3/4.6.5 ICE CONDENSER

ICE BED

LIMITING CONDITION FOR OPERATION

3.6.5.1 The ice bed shall be OPERABLE with:

a. The stored ice having a boron concentration of at least 1800 ppm boron as sodium tetraborate and a pH of 9.0 to 9.5,

b. Flow channels through the ice condenser,

c. A maximum ice bed temperature of less than or equal to 27°F,

d. A total ice weight of at least ~~2,099,790~~ 1,516,800 pounds at a 95% level of confidence, and

e. 1944 ice baskets.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTION:

With the ice bed inoperable, restore the ice bed to OPERABLE status within 48 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.6.5.1 The ice condenser shall be determined OPERABLE:

a. At least once per 12 hours by using the Ice Bed Temperature Monitoring System to verify that the maximum ice bed temperature is less than or equal to 27°F,

b. At least once per 9 months by:

1) Chemical analyses which verify that at least nine representative samples of stored ice have a boron concentration of at least 1800 ppm as sodium tetraborate and a pH of 9.0 to 9.5 at 20°C;

~~*~~2) Weighing a representative sample of at least 144 ice baskets and verifying that each basket contains at least ~~1081~~ 781 lbs of ice. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall be constituted of

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~~*For Unit 2 only, this surveillance is not required to be performed until the next outage of sufficient duration, but no later than February 28, 1992.~~

1 basket each from Radial Rows 1, 2, 4, 6, 8, and 9 (or from the same row of an adjacent bay if a basket from a designated row cannot be obtained for weighing) within each bay. If any basket is found to contain less than ~~1081~~ 781 pounds of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The minimum average weight of ice from the 20 additional baskets and the discrepant basket shall not be less than ~~1081~~ 781 pounds/basket at a 95% level of confidence.

The ice condenser shall also be subdivided into 3 groups of baskets, as follows: Group 1 - Bays 1 through 8, Group 2 - Bays 9 through 16, and Group 3 - Bays 17 through 24. The minimum average ice weight of the sample baskets from Radial Rows 1, 2, 4, 6, 8, and 9 in each group shall not be less than 781 ~~1081~~ pounds/basket at a 95% level of confidence.

The minimum total ice condenser ice weight at a 95% level of confidence shall be calculated using all ice basket weights determined during this weighing program and shall not be less than ~~2,099,790~~ 1,516,800 pounds; and

3) Verifying, by a visual inspection of at least two flow passages per ice condenser bay, that the accumulation of frost or ice on flow passages between ice baskets, past lattice frames, through the intermediate and top deck floor grating, or past the lower inlet plenum support structures and turning vanes is restricted to a thickness of less than or equal to 0.38 inch. If one flow passage per bay is found to have an accumulation of frost or ice with a thickness of greater than or equal to 0.38 inch, a representative sample of 20 additional flow passages from the same bay shall be visually inspected. If these additional flow passages are found acceptable, the surveillance program may proceed considering the single deficiency as unique and acceptable. More than one restricted flow passage per bay is evidence of abnormal degradation of the ice condenser.

c. At least once per 40 months by lifting and visually inspecting the accessible portions of at least two ice baskets from each one-third of the ice condenser and verifying that the ice baskets are free of detrimental structural wear, cracks, corrosion, or other damage. The ice baskets shall be raised at least 12 feet for this inspection.

3/4.6.5 ICE CONDENSER

The requirements associated with each of the components of the ice condenser ensure that the overall system will be available to provide sufficient pressure suppression capability to limit the containment peak pressure transient to less than 14.8 psig during LOCA conditions.

3/4.6.5.1 ICE BED

The OPERABILITY of the ice bed ensures that the required ice inventory will: (1) be distributed evenly through the containment bays, (2) contain sufficient boron to preclude dilution of the containment sump following the LOCA, and (3) contain sufficient heat removal capability to condense the Reactor Coolant System volume released during a LOCA. These conditions are consistent with the assumptions used in the accident analyses.

The minimum weight figure of 1081 pounds of ice per basket contains a 10% conservative allowance for ice loss through sublimation which is a factor of 10 higher than assumed for the ice condenser design. The minimum weight figure of 2,099,790 pounds of ice also contains an additional 1.1% conservative allowance to account for systematic error in weighing instruments. In the event that observed sublimation rates are equal to or lower than design predictions after 3 years of operation, the minimum ice baskets weight may be adjusted downward. In addition, the number of ice baskets required to be weighed each 9 months may be reduced after 3 years of operation if such a reduction is supported by observed sublimation data.

REPLACE W/ ATTACH'D

3/4.6.5.2 ICE BED TEMPERATURE MONITORING SYSTEM

The OPERABILITY of the Ice Bed Temperature Monitoring System ensures that the capability is available for monitoring the ice temperature. In the event the system is inoperable, the ACTION requirements provide assurance that the ice bed heat removal capacity will be retained within the specified time limits.

3/4.6.5.3 ICE CONDENSER DOORS

The OPERABILITY of the ice condenser doors and the requirement that they be maintained closed ensures that the Reactor Coolant System fluid released during a LOCA will be diverted through the ice condenser bays for heat removal and that excessive sublimation of the ice bed will not occur because of warm air intrusion.

If an ice condenser door is not capable of opening automatically, then system function is seriously degraded and immediate action must be taken to restore the opening capability of the door. Not capable of opening automatically is defined as those conditions in which a door is physically blocked from opening by installation of a blocking device or by obstruction from temporary or permanent installed equipment or is otherwise inhibited from opening such as may result from ice, frost, debris or increased door opening torque.

REPLACEMENT

The minimum required ice weight (781 pounds avg. for 1944 baskets ≅ 1,516,800 pounds) contains a conservative allowance (108 pounds/basket) for ice loss due to sublimation, and to account for weighing inaccuracy. The allowance, which is not dependent upon ice mass, has been determined to be appropriate based on observed sublimation rates through the course of plant operation.

Attachment Ib
Revised Originals

3/4.6.5 ICE CONDENSER

ICE BED

LIMITING CONDITION FOR OPERATION

3.6.5.1 The ice bed shall be OPERABLE with:

a. The stored ice having a boron concentration of at least 1800 ppm boron as sodium tetraborate and a pH of 9.0 to 9.5,

b. Flow channels through the ice condenser,

c. A maximum ice bed temperature of less than or equal to 27°F,

d. A total ice weight of at least 1,516,800 pounds at a 95% level of confidence, and

e. 1944 ice baskets.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTION:

With the ice bed inoperable, restore the ice bed to OPERABLE status within 48 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.6.5.1 The ice condenser shall be determined OPERABLE:

a. At least once per 12 hours by using the Ice Bed Temperature Monitoring System to verify that the maximum ice bed temperature is less than or equal to 27°F,

b. At least once per 9 months by:

1) Chemical analyses which verify that at least nine representative samples of stored ice have a boron concentration of at least 1800 ppm as sodium tetraborate and a pH of 9.0 to 9.5 at 20°C;

2) Weighing a representative sample of at least 144 ice baskets and verifying that each basket contains at least 781 lbs of ice. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall be constituted of

SURVEILLANCE REQUIREMENTS (Continued)

1 basket each from Radial Rows 1, 2, 4, 6, 8, and 9 (or from the same row of an adjacent bay if a basket from a designated row cannot be obtained for weighing) within each bay. If any basket is found to contain less than 781 pounds of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The minimum average weight of ice from the 20 additional baskets and the discrepant basket shall not be less than 781 pounds/basket at a 95% level of confidence.

The ice condenser shall also be subdivided into 3 groups of baskets, as follows: Group 1 - Bays 1 through 8, Group 2 - Bays 9 through 16, and Group 3 - Bays 17 through 24. The minimum average ice weight of the sample baskets from Radial Rows 1, 2, 4, 6, 8, and 9 in each group shall not be less than 781 pounds/basket at a 95% level of confidence.

The minimum total ice condenser ice weight at a 95% level of confidence shall be calculated using all ice basket weights determined during this weighing program and shall not be less than 1,516,800 pounds; and

3) Verifying, by a visual inspection of at least two flow passages per ice condenser bay, that the accumulation of frost or ice on flow passages between ice baskets, past lattice frames, through the intermediate and top deck floor grating, or past the lower inlet plenum support structures and turning vanes is restricted to a thickness of less than or equal to 0.38 inch. If one flow passage per bay is found to have an accumulation of frost or ice with a thickness of greater than or equal to 0.38 inch, a representative sample of 20 additional flow passages from the same bay shall be visually inspected. If these additional flow passages are found acceptable, the surveillance program may proceed considering the single deficiency as unique and acceptable. More than one restricted flow passage per bay is evidence of abnormal degradation of the ice condenser.

c. At least once per 40 months by lifting and visually inspecting the accessible portions of at least two ice baskets from each one-third of the ice condenser and verifying that the ice baskets are free of detrimental structural wear, cracks, corrosion, or other damage. The ice baskets shall be raised at least 12 feet for this inspection.

3/4.6.5 ICE CONDENSER

The requirements associated with each of the components of the ice condenser ensure that the overall system will be available to provide sufficient pressure suppression capability to limit the containment peak pressure transient to less than 14.8 psig during LOCA conditions.

3/4.6.5.1 ICE BED

The OPERABILITY of the ice bed ensures that the required ice inventory will: (1) be distributed evenly through the containment bays, (2) contain sufficient boron to preclude dilution of the containment sump following the LOCA, and (3) contain sufficient heat removal capability to condense the Reactor Coolant System volume released during a LOCA. These conditions are consistent with the assumptions used in the accident analyses.

The minimum required ice weight (781 pounds avg. for 1944 baskets ≅1,516,800 pounds) contains a conservative allowance (108 pounds/basket) for ice loss due to sublimation, and to account for weighing inaccuracy. The allowance, which is not dependent upon ice mass, has been determined to be appropriate based on observed sublimation rates through the course of plant operation.

3/4.6.5.2 ICE BED TEMPERATURE MONITORING SYSTEM

The OPERABILITY of the Ice Bed Temperature Monitoring System ensures that the capability is available for monitoring the ice temperature. In the event the system is inoperable, the ACTION requirements provide assurance that the ice bed heat removal capacity will be retained within the specified time limits.

3/4.6.5.3 ICE CONDENSER DOORS

The OPERABILITY of the ice condenser doors and the requirement that they be maintained closed ensures that the Reactor Coolant System fluid released during a LOCA will be diverted through the ice condenser bays for heat removal and that excessive sublimation of the ice bed will not occur because of warm air intrusion.

If an ice condenser door is not capable of opening automatically, then system function is seriously degraded and immediate action must be taken to restore the opening capability of the door. Not capable of opening automatically is defined as those conditions in which a door is physically blocked from opening by installation of a blocking device or by obstruction from temporary or permanent installed equipment or is otherwise inhibited from opening such as may result from ice, frost, debris or increased door opening torque.

ATTACHMENT 2

Technical Justification and Safety Analysis

The requested changes to the McGuire Nuclear Station Technical Specification (T.S.) 3/4.6.5.1 reduce the required ice condenser ice weight (total ice inventory and per ice basket) of the containment ice condenser from the current values of 2,099,790 lbs total and 1081 lbs. per basket to 1,516,800 lbs. total and 781 lbs. per basket. These changes would provide needed additional flexibility while reducing the overall costs of maintaining the required ice weight. Sublimation of the ice requires a large maintenance effort and associated costs during each refueling outage. Changes in the core design have resulted in increased fuel cycle length. These increases in fuel cycle length, in combination with schedule constraints and the desire to keep maintenance activities associated with the ice condenser from becoming critical path items during refueling outages, have resulted in the need for greater flexibility in maintaining the required ice weight.

Background:

As discussed in FSAR Section 6.2.1.1.1, the ice condenser is designed to limit the containment pressure below the design pressure for all reactor coolant pipe break sizes up to and including a double-ended severance. Analyses have shown that the accident which produces the highest blowdown rate results in the maximum containment pressure rise. This accident is the double-ended cold leg break loss of coolant accident (LOCA). The ice condenser containment and associated systems can also accommodate post-blowdown energy releases without exceeding the containment design pressure.

The ice condenser is subdivided into 24 bays which contain 1944 ice baskets that are 12 inches in diameter and 48 feet long. The ice baskets ensure that ice inventory will be distributed evenly and contain sufficient heat removal capability.

Technical Specification 3/4.6.5.1 specifies that the ice condenser shall be operable with a total ice weight of at least 2,099,790 pounds at a 95% level of confidence (LOC) with 1944 ice baskets. This is the minimum amount of ice to be maintained to mitigate the energy release following a LOCA. These conditions are applicable in Mode 1, Power Operation, Mode 2, Start-up, Mode 3, Hot Standby, and Mode 4, Hot Shutdown. The T.S. action statement specifies that with the ice condenser inoperable, restore the ice condenser to operable status within 48 hours or the unit must be in at least Hot Standby within the next 6 hours and in Cold Shutdown within the following 30 hours.

Per FSAR Section 6.2.1.1.3.1, Containment Functional Design Evaluation for the Loss of Coolant Accident, the peak containment pressure transient analysis assumes 1,890,000 pounds of ice initially in the ice condenser (basis for the Technical Specification Limit). The minimum T.S. specified ice weight of 2,099,790 pounds contains a 10% conservative allowance for ice loss through sublimation, and also contains an additional 1.1% conservative allowance to account for systematic error in weighing the ice. These conservative allowances are intended to ensure that

actual total ice weight remains above the value assumed in the FSAR analysis for the duration of the fuel cycle. Thus, the T.S. minimum ice weight is calculated as 1,890,000 lbs. plus 11.1% (209,790 lbs.) equals 2,099,790 lbs.

T.S. 4.6.5.1 requires that at least once per 9 months a representative sample of at least 144 ice baskets be weighed. If any basket is found to contain less than 1081 lbs. of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The minimum average weight of ice from the 20 additional baskets and the discrepant basket shall not be less than 1081 lbs. per basket at a 95% confidence level. The basis for this requirement recognizes that ice basket degradation (e.g., sublimation) will occur during unit operation resulting in lowered ice weights (some possible below 1081 lbs.), and is not meant to impose this weight limit for all baskets at all times as long as the total ice weight can be shown to be not less than 2,099,790 lbs. at a 95% LOC (i.e., the ice condenser does not have to be declared inoperable just because a surveilled ice basket weighs less than 1081 lbs.).

As noted above the T.S. limiting condition for operation (LCO) total ice weight specified was determined/calculated to ensure the actual ice weight remains above the value assumed in the FSAR analysis for the duration of the fuel cycle. Therefore, the T.S. surveillance requirements were written to ensure that the actual minimum average ice weight for any statistical sub-group always remains above 973 lbs. (i.e., the FSAR analysis assumed ice weight per ice basket, 1,890,000 lbs. divided by 1944 ice baskets) and thus the actual total ice weight above 1,890,000 lbs., for the duration of the surveillance interval. The surveillance requires that ice weight be measured at a point in time (i.e., at least once per 9 months), and assumes the 10% conservative allowance added will account for expected sublimation until the next required surveillance, and the 1.1% conservative allowance added will account for any instrument weighing errors. Thus, as long as the measured average ice basket ice weight is at least 1081 lbs. when the surveillance is performed, the actual ice weight should remain above the weight assumed in the FSAR analysis until the next required surveillance (at which time ice could be added if needed). Therefore, normal degradation of the ice bed following surveillance is not considered an operability concern. Note that the minimum average ice weight for the duration of the surveillance interval for any statistical sub-group based on measured (weighed) values is 983 lbs. per basket (i.e., 973 lbs. plus the 1.1% instrument weighing uncertainty equals 983, conservatively rounded up), and is referred to as the "safety margin".

History of Technical Specification Ice Weight

The FSAR peak containment pressure analysis submitted with the original McGuire license application assumed an ice weight of 2.22×10^6 lbs. This analysis was performed by Westinghouse utilizing the LOTIC-1 computer code, and resulted in a calculated peak containment pressure of 14.8 psig. This was lower than the McGuire containment design pressure of 15.0 psig. This provided the basis for the Technical Specification 3/4.6.5.1 minimum ice weight of 2,466,420 lbs, which was in place from the original McGuire license until 1991. A request to reduce the Technical Specification limit was submitted by Duke Power Company on June 7, 1990, to facilitate ice condenser maintenance. The new T.S. 3/4.6.5.1 minimum ice weight was 2,099,790 lbs, based on an analytical assumption of 1,890,000 lbs. The resulting peak

containment pressure was 14.07 psig, which is the current FSAR analysis value. The request was approved on June 12, 1991 (Amendment 120/102 for MNS-1/2).

A reduced ice weight resulting in a lower containment pressure is explained by the fact that numerous other LOTIC-1 input changes and a change in methodology have had an overall mitigating effect on the peak pressure. Most importantly, Westinghouse's new mass/energy methodology, described in WCAP-10325, resulted in substantially lower peak containment pressures. Other assumptions lowering the containment pressure were: a decreased refueling water tank temperature, an increased RHR (auxiliary) spray flow, and an increased active sump volume. These changes resulted either from refined analytical methods and/or from upgraded plant system performance capabilities. On the other hand there were input changes which caused containment pressure to increase due to degradation of system performances. These were, specifically, heat exchanger degradation due to fouling and/or flow reduction, and an increase in the standby nuclear service water pond temperature. These modifications were implemented in LOTIC-1 in the course of several years and numerous analyses were performed to arrive at acceptable results. The overall combined impact of these input changes is a lower peak containment pressure.

Basis for Change

Sublimation of the ice bed requires a large maintenance effort and associated costs during each refueling outage. Changes in the core design have resulted in increased fuel cycle length. These increases in fuel cycle length, in combination with schedule constraints and the desire to keep maintenance activities associated with the ice condenser from becoming critical path items during refueling outages, have resulted in the need for greater flexibility in maintaining the required ice weight.

The current FSAR peak containment pressure calculation is performed utilizing methodology which is of 1970's vintage. This methodology has no remaining margin which can be used to reduce the required ice weight and as such is excessively simplistic and conservative. New methodology for analyzing the mass and energy release and containment response has been developed by Duke Power Company for the McGuire and Catawba Nuclear Stations. This methodology is described in the topical report DPC-NE-3004-P. This methodology utilizes more sophisticated computer codes, and is available for use in reanalyzing the long-term containment pressure response to a reduction in the assumed ice bed ice weight. Topical Report DPC-NE-3004-P was submitted for NRC review on September 30, 1994; approval is expected shortly.

Description of Requested Technical Specifications Changes:

The requested amendments incorporate the results of a reanalysis of the peak containment pressure calculation following a LOCA into the Technical Specifications. The required ice condenser total ice bed ice weight specified in T.S. LCO 3.6.5.1.d is reduced from 2,099,790 to 1,516,800 lbs., along with its use in associated surveillance requirement 4.6.5.1.b.2 and T.S. 3/4.6.5.1's Bases Section. Correspondingly, the minimum ice basket ice weight specified (in 4 places) in surveillance requirement 4.6.5.1.b.2 and in T.S. 3/4.6.5.1 Bases Section, is also reduced from 1081 to 781 lbs.

Justification and Safety Analysis:

Topical report DPC-NE-3004-P describes the methodology for simulating the mass and energy release from high energy line breaks and the resulting containment response which has been developed by Duke Power Company for the McGuire and Catawba Nuclear Stations. The mass and energy release resulting from LOCAs is simulated with the RELAP5/MOD3.1DUKE computer code for a spectrum of break locations. The mass and energy release resulting from steam line breaks is simulated with the RETRAN-02 MOD5.1DKE computer code for a spectrum of break sizes. The ice condenser containment response is simulated with the GOTHIC4.0/DUKE computer code. The methodology includes models for both the current Westinghouse steam generators and the future Babcock & Wilcox International (BWI) steam generators. These methods are used to demonstrate that the containment peak pressure and temperature limits are not exceeded. This methodology is approved for use in predicting the containment pressure and temperature responses to design basis accidents for the McGuire and Catawba Nuclear Stations.

<u>Mass and Energy Release Methodology</u>

The methodology described in the topical report DPC-NE-3004-P for simulating the mass and energy release resulting from a design basis LOCA utilizes the RELAP5/MOD3.1DUKE computer code for a spectrum of break locations. This code is derived from RELAP5/MOD3.1 which is an advanced thermal-hydraulic computer code developed by EG&G Idaho for the Nuclear Regulatory Commission (NRC). Duke Power Company has modified the RELAP5/MOD3.1 code by including error corrections provided by EG&G Idaho to obtain RELAP5/MOD3.1DUKE.

The energy released into containment by a LBLOCA is that energy that is initially contained in the primary and secondary coolant systems fluid, associated metal components of the system boundaries, and sensible heat stored in the core, plus the additional energy that is produced and released subsequent to the break as a result of continued fission, fission product decay, and metal-water reaction. The initial conditions for LBLOCA analyses are chosen to maximize the stored energy in both the primary and secondary systems. Maximizing the stored energy will ensure that conservative mass and energy boundary conditions are provided to the containment response analyses. Guidance and criteria for selecting the initial values for the principal system parameters are provided in ANSI/ANS-56.4-1983.

The most limiting single failure assumed for minimum safeguards situations is the loss of one emergency diesel generator in conjunction with a loss of offsite power. This failure minimizes the capability to mitigate the LOCA mass and energy release and the resulting containment response. Other conservative assumptions include ECCS injected flowrates, available refueling water storage tank volume, steam generator pressure and level control, main and auxiliary feedwater flowrates and temperatures, and containment backpressure. The ECCS injection temperature during the sump recirculation phase is obtained through an iterative process using RELAP5/GOTHIC results.

<u>Containment Response Methodology</u>

The methodology described in the topical report DPC-NE-3004-P for simulating the containment response to high energy line breaks utilizes the GOTHIC4.0/DUKE computer code. The GOTHIC code, derived from the COBRA-NC thermal-hydraulic code, was developed by Numerical Applications, Inc. (NAI), under contract from EPRI, for performing thermal-hydraulic analysis of nuclear power plant containment and auxiliary buildings. Duke Power Company has modified the GOTHIC Version 4.0 code by including minor code changes provided by NAI to obtain GOTHIC4.0/DUKE.

The McGuire GOTHIC model simulates the four different regions in an ice condenser containment building. These are the lower containment, upper containment, ice condenser, and dead-ended compartments. The ice condenser and passive heat structures are modeled in detail. The initial conditions that result in a conservative peak containment pressure analysis produce a high mass of non-condensible gases, and minimize the warming of ice prior to melting. The boundary conditions for the GOTHIC analyses include break mass flow rate and energy input data, containment spray mass flow rate and energy input, containment sump cooling, and nitrogen addition to containment from the cold leg accumulators. The most limiting single failure results in one train of containment spray available to mitigate the pressurization transient.

<u>Ice Weight Reduction Analysis</u>
The mass and energy release and containment response methodology described above is utilized to reanalyze the long-term peak containment pressure response assuming a reduced ice weight of 1,306,800 lbm. for both the existing Westinghouse Model D2/D3 steam generators and the Babcock & Wilcox International (BWI) feedring steam generators which will be installed in the near future. In addition to the reduced initial ice mass, two emergency procedure changes have been credited. The first procedure change alters the point in time at which operator action is taken during minimum safeguards situations to close the RHR discharge crossover valves (ND15 or ND30) following the transfer to cold leg recirculation. These valves are closed to protect against a long-term passive failure, necessary during maximum safeguards situations. For minimum safeguards situations however, a single failure has already been assumed and therefore actions to protect against long-term passive failures is not required. The impact of this change would decrease the amount of ECCS flow directly spilled to the containment sump until auxiliary containment spray is aligned. These RHR discharge crossover valves would be closed prior to initiation of auxiliary containment spray to ensure adequate auxiliary spray flow. The second procedure change instructs the operator to increase steam generator level to full range following verification of a setpoint based upon indications of a large break LOCA. By changing the level setpoint that the operator controls auxiliary feedwater to, the stored energy available to be transferred from the secondary to primary systems is minimized, effectively reducing the heat load on the ice condenser systems.

The results of the mass and energy release analysis are illustrated by the integrated mass and energy release, Figures 1 through 4. These figures present the total integrated release results for both sides of the break. Figure 1 presents the total integrated vapor mass release. The inflection point at approximately 1500 seconds results from the transfer to sump recirculation, which is a hotter ECCS suction source. Figure 2 presents the total integrated liquid mass release. The change in the mass release slope at 3000 seconds is indicative of the initiation of auxiliary spray,

which reduces the ECCS flowrate. Figures 3 and 4 present the total integrated vapor energy release and liquid energy release, respectively. The integrated release trends for these figures closely matches those of Figures 1 and 2. This analysis incorporates the emergency procedure changes described above and accounts for the changes in the containment pressure and sump temperature response that result from a reduction in the assumed ice weight. As described in the methodology topical report (DPC-NE-3004-P), the limiting mass and energy release results from a double-ended break located at the cold leg reactor coolant pump discharge.

The peak containment pressure reanalysis used a reduced ice bed ice weight of 1,306,800 lbs., rather than the current 1,890,000 lbs. Figures 5 through 9 show the results of this analysis. The containment pressure is shown in Figure 5. Following the blowdown period, the pressure reaches a plateau level of about 8 psig. This increases to about 10 psig at about 2500 seconds, after several of the ice bays become depleted of ice. After the ice is completely melted at 3540 seconds, the pressure increases to a peak value of 13.7 psig. This decreases gradually as the steaming rate out the break decreases.

Figure 6 shows the sump temperature response. At the time of cold leg injection from the ND system at about 1800 seconds, the sump temperature is at 176°F. This decreases to around 172°F as more ice meltwater and spray water collects in the sump. The sump temperature increases to about 178°F at the end of the transient simulation.

Figures 7 and 8 show the upper and lower containment average temperatures, respectively. The upper containment temperature remains fairly low until about 1800 seconds, when increasing steam masses reaching upper containment cause the temperature to exceed 160°F. Once the ice completely melts, the temperature increases to a peak level of 185°F, and then starts to decrease. The lower containment temperature decreases from a blowdown peak of 250°F to below 200°F and settles to a plateau level of about 175°F. This temperature increases to about 200°F following ice meltout but does not go back significantly above this level during the transient.

Figure 9 shows the quantity of ice melted. About 500,000 lbs, or about 40% of the ice mass melts during the blowdown period. Another 500,000 lbs. melts within the first 30 minutes of the transient. The last of the ice is melted at 3540 seconds, or about one hour after the transient starts.

The peak containment pressure (shown in Figure 5) decreases from the current value of approximately 14.1 psig to approximately 13.5 psig (which is within the maximum allowable value of 14.8 psig specified by T.S. 3/4.6.1.1). Therefore, this reanalysis which utilizes the recently approved Duke Power methodology will result in a reduction in the required ice weight.

The maximum containment sump temperature is obtained from a double-ended hot leg break. The sump temperature must remain low enough to ensure stable RHR pump operation during the recirculation phase. The mass and energy release and containment response analyses performed for this break location, assuming a reduced ice weight, demonstrate that the maximum containment sump temperature remains below the current acceptance criteria.

The current T.S. ice basket ice weight is 1081 lbs. which includes 11.1% margin for the sublimation and instrument-error conservative allowances. Given that ice sublimation rates are constant and not dependent on ice volume (a conclusion which is supported through years of operation), it is desired that the sublimation allowance should be maintained at its current value. By maintaining the sublimation allowance at its current value of 108 lbs. (i.e., 11.1% of 1,890,000 lbs. divided by 1944 required ice baskets in ice condenser equals 108 lbs. per ice basket, conservatively rounded up), then the new required ice basket ice weight would become 781 lbs. (i.e., 1,306,800 lbs. divided by 1944 required ice baskets equals 673 lbs plus 108 lbs.). The total allowances would become 108 lbs. per ice basket or a 210,000 lbs. total ice weight allowance. This approach provides a conservative requirement that includes the sublimation and instrument-error conservative allowances.

The LOCA peak containment pressure reanalysis provides the supporting basis for reducing the T.S. specified total ice bed ice weight in containment to 1,516,800 lbs. (i.e., the FSAR reanalysis assumed value of 1,306,800 lbs plus 210,000 lbs. for the sublimation and instrument-error conservative allowances). Accordingly, the T.S. required ice basket ice weight becomes 781 lbs. (i.e., 1,516,800 lbs. T.S. total ice bed ice weight divided by 1944 required ice baskets in ice condenser equals 781 lbs. per ice basket, conservatively rounded up). Likewise, the new ice basket safety margin ice weight becomes 680 lbs. (i.e., 1,306,800 lbs. divided by 1944 equals 673 lbs. FSAR analysis assumed ice weight per ice basket, plus the 1.1% instrument weighing uncertainty equals 680, conservatively rounded up). These requested changes are based upon a conservative analysis using NRC-approved methods.

The McGuire FSAR will be revised to reflect this reanalysis in the applicable annual FSAR update following NRC approval of these requested amendments. Appropriate changes in station procedures to reflect the new weight limits will be implemented upon approval of these requested amendments.

Short-Term Blowdown Peak Pressure

The current method used to calculate the blowdown peak pressure consists of the calculation of the air mass compression ratio, using the polytropic exponent for this compression process taken from the Waltz Mill results (shown in MNS FSAR Figure 6-6) and compartment volumes taken from TMD input data. This method is described in Section 6.2.1.1.3 of the MNS FSAR. The effect of steam bypass through the operating deck on this compression process is also considered.

This method is repeated to determine the new compression peak pressure of 22.4 psia or 7.7 psig. The new compression peak pressure is slightly smaller than the current FSAR value of 7.8 psig due to updated TMD compartment volumes and the slightly larger volume in the ice condenser due to the displaced ice.

The possibility of substantial amounts of steam passing through the ice condenser without being condensed during the blowdown period is prevented by the requirement that each basket meet a minimum weight requirement of 781 lbm. Only 40% of the ice melts during the blowdown phase. This requirement ensures that no area of the ice condenser will be voided of ice to the degree that significant amounts of steam may pass through the condenser without being condensed during the

blowdown phase. There is over 7 psi of margin between the calculated peak pressure above and the allowable value of 14.8 psig, thus considerable amounts of steam could pass through the ice condenser without exceeding the allowable pressure.

Therefore, it is concluded that the short-term containment pressure response is not affected by the requested reduction in ice weight and the analysis currently presented in the FSAR remains valid.

LOCA Peak Cladding Temperature
The minimum containment pressure used in the LOCA peak cladding temperature analysis is unaffected by a reduction in the ice weight. This is primarily because the minimum pressure analysis assumes a conservatively high ice weight. Therefore, it is concluded that the minimum containment pressure analysis and the LOCA peak cladding temperature analysis currently presented in the FSAR remain valid.

Peak Reverse Differential Pressure
The peak reverse differential pressure analysis currently presented in the FSAR makes conservative assumptions that maximize the air mass forced into the upper ice condenser and upper containment and maximizes upper containment temperature while minimizing lower containment temperature. A reduction in ice weight will increase the air mass forced into upper containment, which should increase the peak reverse differential pressure. For the ice weight reduction considered in this submittal, the change in the maximum pressure differential is not expected to be significant. The current FSAR analysis presents two cases, the most conservative of which results in a peak reverse differential pressure of 1.3 psi. Significant margin exists between the design reverse differential pressures for this analysis, 15.0 psi and 8.6 psi across the operating deck and ice condenser lower inlet doors respectively, and the current FSAR analysis results. Given that significant margin exists, and that the maximum reverse differential pressure occurs well before the time of ice meltout, it is reasonable to conclude that the ice weight reduction considered in this submittal will not adversely impact the acceptance criterion for this analysis. Therefore, it is concluded that the maximum reverse differential pressure analysis currently presented in the FSAR remains valid.

Steam Line Break
The peak containment temperature transient for McGuire is the steam line break accident. The reduced ice weight has no impact on this analysis, since the steam line break mass and energy release is concluded well before the time of ice meltout. The peak containment temperature, which occurs in lower containment, is dependent upon the mass flow rates and enthalpies from the broken steam line, and is unaffected by a reduction in the mass of ice in the ice condenser. Therefore, the peak containment temperature transient is unaffected by the reduction in ice condenser ice mass.

Summary:

The NRC approved Duke Power Company mass and energy release and containment response methodology is utilized to reanalyze the long-term peak containment pressure response. The

results of this reanalysis demonstrate that the applicable acceptance criteria are satisfied while maintaining the operational and safety margins.

Other FSAR analyses concerning the containment response have been evaluated for a reduction in ice weight, and it has been concluded that, the conclusions presented in the FSAR remain valid.

These requested Technical Specifications changes reduce the required ice condenser total ice inventory and ice basket ice weights. Based upon the preceding justification, Duke Power Company concludes that the requested amendments are necessary to provide needed additional flexibility in maintaining the required ice weight for the containment ice condenser. Based upon the safety analysis, Duke Power Company concludes that the requested amendments will not be adverse to the health and safety of company personnel or the public.

McGuire LOCA (Cold Leg Break)
Mass and Energy Release Analysis

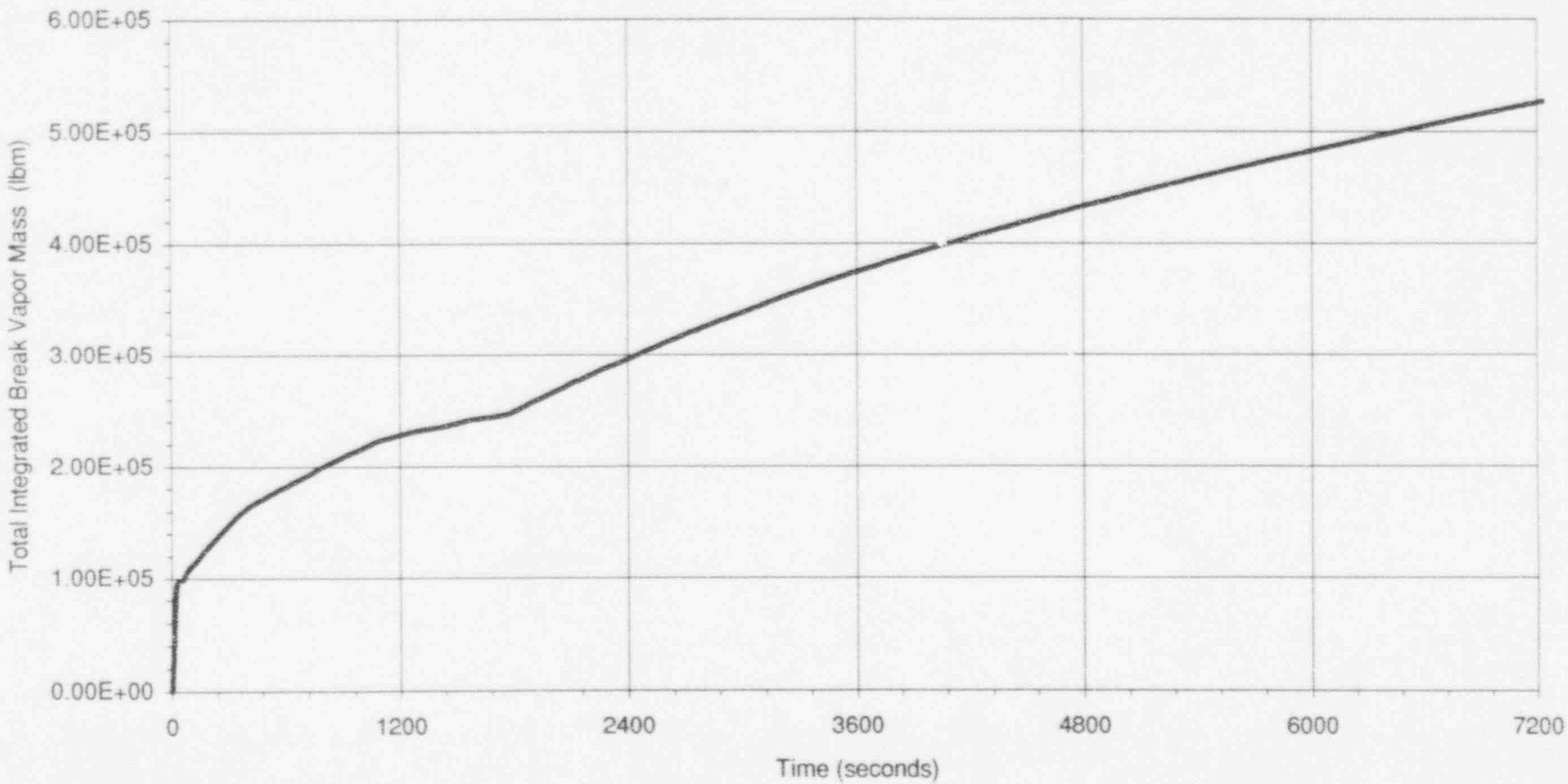


Figure 1

McGuire LOCA (Cold Leg Break)
Mass and Energy Release Analysis

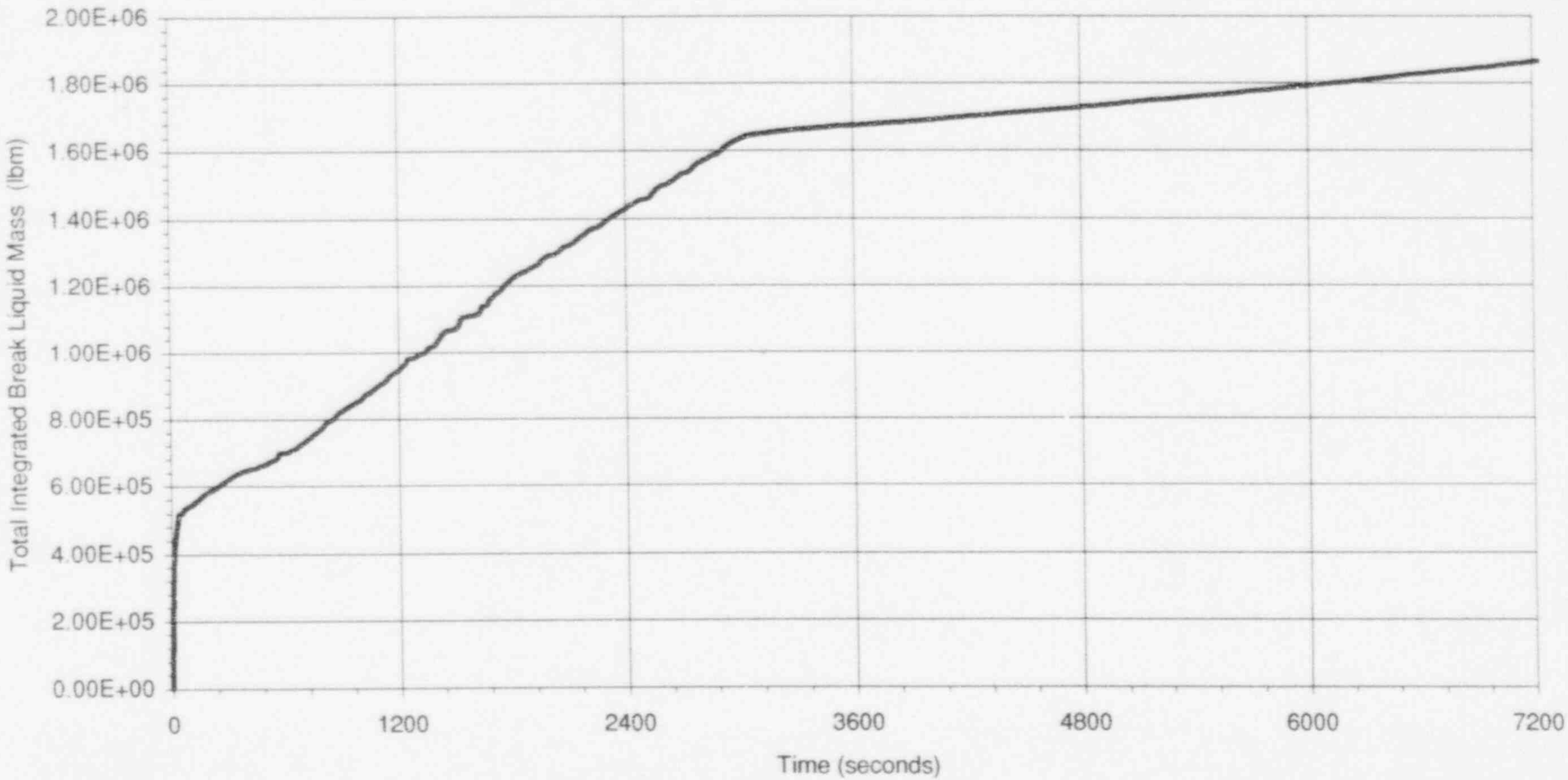


Figure 2

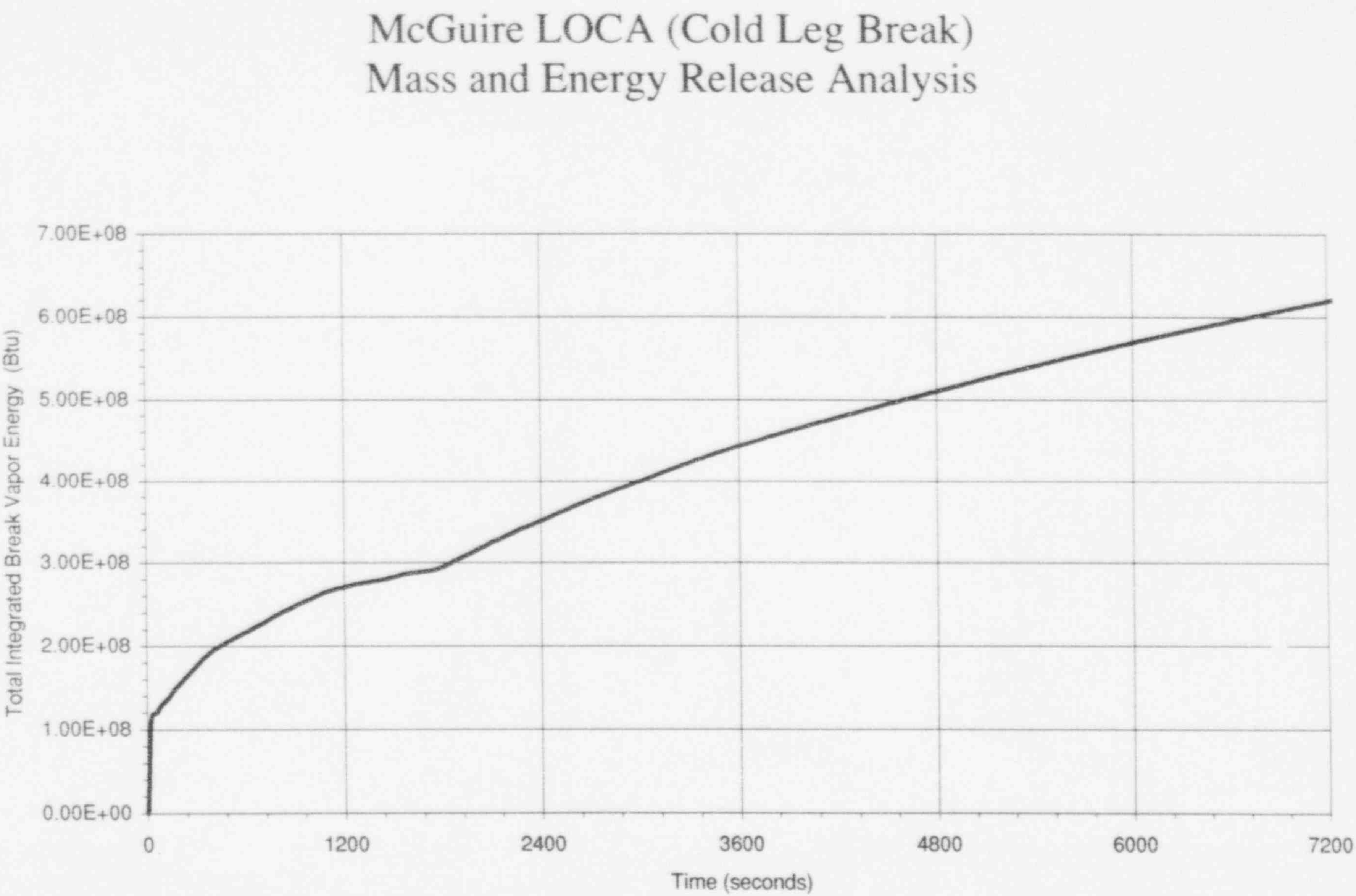

McGuire LOCA (Cold Leg Break)
Mass and Energy Release Analysis
Total Integrated Break Vapor Energy (Btu)
7.00E+08
6.00E+08
5.00E+08
4.00E+08
3.00E+08
2.00E+08
1.00E+08
0.00E+00
0
1200
2400
3600
4800
6000
7200
Time (seconds)

Figure 3

McGuire LOCA (Cold Leg Break)
Mass and Energy Release Analysis

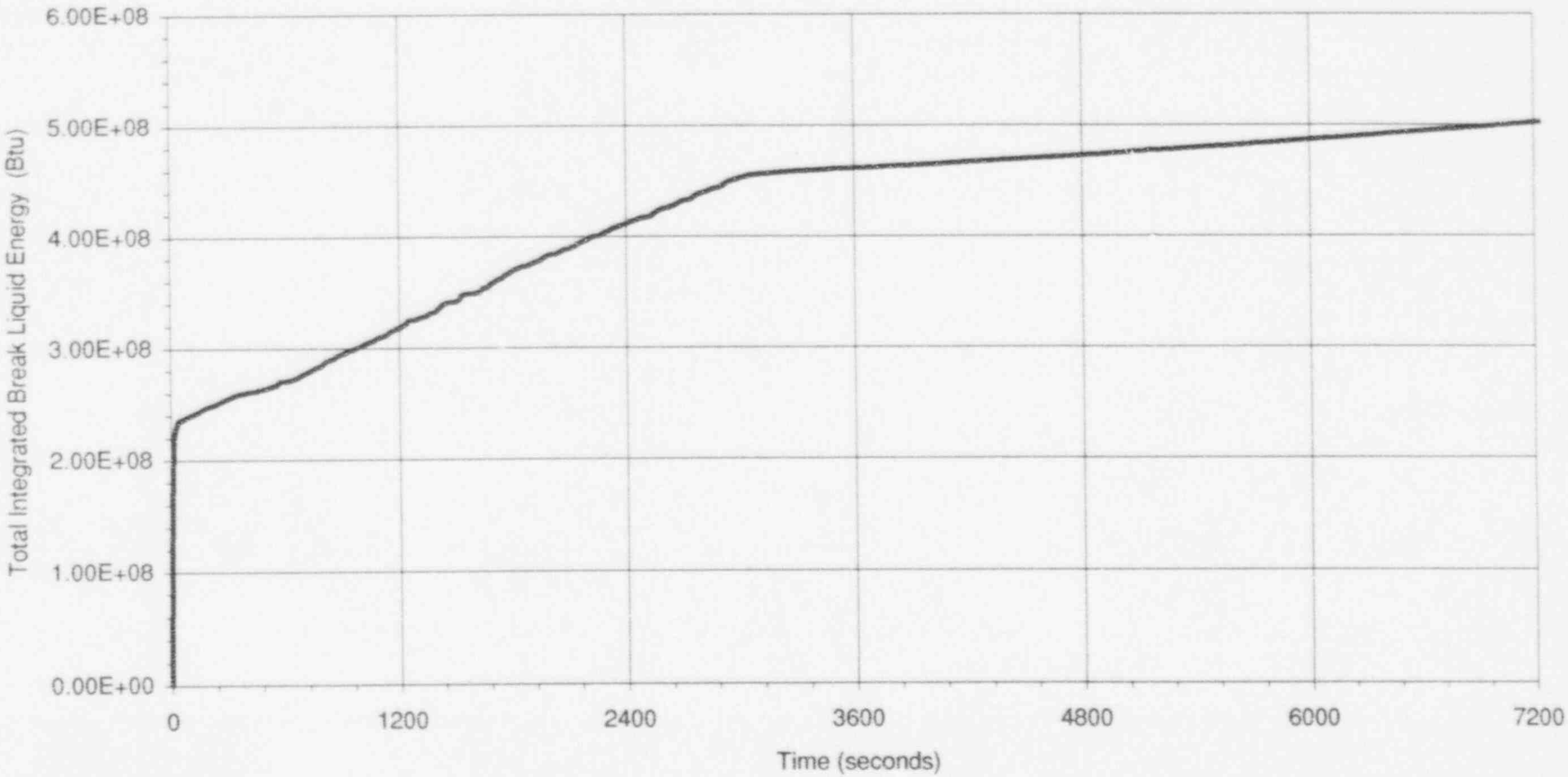


Figure 4

McGuire LOCA (Cold Leg Break)
Containment Pressure

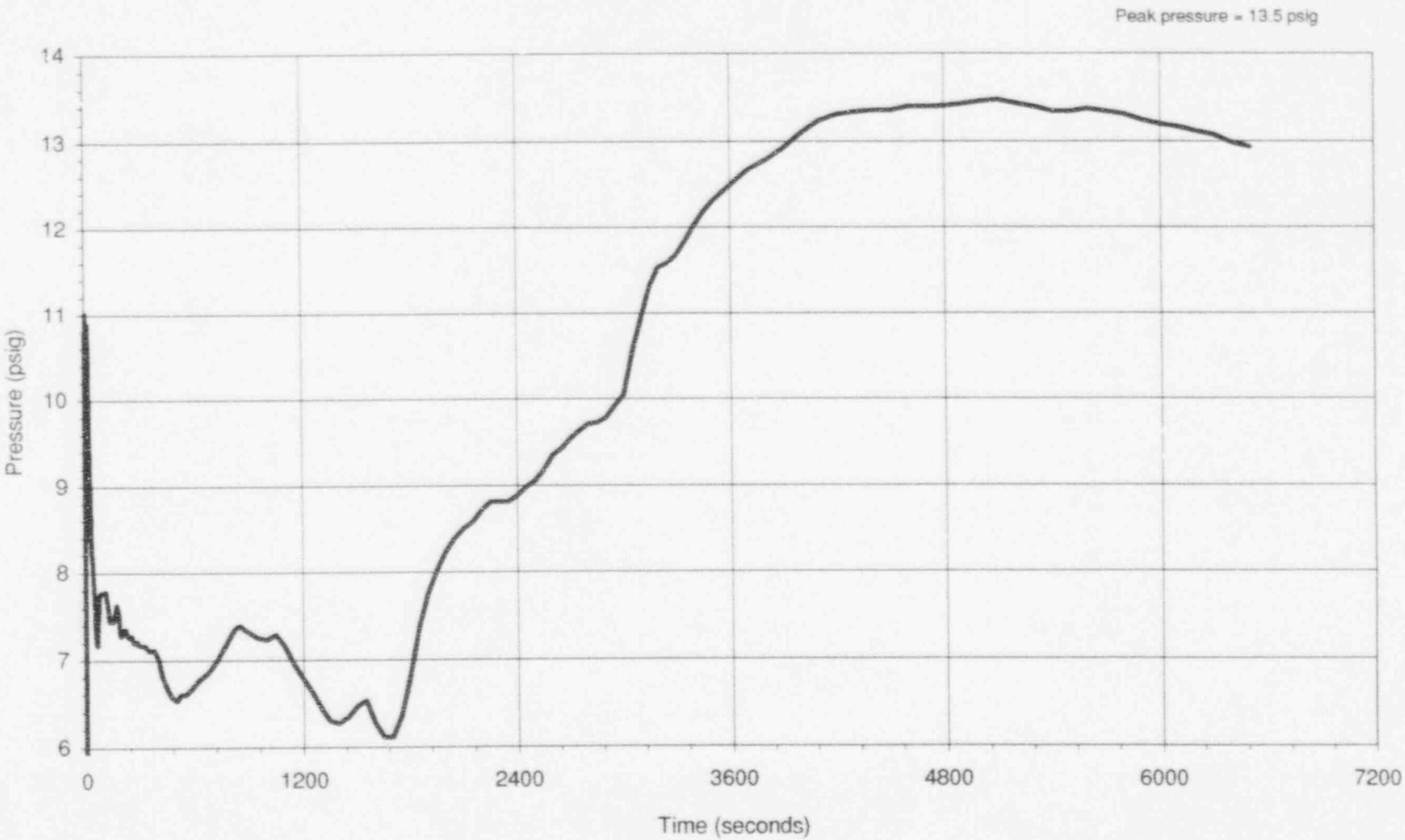


Figure 5

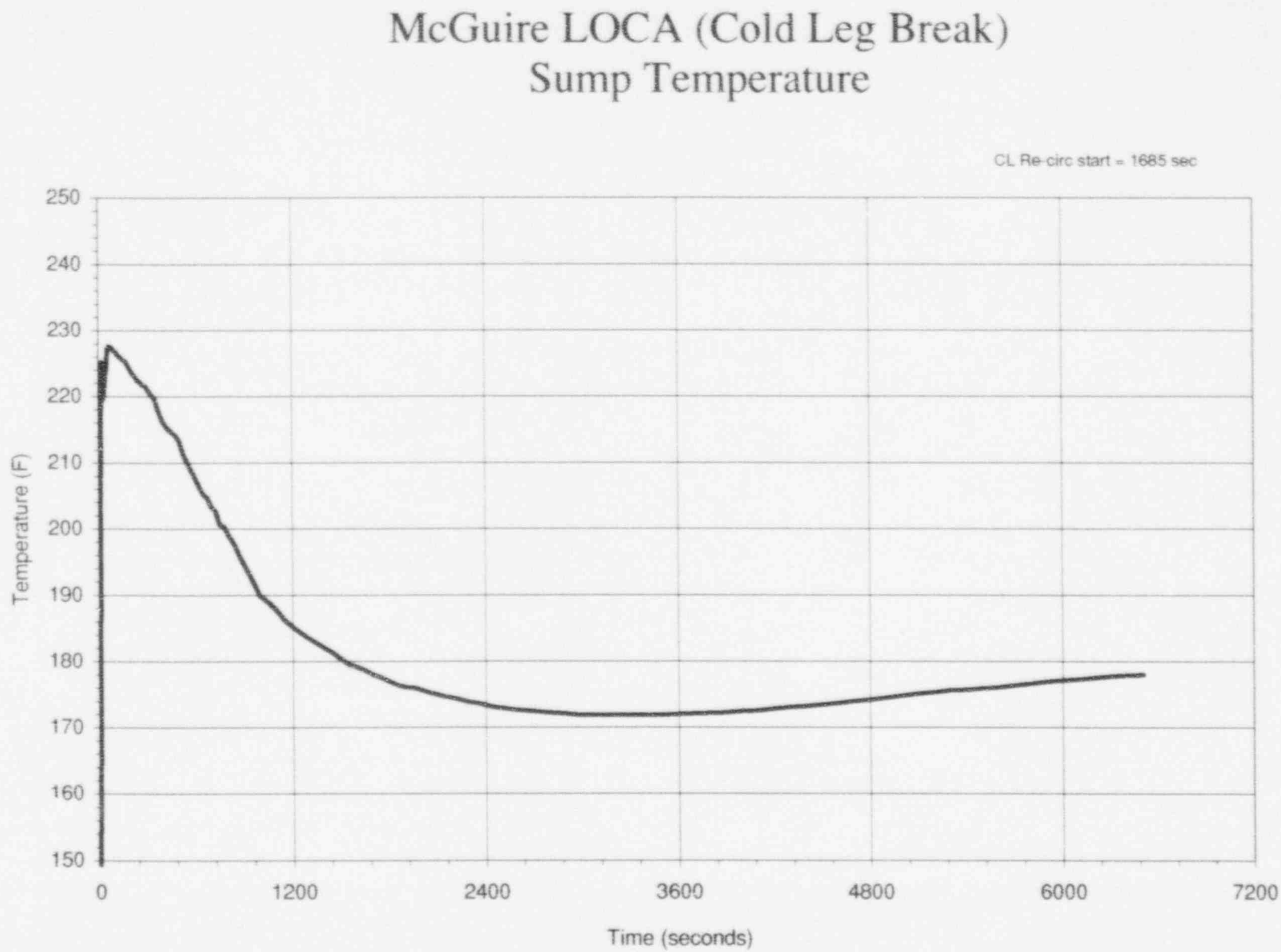

McGuire LOCA (Cold Leg Break)
Sump Temperature
CL Re-circ start = 1685 sec
250
240
230
220
210
200
190
180
170
160
150
Temperature (F)
0
1200
2400
3600
4800
6000
7200
Time (seconds)

Figure 6

McGuire LOCA (Cold Leg Break)
Upper Containment Temperature

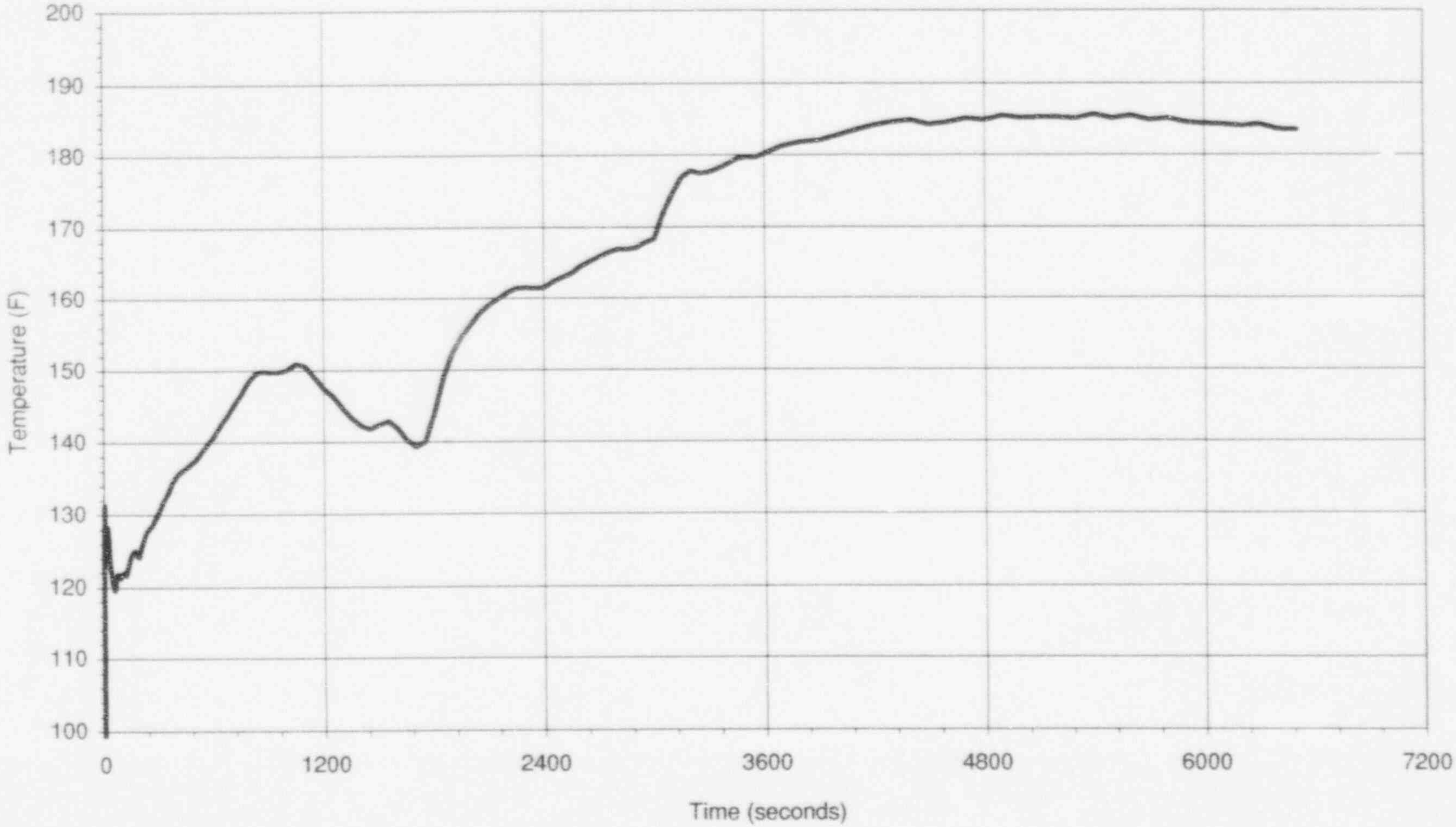


Figure 7

McGuire LOCA (Cold Leg Break)
Lower Containment Temperature

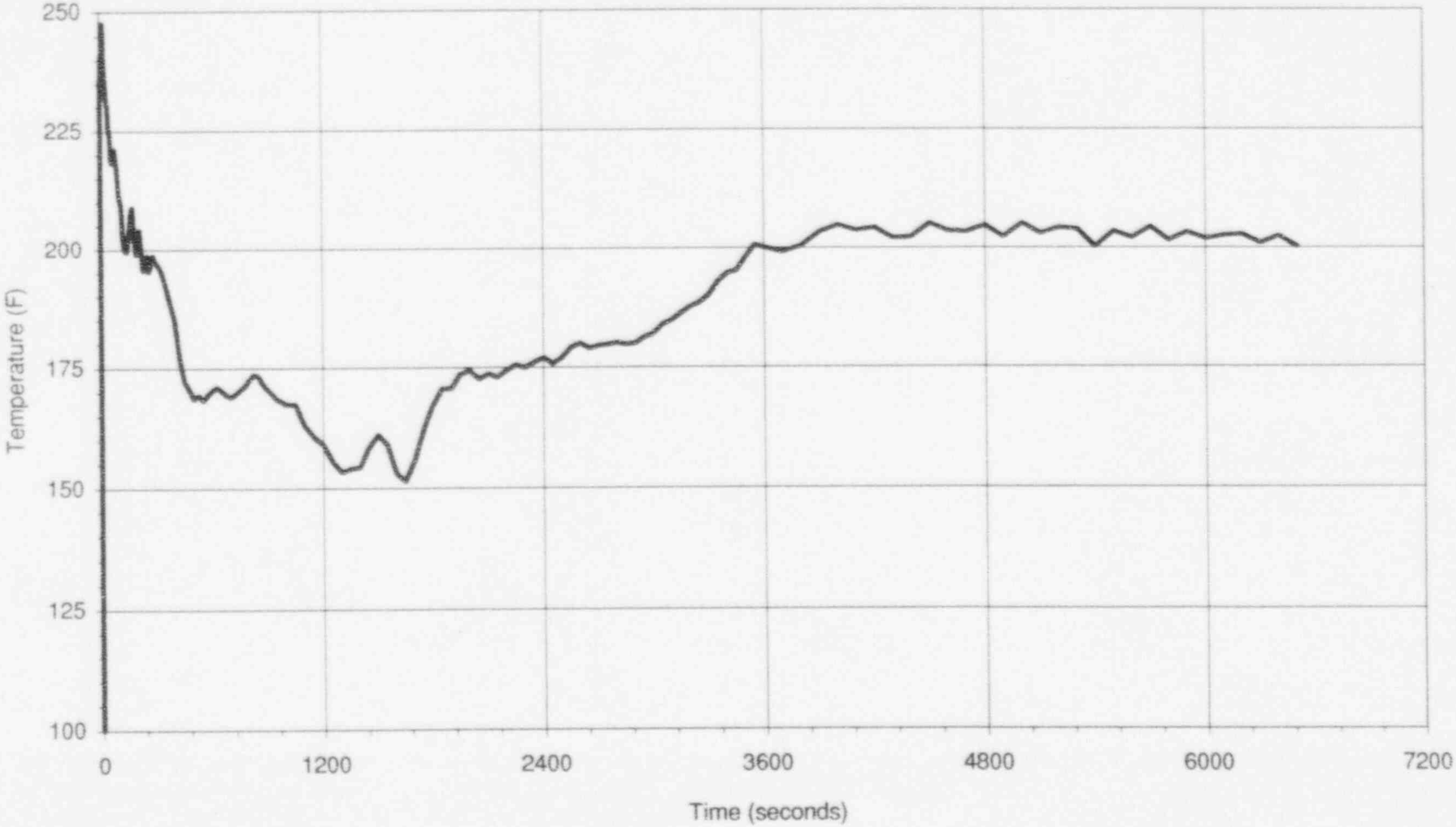
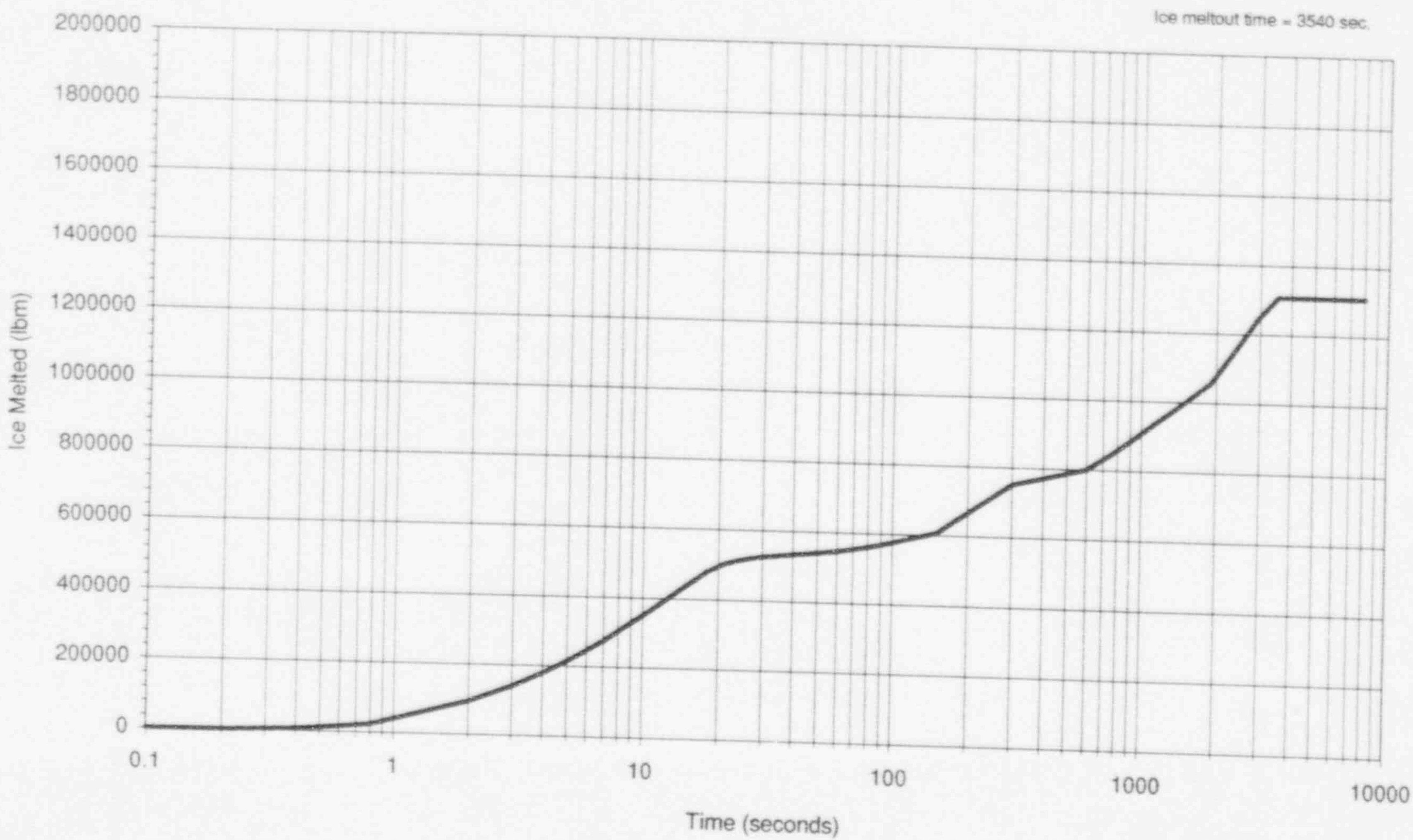


Figure 8

Figure 9

McGuire LOCA (Cold Leg Break)
Ice Melted



Attachment 3
No Significant Hazards Analysis

This analysis is provided, pursuant to 10 CFR 50.91, to determine whether any significant hazards considerations, as defined by the criteria of 10 CFR 50.92 (highlighted in **bold,** below), would be created by the proposed change to reduced the required ice weight in the ice condensers from 2,099,790 lbs to 1,516,800 lbs.

The requested amendments incorporate the results of a conservative reanalysis (see Attachment 2) of the containment pressure following a loss-of-coolant accident (LOCA) (FSAR Section 6.2.1.1.3.1) into Technical Specification (TS) requirements for ice weight. This analysis was performed using the methodology described in DPC-NE-3004, "Mass and Energy Release and Containment Response Methodology." This Duke Power proprietary Topical Report was submitted for NRC review on September 30, 1994.

1) **The requested amendments would not involve a significant increase in the probability of an accident previously evaluated.** The changes would be only to the limits provided in the TSs, and do not involve any plant hardware changes. The changes to the values in the TSs could not increase the probability of an accident because the ice condenser is a passive system that requires no operator action or manipulation to fulfill its design function. The condition of the ice condenser has no causal effect on any postulated accident scenario.

The requested amendments would not have a significant increase in the consequences of an accident previously evaluated. The peak pressure reanalysis with reduced ice weight describes the containment pressure, temperature, and ice melt response to the design basis transient. The analysis shows that while various parameters are affected somewhat, they remain within bounding values, and the ice condenser would satisfactorily perform its design function in the event of a LOCA.

2) The requested amendments would not create the possibility of a new accident not previously evaluated. As noted above, the ice condenser is a passive system which requires no operator action or manipulation to perform its function. Indeed, other than the water to which the ice melts in the course of a postulated accident, there are no moving parts in the ice condenser which could malfunction or operate spuriously and create a new type of accident.

3) **The requested amendments would not involve a significant decrease in a margin of safety.** Although the ice bed weight is reduced from 2,099,790 lbs. to 1,516,800 lbs., the total margin (108 lbs./ basket for sublimation + instrument error) remains constant. This allowance for sublimation is based on observed sublimation rates, which are not dependent upon ice mass,

and represents an increased conservatism. The reanalysis results in a peak containment pressure decrease from 14.1 psig to approximately 13.7 psig, which is easily within the required (per TS 4.6.1.1) maximum allowable value of 14.8 psig.

Based on the foregoing analysis, it is concluded that the proposed amendment will not create a significant hazards consideration. In addition, the reduction of the required volume of borated ice will not have any significant adverse effect on the environment.