Engineering evaluated the results from these tests and the lines were declared operable. Also on this day, the RN lines supplying the Unit 2 CA System were flushed to the RC System in the same manner as had been performed on Unit 1. In order to provide additional certainty of the success of this operation, radiographs were taken at suspected clam traps on the Unit 2 lines. The results of these radiographs showed no evidence of clams remaining in these lines after the flush.

Based on the discovery of clams in the stagnant RN lines, the question was raised as to whether the impulse lines for RN instrumentation could also be blocked. The decision was made to inspect a representative sample of RN instrumentation considered susceptible to blockage. Several Instrumentation and Electrical (IAE) work requests were originated to perform this inspection, and these were worked over the next few days. During an inspection of 1RNPS7490 (RN Pump Strainer 1B Differential Pressure), a clog was discovered on the low pressure side. The clog was removed and inspected by IAE and Chemistry personnel. It appeared to be composed of mud and silt from the lake water. Based on this finding, it was decided to expand the survey of RN instrumentation to include all safety related instruments and non-safety instruments which are indirectly Technical Specification related. Only instruments with stagnant impulse lines connecting to the RN System were included. Later, impulse lines for 0RNPS6040 (Control Room Area Chiller Condenser B Differential Pressure), 2RNPS8220 (Auxiliary Shutdown Panel Air Handling Unit B Differential Pressure), and 0RNPS6000 (Control Room Area Chiller Condenser A Differential Pressure) were also discovered to be clogged with sludge, and were repaired. IAE personnel determined that the clog in 2RNPS8220 did not prevent the instrument from operating properly. No other RN instrument lines were found to be blocked.

On March 12, 1988, a heat-up of Unit 1 was begun and the Unit entered Mode 3 at 0120 hours. The RN lines providing an assured source of makeup water to both Units' KC Systems were radiographed to determine if clams were present (see Figure 3). No clams were indicated in the Train 1A RN line leading to the KC System. This is probably because the line begins with a vertical run upward from the RN header. The 1B supply line begins with a horizontal run off the RN header. Radiography indicated that either clams or pipe corrosion were present in this line. Therefore, the line was flushed by removing the internals of check valve 1KC498 and directing the flow into the "C" Groundwater Drainage Sump via a four inch hose. Following the flush, the line was re-radiographed, and the results looked no different than the first examination. The line was then declared operable at 2025 hours based on the fact that whatever was in the line was not moving. Radiography of the Train 2A supply line showed the line to be totally blocked with clams. A similar flushing operation was performed, and a second radiographic examination showed the line to be completely clear. The line was declared operable following reassembly of check valve 2KC495.

Also on this day, Performance and Operations personnel began flushing operations to remove shredded clams from the CA lines between MDCAP 2A and the flow control valves which had become clogged. This operation was performed by reducing S/G 2A and 2B levels to approximately 25%, then using MDCAP 2A to flush the lines with condensate grade water until each S/G reached approximately 70% level. The Cavitrol cages on valves 2CA56 and 2CA60 were used to prevent the shells from entering the S/Gs and provide a point for their removal. This operation was performed for one S/G at a time in order to maximize flow rates during the flush. When 2CA56 and 2CA60 became clogged again, the flushing operations were suspended while the valves were cleaned. At approximately 1400 hours, Performance personnel began PT/2/A/4250/06, CA Pump Head and Valve Verification Test, in order to verify that CA Pump 2A had not been damaged by clams. The test was terminated because 2CA179, CA Pump 2A Discharge to UST Dome Throttle valve, became clogged.

On March 13, 1988, cleaning operations on valves 2CA179, 2CA56, and 2CA60 were completed and the valves were reassembled. After clearance was obtained from the NRC, Unit 1 was returned to Mode 1 at 2210 hours.

On March 14, 1988, flushing operations on the Unit 2 CA lines were resumed and completed by approximately 1400 hours. During the flushing, S/G 2A was accidentally overfed resulting in a P-14 signal being generated. The Train 2B RN supply line to the Unit 2 KC System was flushed and re-radiographed twice. Each time, the radiography results looked the same, and the line was declared operable following reassembly of check valve 2KC498, again based on the inability to dislodge whatever was in the line.

2CA56 and 2CA60 were cleaned and reassembled following the CA flushing operation on March 15, 1988.

On March 16, 1988, a head curve verification was performed on MDCAP 2A. The results showed a drop in performance of approximately 1/2% from the head curve verification performed three weeks earlier at the end of the Unit 2 refueling outage. This drop was considered to be within the tolerance of the test equipment and did not indicate damage to the pump from clams. During the testing, a problem was discovered with 2CA27, CA Pump 2A Minimum Flow Control valve. The O-ring sealing surfaces were discovered to be degraded with a gummy substance preventing proper operation of the valve. It was postulated that the degradation was caused by the presence of clam shell debris. The valve internals were replaced. Unit 2 was returned to Mode 3 at 1400 hours.

On March 17, 1988, testing was performed on the CA System to troubleshoot the cause of the CA suction swap which occurred on March 9. During the testing, CF Pump 2B tripped on low vacuum initiating a CA autostart. MDCAP 2A again swapped suction automatically to the RN System. Following this event, a series of starts were performed at various UST levels. These tests confirmed that the low suction pressure alarms/suction swaps were caused by operating with lower than recommended levels in the UST combined with having the CACST isolated.

On March 18, 1988, flow balance testing was completed for MDCAP 2A. At approximately 0900 hours, the NRC gave verbal permission to restart Unit 2 provided that the CA CST Isolation valve remained open pending further analysis. The Unit was returned to Mode 1 at 2035 hours.

CONCLUSION:

This incident has been attributed to Asiatic Clam larvae from Lake Wylie entering the RN System, settling in stagnant piping, and growing to maturity. The clam accumulation caused the Unit 2 CA System Train A performance to be degraded during the transient on March 9, 1988. Following discovery, both Units were forced to shut down to Mode 4 as required by Technical Specifications. The strainers on the RN System intakes are intact. These strainers have a 1/32 inch mesh and are periodically backflushed to remove debris. The strainer mesh could not have prevented the clam larvae from entering the RN System.

A task force has been established to study long term solutions to the clam problem at CNS. One objective of the task force will be to study methods to eliminate clams before and/or after they enter the system and determine the optimum solution in terms of economic cost and benefit. To accomplish this, the task force will study the clam life cycle, conditions for growth in the plant, and methods of killing clams. They will also review industry and Duke Fossil experience with clams.

Prior to this incident, in April 1987, Performance personnel had originated a Problem Investigation Report (PIR) identifying the RN to CA lines as a potential location for clam infestation which was unmonitored (PIR-0-C87-0086). The resolution to the PIR was to conduct radiography on the low point areas of these lines, and develop procedures to periodically monitor these lines. The radiography of the lines revealed no clam infestation in April 1987 on either Unit. Procedures are now in place for periodic monitoring and flushing of these lines. The task force will determine an appropriate frequency for monitoring these lines as part of the long term resolution to this problem.

The short term corrective actions restored the affected systems to operability or verified that operability was not affected. These actions included visual inspections, radiography, and flushing of affected lines. MDCAP 2A was verified to be undamaged by the clams by performing a head curve verification. All RN instrumentation considered susceptible to impulse line blockage was inspected. Any clogs were cleared and samples were taken for analysis. The standing work requests for periodic calibration of the affected RN instrumentation will be revised to include inspection for impulse line blockage.

The RN lines supplying the Spent Fuel Cooling (KF) System were radiographed, and minor accumulations of clams were discovered in two lines. All four of the RN to KF lines have been flushed and re-radiographed to verify that any clams were removed.

There have been no previous reportable incidents at CNS caused by aquatic wildlife. Therefore, this is considered to be an isolated event.

CORRECTIVE ACTION:

SUBSEQUENT

(1) All RN lines to both Units' CA Systems were backflushed into the RC System.

(2) Visual inspections of both Units' Train A RN to CA lines were performed following flushing and prior to restarting the Units.

(3) Radiography was performed on suspected clam traps for the Unit 2 RN to CA lines following flushing and prior to restarting the Unit.

(4) RN lines to both Units' NW Surge Chambers were flushed, and acceptable flow rates verified.

(5) RN instrumentation impulse lines were checked for blockage.

(6) Impulse lines for 1RNPS7490, 0RNPS6040, 0RNPS6000, and 2RNPS8220 were cleared and samples of the clogs were taken for analysis.

(7) All RN to KC lines for both Units were radiographed to determine if clams were present.

(8) RN to KC lines for Trains 1B, 2A, and 2B were flushed to remove clams and re-radiographed prior to Unit startup.

(9) CA lines downstream of MDCAP 2A were flushed with condensate grade sources to remove shredded clam parts. Flushing was repeated until the internals of 2CA56 and 2CA60 were free of debris.

(10) 2CA56 and 2CA60 Cavitrol cages were cleaned following the transient on March 9, 1988, and following each flushing operation of the CA System.

(11) MDCAP 2A head curve verification was performed to verify that the pump was not damaged by the clam shells.

(12) 2CA179 internals were cleaned.

(13) 2CA27 internals were replaced.

(14) Unit 2 CA System flow balancing was performed.

(15) A task force has been formed to study long term solutions to the clam problem.

(16) Design Engineering completed operability evaluations for both Units' safety related systems affected by this incident.

(17) All RN to KF lines for both Units were flushed and re-radiographed.

(18) IAE has submitted revisions to the standing work requests for periodic calibration of the RN instrumentation considered susceptible to blockage, to include inspection for clogged impulse lines.

PLANNED

(1) Long term solutions to the problem of clam infestation in stagnant or low flow raw water lines will be evaluated and a report will be provided to management.

SAFETY ANALYSIS

During this incident, the clam infestation affected several safety related systems which potentially receive assured makeup water from stagnant or low flow

RN lines. The safety significance of the potential effects on each system is discussed individually below. In each case, the potential effects are evaluated based on actual test data or simulations which reflect conditions found during testing.

Flow verification testing of the MDCAPs following the March 9, 1988 transient yielded the following results [illegible] [illegible]0 psig S/G pressure):

[illegible]IFICATION ALIGNMENT

| STEAM GENERATOR | [illegible] | ALIGNED INDIVIDUALLY |
|---|---|---|
| A | [illegible] gpm | 320 gpm |
| B | [illegible] gpm | 190 gpm |
| C | 310 gpm | N/A |
| D | 310 gpm | N/A |

The Catawba FSAR, Chapter 15 transient and accident analysis assume that the CA System has the capacity to supply a total of at least 491 gpm at the design overpressure of 1210 psig. This flow rate is based on the minimum capacity of one MDCAP supplying two intact S/G's. Since the total measured capacity of MDCAP 2A was 320 gpm due to clam fouling, the total CA System capacity would be less than that assumed in the FSAR (if the TDCAP were assumed to fail, and MDCAP 2B were assumed to supply a faulted S/G). Design Engineering has performed an evaluation to identify the limiting FSAR transient requiring CA System operation, and to analyze the impact of the degraded CA flow rates on plant response during this transient. The limiting transient was determined to be a Main Feedwater line break at S/G 1D. S/G 1D was chosen because the event could have occurred on Unit 1, and Unit 1 is more limiting during undercooling transients due to differences in S/G designs. Also, the CA pump runout protection would automatically isolate MDCAP 1B from the faulted S/G if the break were to occur at S/G 1C. The limiting transient was simulated using a three loop RETRAN-02 MOD003 computer code model. The following assumptions were made in modeling the Main Feedwater Line Break:

a) All Main Feedwater flow lost through the break.
b) All CA Flow from MDCAP 1B lost through the break (during the first 30 minutes).
c) The TDCAP is assumed to be unavailable as the limiting single failure.
d) MDCAP 1A supplies 220 and 100 gpm (at 1000 psig) to S/Gs 1A and 1B respectively. All CA flow rates are corrected for actual S/G pressure during the transient.
e) Maximum decay heat is present following Reactor Trip.

f) Operator action is assumed after 30 minutes to isolate MDCAP 1B from the faulted S/G in accordance with emergency procedures. Minimum degraded CA flow of 190 gpm (at 1000 psig) is then supplied to S/G 1C.

The transient is initiated by a break in the S/G 1D feedwater piping at time zero, which causes a loss of all main feedwater and secondary side depressurization. The Reactor trips automatically on low-low S/G level at 14.5 seconds, and is immediately followed by a Turbine trip. MDCAP 1A starts, following the Reactor trip, and begins supplying S/Gs 1A and 1B at the above degraded flow rates (corrected for S/G pressure). S/G 1D boils dry at 63 seconds. The other S/Gs continue to depressurize by blowing down through the break. At 171 seconds, a Safety Injection signal occurs on low Pressurizer pressure, and the Centrifugal Charging Pumps start supplying borated water to the NC System. At 393 seconds, a Main Steam (SM) Isolation signal occurs and the Main Steam Isolation valves close and isolate the intact S/Gs from the break. Up until this time, the plant response to the feedwater line break can be characterized as an overcooling event. The NC System temperature has decreased to 520 degree F, which is well below the normal post-trip temperature of 557 deg. F. Following the SM Isolation, the plant response evolves into an undercooling event. NC System average temperature increases along with Pressurizer level and pressure. The Pressurizer goes water solid at 1430 seconds from a combination of NC System heatup and sustained Safety Injection. The Pressurizer Power Operated Relief Valves (PORVs) begin cycling at 1435 seconds. At 1800 seconds, the Operator manually isolates MDCAP 1B from the faulted S/G and realigns it to S/G 1C. Again, a degraded flow rate is assumed based on measured data and corrected for actual S/G pressure. The total CA flow at 30 minutes has been restored to 452 gpm. At 40 minutes, the CA flow rate required to match decay heat and Reactor Coolant Pump heat is 443 gpm. Since the available heat sink exceeds the heat source, and since decay heat will decrease with time, the undercooling transient has been successfully mitigated. The results of this analysis show that the average NC System temperature never exceeds 570 degree F post-trip (which is the normal post temperature following any transient which results in a Main Steam Isolation). Inventories In S/Gs 1A, 1B, and 1C are stable or increasing at the end of the simulation. The potential safety concerns associated with loss of heat sink transients, which are bulk boiling of the NC System and overpressurization, have not been approached. Plant conditions have been stabilized and recovery actions can be undertaken. Based on these results, it is concluded that the degraded CA flow rates due to clam fouling would not have adversely affected plant safety in the unlikely event the limiting FSAR Chapter 15 transient had occurred.

The NW System assured water source was demonstrated operable by means of a flow verification. This was performed by measuring RN flow through the supply line and out a vent near the NW Surge Tanks. Design engineering then evaluated the results of these tests and determined that the supply lines were clear of any obstructions which could degrade the operability of the NW System. The minimum RN to NW makeup flow measured during the test was 13.3 gpm in Train 2B. Technical Specifications require that the total valve seal injection flow rate be

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

less than 1.7 gpm (maximum), which is an 18 month surveillance requirement. Therefore, the RN makeup capability was sufficient to ensure that the NW System would have been capable of performing its intended function, had it been required.

Radiography and flushing of the KC System confirmed the presence of clams in the stagnant RN line leading to KC Surge Tank 2A. Since the dead leg of the 4 inch RN piping leading to the KC Surge Tanks is at most 2 feet in length, the maximum volume of clams which could have been introduced into any one train of KC was approximately 1.3 gallons. The effect of this amount of clams on overall performance of KC Train 2A would have been negligible in the unlikely event RN had been required to makeup to KC. The clams would enter the system upstream of the one stage KC Pumps and pass into the shell side of the KC Heat Exchangers. The larger significant clam parts would be trapped in the heat exchanger with negligible effect on KC hydraulic performance. Any remaining debris would be small enough that clogging of any particular KC component is unlikely.

The RN lines to the KF System were discovered to contain some clams in Trains 1A and 2B. Since the lines are not restricted by valves with anti-cavitation trim or components with narrow passages, the clams would not have prevented the KC System from performing its safety function of maintaining level in the pool. Even if the introduction of clams were to disable the KF cooling loops, the pool is designed to withstand boiling conditions which would adequately cool the spent fuel. This cooling mechanism could be maintained indefinitely with RN maintaining pool level. Design calculations show that it would nominally take 12 1/2 hours for the spent fuel pool temperature to reach 200 degree F if all cooling loops were lost. If the maximum heat load is assumed, it would take 5 1/2 hours to reach 200 degree F. The above time periods would probably be sufficient to effect corrective maintenance before boiling occurred.

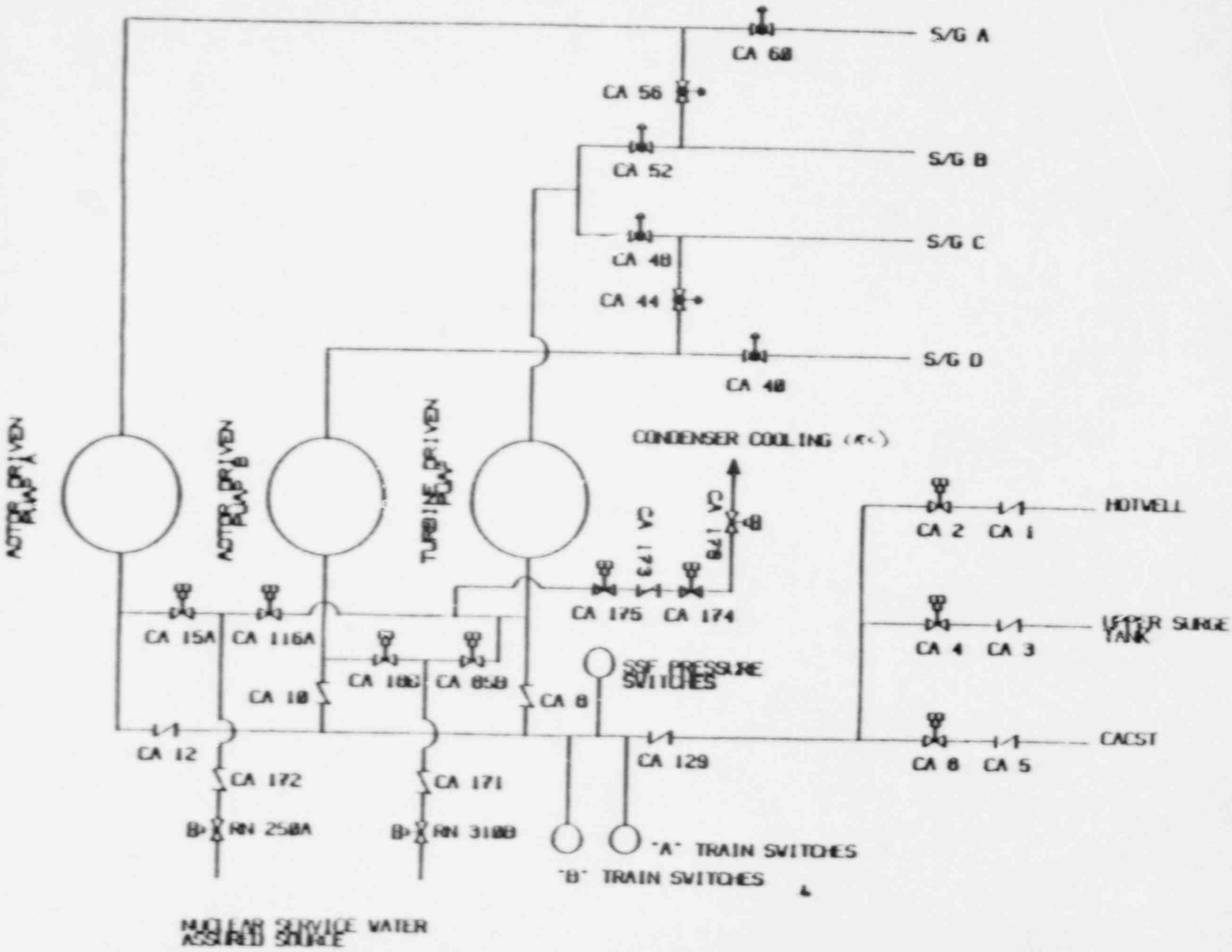
The clogs that were discovered in the low pressure impulse lines of ORNPS6000 and ORNPS6040 did not affect the operability of the Control Room Area Chillers. Both switches provide interlocks to allow the chillers to operate when a high differential pressure (D/P) signal is present (indicating the presence of cooling water flow). With the low pressure impulse line clogged, the instruments would see a larger D/P than was actually present. Therefore, the chiller units would continue to operate. The only possible consequence of these clogs is that the chiller units may not have tripped as designed on a decrease or loss of RN flow.

The clog in the low pressure impulse line of 1RNPS7490 would cause a higher than actual D/P to be sensed across RN Pump Strainer 1B. Therefore, automatic backwashing would occur more frequently (or continuously) while the strainer was in service. Since the backwashing operation does not entail removing the strainer from service, this problem did not affect the operability of the strainer. The more frequent backwashing would reduce the buildup of residue on the strainer.

The health and safety of the public were not affected by this incident.

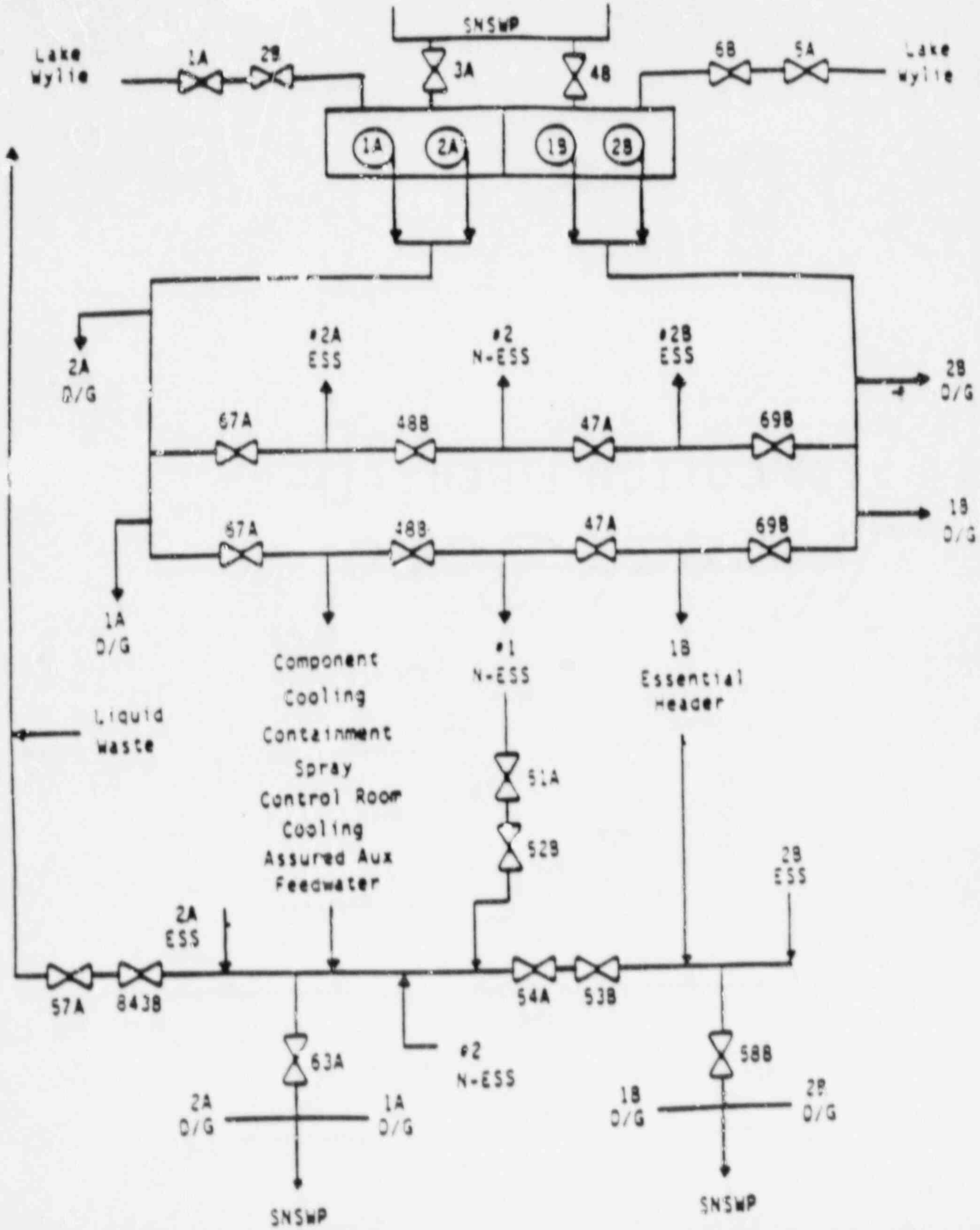
This incident is reportable pursuant to 10 CFR 50.73, Sections (a)(2)(i)(A) and (a)(2)(v).

# CATAWBA NUCLEAR STATION - (FIGURE 1) AUXILIARY FEEDWATER SYSTEM



| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | PAGE (3) |
|---|---|---|---|---|---|
| Catawba Nuclear Station, Unit | 0 5 0 0 0 4 1 3 | 8 8 | — 0 1 5 — | 0 1 | 1 3 OF 1 4 |

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




CATAWBA NUCLEAR STATION - (FIGURE 2)
NUCLEAR SERVICE WATER SYSTEM

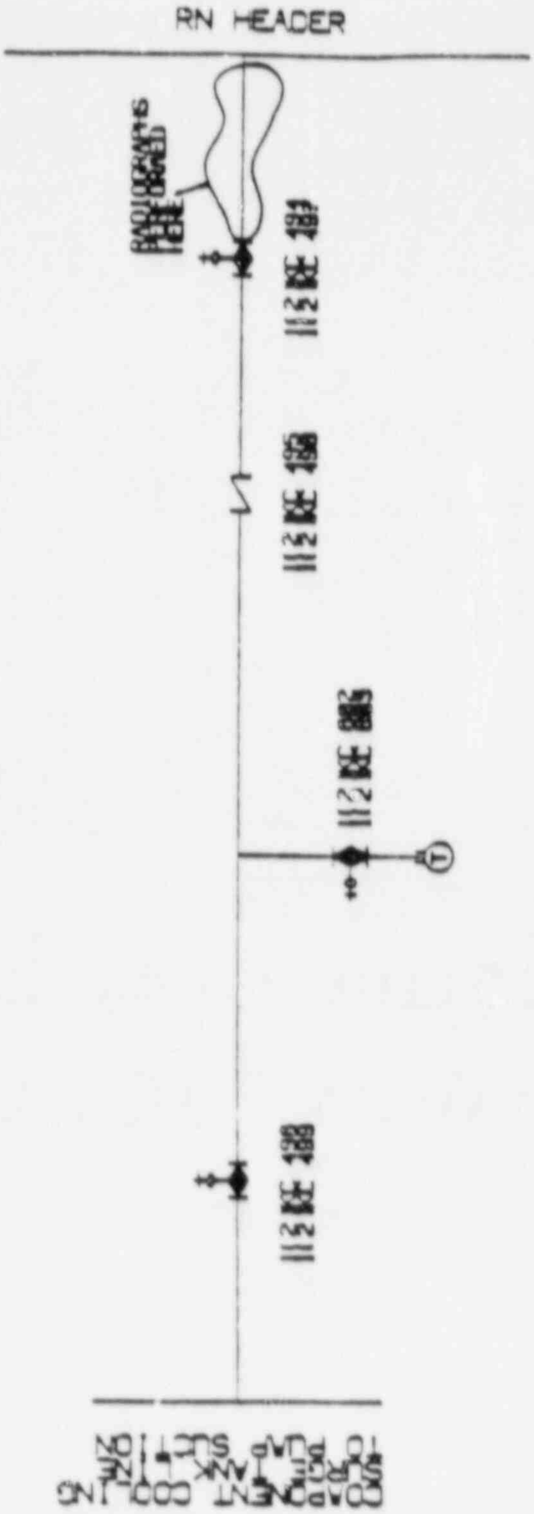
NRC Form 366A (9-83)

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

# LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | PAGE (3) |
|---|---|---|---|---|---|
| Catawba Nuclear Station, Unit | 0 5 0 0 0 4 1 5 | 8 8 | — 0 1 5 — | 0 1 | 1 4 OF 1 4 |

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




CATAWBA NUCLEAR STATION - (FIGURE 3)
RN TO KC
FLOW DIAGRAM

Duke Power Company
P.O. Box 33198
Charlotte, N.C. 28242

Hal B. Tucker
Vice President
Nuclear Production
(704)373-4531

**DUKE POWER**

September 6, 1988

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

Subject: Catawba Nuclear Station, Units 1 and 2
Docket Nos. 50-413 and 50-414
LER 413/88-15, Revision 1

Gentlemen:

Pursuant to 10 CFR 50.73 Section (a) (1) and (d), attached is Revision 1 to Licensee Event Report 413/88-15 concerning the degraded performance of the Unit 2 Auxiliary Feedwater System and required Hot Shutdown of both Units due to Asiatic Clam infestation in the Nuclear Service Water System. This event was considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

JGT/10020/lcs

Attachment

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IE22
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Group File: CN-801.01
Group File: CN-815.04
(37)