NORTHEAST UTILITIES
The Connecticut Light And Power Company
Western Massachusetts Electric Company
Holyoke Water Power Company
Northeast Utilities Service Company
Northeast Nuclear Energy Company

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Re: 10CFR50.73(a)(2)(v)
July 3, 1991
MP-91-548

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

Reference: Facility Operating License No. DPR-21
Docket No. 50-245
Licensee Event Report 91-019-00

Gentlemen:

This letter forwards Licensee Event Report 91-019-00 required to be submitted within thirty (30) days pursuant to 10CFR50.73(a)(2)(v).

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

For: Stephen E. Scace
Director, Millstone Station

By: John S. Keenan
Millstone Unit 2 Director

SES/WGN:ljs

Attachment: LER 91-019-00

cc: T. T. Martin, Region I Administrator
W. J. Raymond, Senior Resident Inspector, Millstone Unit Nos. 1, 2 and 3
D. H. Jaffe, NRC Project Manager, Millstone Unit Nos. 1 and 3

Cert No P266578662

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NRC Form 366 (6-89) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

Estimated burden per response to comply with this information collection request: 50.0 hrs. Forward comments regarding burden estimate to the Records and Reports Management Branch (p-530), U.S. Nuclear Regulatory Commission, Washington, DC 20555, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1): Millstone Nuclear Power Station Unit 1

DOCKET NUMBER (2): 0 5 0 0 0 2 4 5

PAGE (3): 1 OF 0 8

TITLE (4):

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	
0 6	1 0	9 1	9 1	– 0 1 9	– 0 0	0 7	0 3	9 1		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): N

POWER LEVEL (10): 1 0 0

THIS REPORT IS BEING 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)	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
William G. Noll, Sr. Engineer, Ext. 4442	AREA CODE 2 0 3 — 4 4 7 – 1 7 9 1

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	
B	B G	M O	G 0 8 0	N		B	B O	M O	G 0 8 0	N	

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 June 10, 1991, at 1530 hours, with the plant in Cold Shutdown (82 degrees Fahrenheit and 0 psig), an ongoing engineering analysis concluded that the Low Pressure Coolant Injection (LPCI) system and the Core Spray system motors could not be demonstrated to be operable during postulated accident conditions. This conclusion was based upon higher calculated post accident torus temperatures combined with higher than previously assumed ambient room temperatures. The cooling water supply for the LPCI and Core Spray motor bearings is supplied from the containment torus water via the pump discharge piping. The postulated increase in the torus and reactor building temperatures adversely affected the operation of the upper motor bearings.

On June 19, 1991, at 1510, with the plant in Cold Shutdown, it was also determined as a result of the postulated increase in reactor building temperatures near the torus area that the wide range torus level instruments did not meet the environmental temperature conditions postulated during accident conditions.

No safety systems were required to function as a result of this event and no safety consequences resulted from this event.

I. Description of Event

On June 10, 1991, at 1530 hours, with the plant in Cold Shutdown (82 degrees Fahrenheit and 0 psig), an ongoing engineering analysis concluded that the Low Pressure Coolant Injection (LPCI) system and the Core Spray system motors could not be demonstrated to be operable during postulated accident conditions. This conclusion was based upon higher calculated post accident torus temperatures combined with higher than previously assumed ambient room temperatures. The cooling water supply for the LPCI and Core Spray motor bearings is supplied from the containment torus water via the pump discharge piping. The postulated increase in the torus and reactor building temperatures adversely affected the operation range of the upper motor bearings.

On June 19,1991, at 1510, with the plant in Cold Shutdown, it was also determined as a result of the postulated increase in reactor building temperatures near the torus area that the wide range torus level instruments did not meet the environmental temperature conditions postulated during accident conditions.

II. Cause of Event

The cause of this event was an incorrect assumption of the design temperature parameters associated with the motor bearing cooling water system to the LPCI and Core Spray motors. The design parameters for the post LOCA torus temperatures and the post LOCA reactor building corner room temperatures have been revised due to on-going analysis.

Prior to initial plant startup in 1970, the motor bearing cooling water system was modified to a "self cooling" mode where the cooling water to the motor bearings was supplied from the respective pump discharge piping. This design was demonstrated to be satisfactory by the performance of testing that simulated the assumed accident conditions in the torus and the reactor building corner rooms where the LPCI and Core Spray pumps are located. Testing demonstrated that the motor bearing oil cooling system could function with accident temperature conditions in the torus at 203 degrees with simulated high temperature room temperatures. However, recent evaluations have shown that the simulated accident temperature for the reactor building corner rooms was not representative of the current post accident temperature profile.

The significance of the ambient room temperature was amplified by the removal of a portion of the piping insulation in the reactor building corner rooms during the 1987 Refueling Outage for in-service piping inspections. The decision not to replace the piping insulation did not consider the effects on the LPCI or Core Spray motor bearing temperatures. Although the removal of the piping insulation was a contributing factor, it should be noted that this was not the determining factor for increased corner room temperature.

III. Analysis of Event

These two events are reportable pursuant to 10CFR50.73(a)(2)(v), any event or condition that alone could have prevented fulfilling the safety function of structures or systems. A potential failure of the LPCI and Core Spray motor bearings, or the torus wide range level transmitters, could seriously jeopardize the ability to remove residual heat, or mitigate the consequences of an accident. Immediate notifications were performed in accordance with 10CFR50.72(b)(2)(iii).

A review of the LPCI and Core Spray motor bearing oil cooling system for elevated accident torus temperature began following the preliminary results obtained from the containment analysis program. LER 91-002-00 documented the concerns associated with the elevated torus temperatures following a LOCA and the unanalyzed effects on the LPCI and Core Spray system piping, components, and motor bearing operability.

LPCI and Core Spray Motor Upper Bearing Evaluation

The LPCI and Core Spray motor bearing cooling configuration is shown in Figure 1. The self-cooling system was originally designed to provide Emergency Core Cooling System (ECCS) motor operation without reliance upon other systems. This design was considered to be adequate until a review of the preliminary containment analysis indicated higher torus temperatures (i.e., source of motor bearing cooling) would result following a design basis accident LOCA. The operability of the motor bearing self cooling design was reviewed, even though the final torus temperature only changed from 203 degrees to 205 degrees.

Testing was performed in April 1991 to collect bearing oil temperature data for an engineering evaluation being performed by GE. The purpose of the testing was to determine if the self cooling water supply cooling could be isolated and removed by relying upon the air cooling provided by the rotor rotation. The testing indicated that the Core Spray motor bearing stabilized at approximately 136 degrees during full flow testing without cooling water supplied to the upper motor bearing. The LPCI motor was also tested and demonstrated that a cooling water supply was required to achieve an equilibrium motor bearing temperature of less than 170 degrees. The LPCI and Core Spray test results were forwarded to General Electric for evaluation. An analysis of the motor bearing temperature profile with respect to the assumed accident corner room temperature conditions was conducted to determine whether the operability of the LPCI and Core Spray motors could be ensured under all conditions. The GE analysis indicated that the LPCI motors required an external source of cooling to ensure motor operability. However, a bearing cooling water supply from the torus water was not acceptable due to the elevated temperatures following a design basis accident. GE analysis also demonstrated that the Core Spray motors would operate without cooling water with ambient room conditions up to 140 degrees.

The effects on the upper motor bearing condition are directly related to the bearing operating temperature. At bearing temperatures above 250 degrees, the dimensional stability and the subsequent reliability and life of the bearing is jeopardized. These temperature values are derived from analytical assumptions and calculations, not from actual motor test data at the assumed accident conditions.

Corner Room Temperature Evaluation

Because the actual ambient room temperature was an integral part of determining the operability of the LPCI and Core Spray motor bearings, the original corner room design temperature of 120 degrees was reevaluated. Preliminary modeling of the room temperature profile was performed by EBASCO in conjunction with analysis performed by Northeast Utilities. Due to the complexity of the computer modeling, the model was initially limited to the corner room locations near the LPCI and Core Spray motors. The results of this analysis concluded that the conservative room temperature of 156 degrees would exist during the post LOCA accident scenario. (See corrective action item number 6 for additional information.)

Design Basis Accident Evaluation

The significance of the elevated motor bearing oil temperatures on the operability of the LPCI and Core Spray motors is directly related to the design basis LOCA. The torus temperature profile calculated by the recent containment accident analysis is based upon the following design basis initial plant conditions:

1. Initial Service Water temperature of 75 degrees
2. Initial torus water temperature of 90 degrees
3. Maximum decay heat load assumed
4. Single active failure on either the Gas Turbine or Diesel Generator

The combined effects of these initial plant conditions result in a torus temperature profile that could result in LPCI and Core Spray motor bearings being subjected to excessive temperatures during the design basis accident transient. During the postulated accident condition where the torus water reaches 205 degrees, bearing heat would not be transferred from the bearing oil reservoir to the bearing oil coolers. This condition could cause the bearing oil to heat up rapidly.

Wide Range Torus Level Instrument Evaluation

Increased ambient temperatures in the torus area resulted in environmental conditions beyond the qualification of the existing torus wide range level instruments. Torus water level is not expected to vary significantly during any postulated accident; therefore, the effects of potential erroneous torus level indication would not adversely impact an operators ability to implement the Emergency Operating Procedures (EOPs).

Long Term Containment Cooling Evaluation

The most severe impact from elevated torus water temperature for cooling the LPCI and Core Spray motors is related to the long term core and containment cooling requirements following a design basis LOCA. Short term containment cooling requirements are not affected due to the time duration associated with the torus water temperature increase. Operation of the LPCI system in the containment cooling mode only permits one LPCI pump in operation while the LPCI heat exchanger is in service. In addition, the bearing cooling water for the LPCI motors is supplied from a source downstream of the LPCI heat exchanger to take advantage of the addition cooling. Therefore, the maximum design basis temperature that could be supplied to the LPCI motors is 192 degrees that would provide an additional operating margin. Should the operating LPCI motor fail due to bearing degradation during the long term containment cooling mode, the remaining pump in that LPCI subsystem would be available for operation. If the opposite containment cooling loop were available, then peak torus temperatures would be significantly lower due to the operation of an additional LPCI heat exchanger. This condition would result in more acceptable motor bearing temperatures for long term cooling requirements.

Short Term Core Cooling Evaluation

In the short term, the core reflood capability provided by the Core Spray system and the LPCI system would be available under all assumed accident conditions. This conclusion is supported by the containment analysis performed by GE that demonstrated sufficient time following the design basis accident where torus temperatures reach marginal cooling capacity for the LPCI and Core Spray motors. The torus temperature profile during a design basis accident LOCA is shown in Figure 2.

Long Term Core Cooling Evaluation

In a LOCA, immediately after the blowdown phase, the core is flooded to at least the elevation of the jet pumps ($^2/_3$ core height) by the LPCI and Core Spray pumps. The covered portion of the core (lower $^2/_3$ of core) is cooled by two-phase heat transfer. If the Core Spray system was not available to provide the spray flow, then the uncovered portion of the core would be cooled by steam generated in the lower portion of the core. Millstone Unit One specific GE analysis and analyses performed by Northeast Utilities demonstrate that a water level of $^2/_3$ core height will ensure that steam cooling is adequate to maintain core cooling. These analyses were performed in support of EOPs.

Injection flow requirements to maintain reactor vessel level at $^2/_3$ core height decrease to a few hundred gallons per minute after a few hours. This flowrate could easily be provided by any one of six low pressure ECCS pumps (i.e., LPCI or Core Spray) or by an alternate injection system such as the Control Rod Drive system.

Based upon the system configuration of Millstone Unit One described above, the safety significance of this event has been determined to be minimal. Replacement of the Core Spray motors during the current refueling outage, combined with the technical specification bases change for the LPCI system (see Corrective Action section), eliminates the combined adverse effects of torus water and reactor building ambient temperatures. The safety significance of previous LPCI and Core Spray system configuration is indeterminate due to the complexity of torus and ambient temperature effects on the performance of the motor bearings.

IV. Corrective Action

The following paragraphs summarize the comprehensive corrective action implemented by NNECo to resolve the effects of postulated increased post accident temperatures on the LPCI and Core Spray systems.

1. **Replacement Core Spray Motors**

The original Core Spray motors were replaced during the 1991 refueling outage with fully qualified air cooled motors to eliminate the need for an external source of cooling to the upper motor bearing. The equipment qualification of the new Core Spray motors should provide sufficient margin to any future ambient room conditions expected as a result of the continuing reactor building modeling of post accident temperature conditions.

2. **Revision of LPCI Bases Section in Technical Specifications**

The bases section of the Millstone Unit One Technical Specifications was updated under the provisions of 10CFR50.59 to clarify the complement of LPCI pumps required to fulfill the core and containment cooling functions of the LPCI system. The short term function of the LPCI system consists of four LPCI pumps that are required during the first 10 minutes following a design basis LOCA. The long term core and containment cooling function of the LPCI system consists of only two pumps that are required for long term operation. The current LPCI system configuration is based upon limiting the flow through the LPCI heat exchanger to only one pump when the heat exchanger is placed in service. Each containment cooling subsystem contains one air cooled LPCI motor. Therefore, the necessity to operate only one LPCI pump through the heat exchanger satisfies both the long term core and containment cooling functions with an air-cooled motor that meets all long term cooling design requirements.

3. **Restoration of Reactor Building Corner Room Seals and Piping Insulation**

Permanent seals between the reactor building corner rooms and the adjacent torus area were installed during the 1991 refueling outage to establish the original design conditions used during the corner room temperature profile testing performed in 1970. The 1970 test results formed the basis for the current corner room temperature profile of 156 degrees. The seals between the rooms were originally installed to preclude convection air flow communication between these areas. In addition, the corner room insulation was restored to the original test configuration which included insulation on the piping, LPCI heat exchanger, and the LPCI and Core Spray pump casings.

Current plant design change requirements include evaluation of this type of system alteration and the potential impacts on system operability.

4. **Equipment Qualification Review of Components and Instrument in Lower Level Reactor Building**

A review of equipment in the torus room area and the reactor building corner room area was performed to ensure all equipment was qualified to the new higher post accident area temperatures. Previous equipment qualifications were performed at a temperature of 120 degrees based upon the analysis used for the reactor building pipe break analysis. During this review, it was determined that the torus level wide range instruments did not meet the environmental temperature conditions postulated during accident conditions. Replacement torus level wide range instruments will be installed prior to startup from the current refueling outage.

5. **Replacement of Remaining Water Cooled LPCI Motors on an Accelerated Basis**

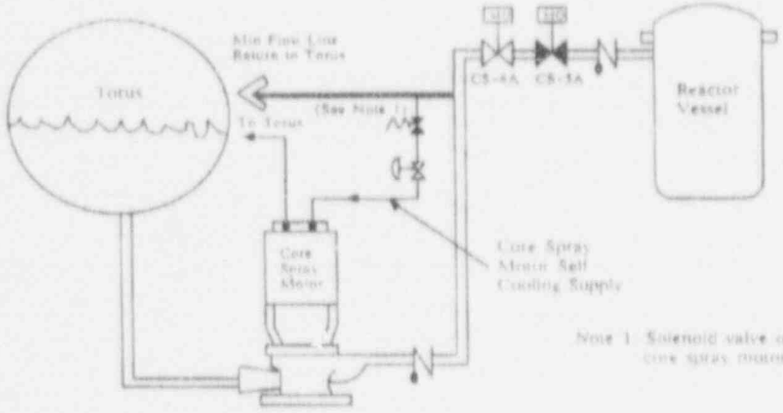
Millstone Unit One is pursuing replacement of the remaining two water cooled LPCI motors on an expedited basis. The replacement motors are expected to be installed at the next refueling outage or at an opportune time during the next operating cycle.

6. **Revision of Reactor Building Post Accident Temperature Profile**

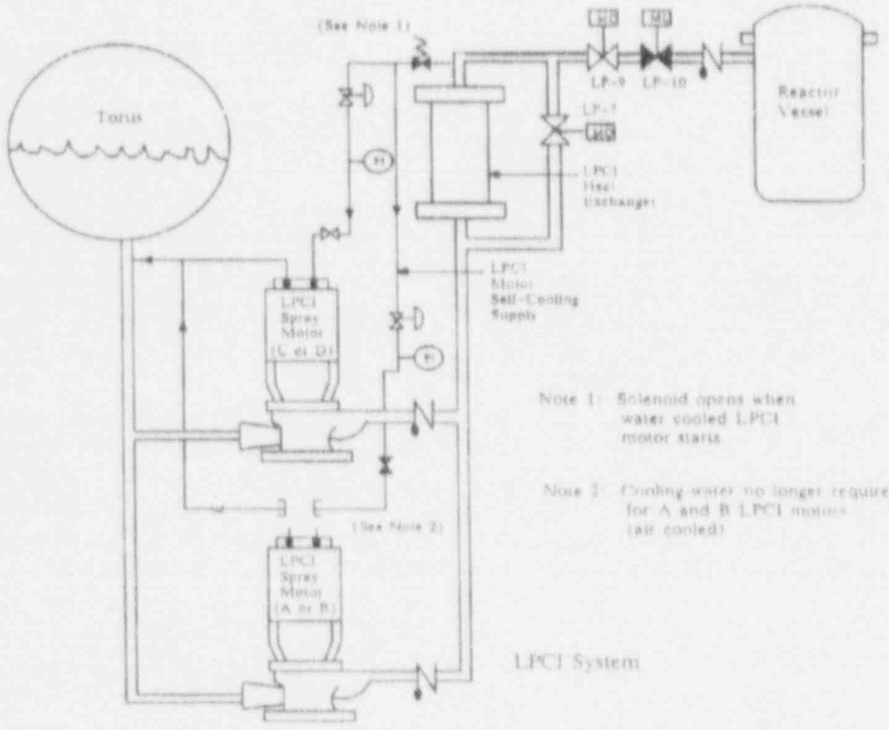
The need to reevaluate the reactor building post accident temperature profile was identified during this event. The current corner room temperature of 156 degrees is considered conservative and yet provides sufficient margin for current equipment and component qualification. Preliminary analysis performed by EBASCO and Northeast Utilities will continue to determine the anticipated reactor building temperature profile following accident conditions.

V. Additional Information

None



Core Spray System



LPCI System

LPCI and Core Spray Motor Bearing Cooling

Figure 1

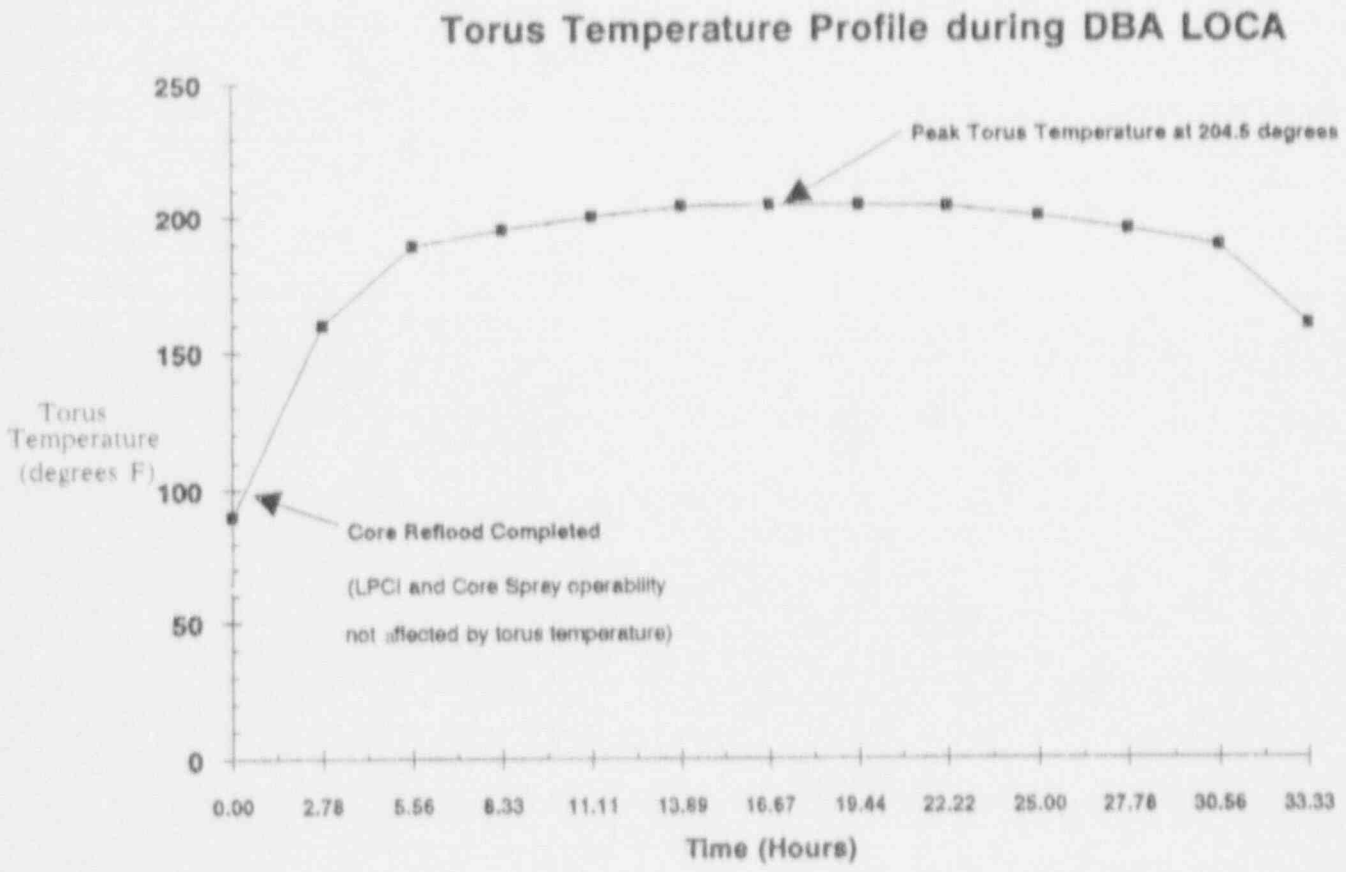

Torus Temperature Profile during DBA LOCA
Peak Torus Temperature at 204.5 degrees
Torus Temperature (degrees F)
250
200
150
100
50
0
Core Reflood Completed
(LPCI and Core Spray operability
not affected by torus temperature)
0.00
2.78
5.56
8.33
11.11
13.89
16.67
19.44
22.22
25.00
27.78
30.56
33.33
Time (Hours)

Figure 2