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May 29, 2003

U. S. Nuclear Regulatory Commission
Washington, D. C. 20555-0001
Attention: R. Martin (addressee only)

Subject: Draft Revision 2 to Ice Condenser Utility Group Topical Report No. ICUG-001: *Application of the Active Ice Mass Management Concept to the Ice Condenser Ice Mass Technical Specification* (TAC No. MB3379)

Gentlemen:

Please find enclosed a draft of Revision 2 to non-proprietary topical report ICUG-001, "Application of the Active Ice Mass Management Concept to the Ice Condenser Ice Mass Technical Specification." This revision is submitted by the Ice Condenser Utility Group (ICUG) to NRC in response to the staff's draft Safety Evaluation Report (SER) for Revision 0 of the ICUG-001 topical report dated May 6, 2003, and also to commitments made at the May 13, 2003 ICUG/NRC meeting.

The enclosed draft revision 2 to the topical report resolves several issues identified in the draft SER and discussed at the 5/13/03 meeting. Upon staff review and acceptance of the changes presented in this draft, a formal Revision 2 to the ICUG-001 topical report will be issued.

If there are any questions or if additional information is needed, please contact the undersigned at (704) 382-3970 or rslytton@duke-energy.com.

Sincerely,

R.S. Lytton

R. S. Lytton
Chair, Ice Condenser Utility Group

Enclosure

xc(w/enclosure): Robert E. Martin (addressee only, 10 copies)
Document Control Desk (one copy)

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Ice Condenser Utility Group

Application of the Active Ice Mass Management Concept to the Ice Condenser Ice Mass Technical Specification

Topical Report ICUG-001, Revision 2

May 2003

DRAFT

NON-PROPRIETARY

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Topical Report ICUG-001

Application of the Active Ice Mass Management Concept to the Ice Condenser Ice Mass Technical Specification

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Nomenclature

This topical report will utilize terminology that describes aspects of the supported technical specification methodology. In the interest of consistency, the following definitions apply to terms used throughout the report:

- ***Radial***: Direction along a line drawn from the center of containment toward the outer containment wall.
- ***Azimuthal***: Direction along a circular line drawn from ice condenser Bay 1 towards Bay 24, or vice-versa.
- ***Row***: Linear population of ice baskets in the azimuthal direction; there are 216 baskets per row in an ice bed, with nine rows total.
- ***Column***: Linear population of ice baskets in the radial direction; there are nine baskets per column and nine columns in a bay, with 216 columns total.
- ***Accuracy***: Generic term referring to the ability of a methodology to assess the mass of an ice basket.
- ***Error***: Statistical term referring to the numerical difference between an actual ice basket mass and its measured mass.
- ***Random sample***: A sample of ice baskets selected from the parent population of ice baskets in an ice bed, where each basket in the parent population has the same probability of being selected.
- ***Stratified random sample***: A sample of ice baskets selected from a defined sub-population of ice baskets, where each basket in the sub-population has the same probability of being selected.
- ***Representative sample***: A sample of ice baskets intentionally selected from specified areas of the ice bed population, such that all areas are equally represented.
- ***Ice mass***: The total mass of ice that exists in a population of individual ice baskets, without the baskets themselves included (i.e., no tare weights).
- ***Radial Zone***: A defined population of ice baskets encompassing all ice baskets in a given row or rows.
- ***Bay-Zone***: A population of ice baskets in a Radial Zone delimited by a given Bay.
- ***Ice bed***: The entire population of ice baskets, ice, and supporting structures in the ice condenser from the Lower Support Structure up to, but not including, the Intermediate Deck, End Walls, and Wall Panels.
- ***Stuck basket***: An ice basket that is prevented from being physically lifted, due to either freezing (to the lattice structure) or mechanical impediment.
- ***Obstructed basket***: An ice basket that, due to excessive external surface ice or other blockage, cannot be inspected along its height.

- ***Alternate Mass Determination Technique***: Any methodology employed to assess the mass of an individual ice basket other than physically lifting the ice basket.
- ***Initial sample***: A set of ice baskets chosen at random from a given Radial Zone as a part of the initial sample grouping for the Ice Mass Technical Specification surveillance requirement.
- ***Expanded sample:*** An additional set of sample baskets chosen at random from a given Radial Zone, with the initial sample set removed from the population.
- ***Alternate basket***: An ice basket chosen to replace the initial sample basket, when the initial sample basket is stuck and obstructed.
- ***Mean***: The average of a set of ice basket masses.
- ***95% level of confidence (or confidence interval)***: 95% confidence refers to an interval (*x* lb to *y* lb, or *x* lb or greater) which is calculated based on the number of samples, sample mean, sample standard deviation, and the confidence level (95% in this case), that aims to predict the actual mean for the entire population. The interval envelopes the actual mean of the parent population 95% of the time. Of all possible sample groups that could be chosen from the parent population, 95% of them would result in an interval that contains the actual mean ice basket mass for the parent population.
- ***Student's t-test***: Statistical procedure used to determine the parent population mean from the mean of a sample group at a prescribed confidence interval.
- ***Error of the mean***: Statistical term that designates the difference between the mean of a sample group and the mean of the parent population at a prescribed confidence interval.
- ***Random error***: A deviation from the actual value which occurs in a non-systematic manner.
- ***Variation of the process***: Statistical term that refers to the variation of the actual mass of the baskets throughout the ice bed.
- ***Variation of the measurement***: Statistical term that refers to the variation of the measured mass of an ice basket due to variations in the measurement technique.
- ***Normality***: The degree to which the sample distribution has the attributes of a normal distribution.
- ***Sampling without replacement***: Taking samples from a parent population wherein each basket in the population can appear only once in the sample. Once a basket is selected from the parent population, it is removed from the candidate population of baskets for the next selection and therefore, it may not be selected again for the sample.

Overview

The Ice Condenser Utility Group (ICUG), consisting of members of all domestic ice condenser-owning utilities (Tennessee Valley Authority, American Electric Power, and Duke Energy), has collectively amassed nearly 150 years of operational experience in the ice condenser since D.C. Cook Nuclear Plant Unit 1 began commercial operation in 1975. Since then, eight more ice condenser containments have been added to the fleet, all of which are currently operational. The original technical specification verifying total ice mass and distribution in the ice bed has been extensively reviewed by both the NRC and ICUG. While it is considered adequate to show operability, some concepts from which the original specification was derived have changed, and others need clarification. Several potential changes to the specification have been identified that allow the application of the industry's accumulated operational history and experience, as well as provide an improved process for verifying total ice mass. This topical report will address those improvements to the Ice Mass Technical Specification and show the inherent linkage to plant-specific maintenance practices.

Active Ice Mass Management

As operational history shows, sublimation rates are quite significant in certain areas of the ice condenser and essentially non-existent in others, and a large effort is required to maintain the ice bed mass inventory each outage. This maintenance effort, however, restores the ice bed mass and distribution characteristics required for continued operation. The process of replenishing the ice baskets to restore ice bed mass based on the monitoring of varying sublimation rates during the cycle is the basis for the **Active Ice Mass Management** (AIMM) concept.

This concept is rooted in the industry's adherence to the 10CFR50 Appendix B requirements governing maintenance to a nuclear safety-related system. Existing AIMM practices manage each ice basket in the ice bed above the required mean mass supporting the safety analysis. It is a natural follow-on, then, to revise and maintain the technical specification to accommodate AIMM methodology and at the same time introduce industry operational experience. For example, the original specification describes an "as-left" (post-maintenance) surveillance of total mass and distribution, which requires that an assumed uniform sublimation (and weighing error) allowance be included in the surveillance limit. In this manner, ice mass is shown to be adequate for the coming operational cycle. The new approach uses an "as-found" (pre-maintenance) surveillance. This improvement accomplishes several things:

- An as-found surveillance shows the adequacy of total ice mass for the *current* operational cycle. The total mass surveillance limit is the actual minimum requirement for ice bed operability.
- The sublimation allowance and mass determination accuracy details become plant-specific procedural entities (allowing them to vary), which is more precise than assuming a uniform sublimation rate across the ice bed.
- The performance of an as-found surveillance inherently verifies the propriety of a plant's Active Ice Mass Management process, since compliance with the technical specification shows awareness of varied ice bed sublimation rates.
- Radial zones in the ice bed can be defined for statistical purposes that delineate groups of ice baskets with similar expected as-found mean mass and a reasonable standard deviation. With AIMM methodology ensuring replenishment of needed mass, these zones facilitate an accurate assessment of total ice bed inventory.

The result is a technical specification that appropriately combines accumulated experience, knowledge of the ice condenser design basis, and the use of statistical methods to support an industry-consistent, simplified surveillance and, in turn, enhanced Unit reliability. In this regard, while the concept of a consistent technical specification surveillance is an important industry objective, plant-specific maintenance techniques used in implementing AIMM methodology must necessarily be allowed to evolve independently. These techniques are constantly being improved at each plant, and the exchange of technical information facilitated through the ICUG ensures industry peer review. Primarily, it is the Ice Mass Technical Specification itself that must be consistent in its intent and application.

Industry Challenges

The design of the ice condenser system constantly challenges industry initiative, given that operational experience has rewritten some of the original assumptions regarding ice bed behavior. While the ice condenser itself appears passive, sublimation, frost build-up, and a saturated environment all take their toll over the course of an operational cycle. Ice bed maintenance processes contribute further; the use of vibrators and thermal drills to replenish sublimated ice baskets creates an outfall of ice/water, which, while expected, tends to make other maintenance-related activities more time-consuming.

Among the most significant challenges faced by the industry in verifying total ice mass are frozen (or "stuck") ice baskets. The situation occurs when external basket surfaces become covered with ice and frost and effectively freezes them to the lattice structure, rendering some baskets incapable of being physically lifted unless a significant amount of force is used. Stuck baskets also occur when support steel or some other mechanical impediment hinders vertical basket movement. This prevents the use of a lifting rig to determine mass, which is the method of choice by the industry since it is relatively fast and the most accurate. The limitation that results has necessitated the selection of representative alternate baskets for the statistical sample, the use of which over time has been implemented differently by individual plants due (in part) to vague original guidance provided. This has created interpretation inconsistencies across the industry. Compounding the issue is the knowledge that all ice baskets that require servicing are replenished during ice bed outage maintenance, but not all can be used to verify the total ice mass: some baskets' mass cannot be ascertained by lifting (stuck) and others were excluded from the sample group by design. The industry realized that a basket that has been just replenished, but is stuck, does not constitute a threat to the design basis of the ice condenser. Likewise, a recently replenished basket that resides in a historically low sublimation region of the ice bed, but is stuck, does not constitute a threat. In the larger view, no basket—stuck or otherwise—is a threat to ice bed operability *unless* the amount of ice in it (or lack thereof) is indicative of a localized area of degraded ice bed mass or contributes to the surveillance requirement for total mass not being met.

The technical specification approach supported by this topical report resolves this by introducing alternate mass determination techniques for ice baskets that cannot be physically lifted. These techniques—the detailed development of which are plant-specific—currently have been designed to utilize both existing historical information (such as in the use of trending software for basket mass projections) and visual profiling/estimation. The methods are valid forms of ice basket mass determination as long as the accuracy of the methods is properly accounted for in both the actual measurement and the statistical sampling plan.

In this respect, it is also recognized that even with alternate mass determination methodology defined, there will be occasions when no currently available technique can ascertain the mass of ice in some baskets, due to a physical obstruction or other situation (such as external frost/ice build-up on a historically stuck basket that prevents visual inspection). As also allowed in previous versions of the technical specification, in these cases an alternate sample basket from the vicinity of the initial sample will need to be selected and therefore guidelines adopted. To accomplish this, the alternate selection criteria have been designed around the Radial Zone concept, in which baskets in the same Radial Zone generally have similar mass. Alternate selections are representative of initial selections as long as they have the same probability of being selected as an initial selection and can be expected to have similar characteristics as an initial selection. Limiting an alternate selection to the same Bay as the obstructed original selection further develops the criterion, and allows inclusion of baskets from previously excluded rows: all ice baskets in the ice bed are included in the sampling plan while the original version exempted 33% (radial rows 3, 5, and 7) of the ice bed from the parent population. In addition, the use of alternate selections is restricted to prevent repeated use of the same alternate basket from affecting statistical confidence.

A further disparity in the historical methodology required *each* statistically sampled basket to contain the specified amount of ice, while the Bases allowed for individual baskets to be "light" (i.e., less than the technical specification required minimum mass) if baskets in the local area were sufficiently full. This contradiction also led to differing industry interpretations, even though the original intent was, as described by the technical specification bases, to prevent localized gross degradation of the ice bed. The technical specification methodology presented here treats this contradiction by recognizing that the two primary concerns of the ice mass design basis—and therefore the two required surveillances—are the presence of sufficient total ice mass in the bed distributed appropriately to accommodate the overall DBA response, and a sufficient minimum mass in any individual basket maintained to prevent localized areas of degradation that might challenge the DBA containment pressure response.

The requirement for the overall DBA response is met by determining total ice mass in the bed based on a sampled group. In this manner, the word "each" is eliminated from the operability requirement, and individual baskets can sublimate during an operating cycle to whatever level their relative position in the ice bed dictates. Conversely, the minimum individual basket mass requirement stipulates a minimum mass of ice for *each* of the statistically sampled baskets so that a minimum amount of ice in the basket is verified to be present. The use of *each* in this instance is appropriate, since the containment analysis is primarily concerned with localized degradation (i.e., a cluster of baskets with degraded mass) and the sampled group is a valid representation of the entire Radial Zone under surveillance. As noted previously, AIMM practice will manage each basket above the required safety analysis mean, such that no individual basket would be expected to sublimate below this mean value. If a basket sublimates below the safety analysis mean value this instance is identified within the plant's corrective action program, including evaluating AIMM practices to identify the cause and to correct any deficiencies. If a basket sublimates below the minimum individual basket mass requirement, then this condition is TS prohibited, necessitating reporting per the requirements of 10CFR50.73 in addition to corrective action program determination of cause and appropriate corrective actions. Certain individual baskets in the corners of the ice bed would typically pose the greatest challenge to maintaining their stored ice mass above the safety analysis mean, due to the relatively high sublimation rates in these areas. However, AIMM practice would generally identify these baskets for servicing every outage, thereby enabling the ice mass in these baskets to be maintained above the safety analysis mean, which would prevent any challenge to the surveillance requirements.

Summary of Significant Aspects

The approach to the Ice Mass Technical Specification supported by this topical report is in some ways similar to the original, but in others, very different. The subdivision of the ice bed into Radial Zones for the purpose of sampling, each comprising a third of the ice baskets in the bed, recognizes that the original *representative sample* did much the same thing by defining the sampled radial rows to be 1, 2, 4, 6, 8, and 9, which essentially outlined three regions of generally similar characteristics. Industry commitments to manage the ice mass in each basket above the required safety analysis mean, a statistically random sample in each Radial Zone, and a defined minimum individual ice mass per basket combine to become the basis for verification of appropriate ice distribution in lieu of a limited azimuthal row-group surveillance. The addition of alternate mass determination techniques for individual baskets and a more restrictive (same Radial Zone, same Bay) procedure for utilizing alternate baskets when original samples are stuck and obstructed clarify two areas of inherent weakness in the original surveillance. These and other enhancements provide a much improved surveillance that is simpler and more clearly defined than the original.

Figure O-1 charts the strategies forming the basis of this technical specification methodology for verification of ice mass.

Figure O-1. Ice Mass Surveillance Strategy

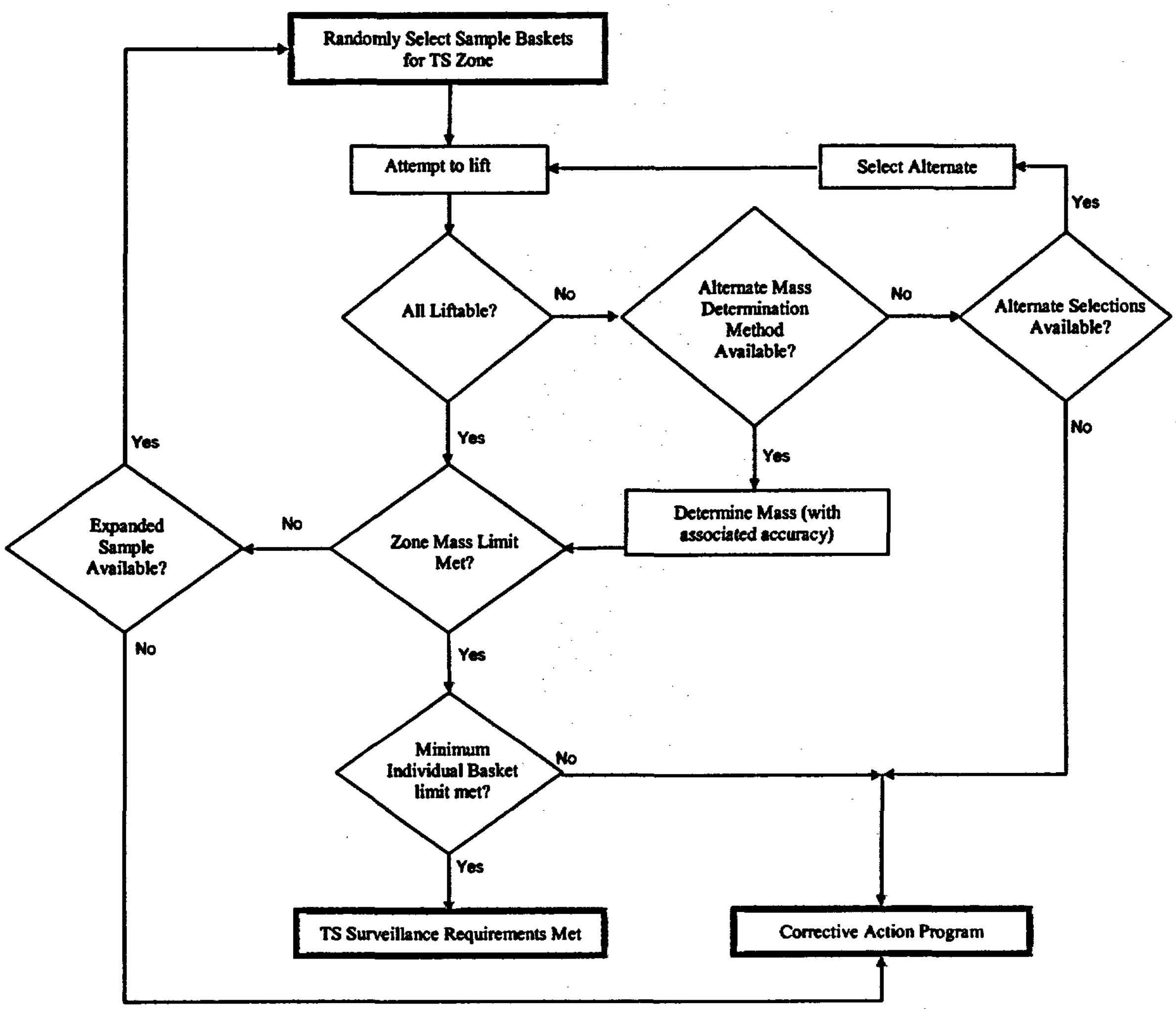


Table O-1 identifies the most significant aspects of the technical specification methodology supported by this topical report:

Table O-1. Significant Aspects of the Ice Mass Technical Specification Methodology

- The surveillances used to ascertain ice mass and distribution are performed in the as-found (pre-maintenance) condition, as opposed to the as-left (post-maintenance) condition
- The minimum operability requirements for total ice mass are defined to better reflect the design basis
- Sublimation allowances and mass determination accuracy are accommodated by plant-specific maintenance procedures
- A surveillance for minimum total ice mass in the bed assures the initial conditions of the DBA analyses
- A surveillance for minimum ice mass in each individual basket prevents localized degradation to avoid any challenge to the DBA containment pressure response
- For the purpose of statistical analysis, the ice bed is divided into three Radial Zones of three sequential rows each to isolate basket populations that have similar mass characteristics
- Proper azimuthal distribution of ice in the ice bed is no longer assessed by a separate surveillance requirement; it is implemented through established industry-wide maintenance practices that manage each ice basket above the required safety analysis mean and confirmed through as-found random sampling techniques
- All ice baskets in the parent population are subject to random statistical sampling, as opposed to only two-thirds of the population subject to representative sampling
- Methods of determining the mass of individual sample baskets other than manual lifting are allowed
- The process for selecting an alternate basket for the statistical sample when the mass of an initial sample basket cannot be ascertained by any method has been revised, restricting alternates to those baskets in the same Radial Zone, same Bay as the initial sample and limiting their re-use as an alternate from prior surveillances

Applicability to Ice Condenser Plants

The generic industry position developed and presented in this topical report utilizes historical operational information and data obtained from Tennessee Valley Authority's Sequoyah and Watts Bar Nuclear Plants, and Duke Energy Corporation's McGuire and Catawba Nuclear Stations. Specific historical ice bed data from D.C. Cook Nuclear Plant was not included due to past configuration control and consistency issues that have since been resolved. Generic data and trends from the Cook plant, however, are consistent with the remainder of the industry and as such were included in assessing the industry position presented herein.

The concept of Radial Zones was developed by the industry based on collective historical sublimation data and the need for a more accurate assessment of ice bed mass as it relates to containment safety analyses and active maintenance practices. Currently, the Design Basis Accident (DBA) containment response model for the short-term blowdown phase for all ice condenser plants is based on Westinghouse Electric Company's Transient Mass Distribution (TMD) code. With the exception of the Duke plants, which utilize a previously approved GOTHIC model, the long-term phase of the DBA is modeled by Westinghouse's Long Term Ice Condenser (LOTIC) codes. With this foundation, all industry plants can adopt the Radial Zone concept—and the ice mass derived therefrom—for the basis of their ice mass technical specification. While this topical report describes the industry-standard Radial Zone configuration (three Radial Zones containing three sequential rows of ice baskets each), it is noted that more refined configurations are possible using similar technical justification. Any Radial Zone configuration different than the industry standard, however, is subject to the same statistical sampling plan and alternate selection criteria described herein.

I

Ice Mass Requirement Design Basis and Industry Data

Purpose / Scope

The purpose of this Section is to describe the historical development of the ice mass requirement design basis and provide the link to the Ice Mass Technical Specification and AIMM methodologies. Analysis of historical operational data is performed to support the approach.

Historical sublimation data from Duke Energy's McGuire and Catawba Nuclear Stations and Tennessee Valley Authority's Sequoyah and Watts Bar Nuclear Plants was compiled and normalized to reflect a typical ice condenser plant. The normalized data from these seven units of record is generally indicative of any domestic ice condenser, including the two at D.C. Cook Nuclear Plant. Concepts introduced in this Section are based on current industry practice, sublimation rate analyses, design basis interpretation, and operating experience.

Design Basis

The ice condenser containment is analyzed for the limiting design basis accident (i.e., a double-ended guillotine reactor coolant pipe break loss-of-coolant accident, or large-break LOCA) for confirmation of pressurization integrity in accordance with 10CFR50, Appendix A General Design Criterion 50. The containment is analyzed for both short-term and long-term pressurization effects.

The short-term containment pressurization analysis is performed using the Westinghouse Transient Mass Distribution (TMD) analysis code. The short-term analysis, whose actual duration is a function of plant specific parameters but is modeled as a ten-second event, establishes the peak pressure differential across the ice condenser and reactor building structures that separate lower containment from upper containment. The analysis confirms the ice condenser and related structures will maintain their structural integrity under peak differential pressure loads caused by the compression of the lower containment air volume as it is forced into upper containment through the ice condenser as a result of the mass and energy released in the initial seconds of a large-break LOCA. The short-term containment integrity analysis assumes a fixed flow area through the ice condenser, which establishes the design basis requirement for ice condenser flow passage area. Westinghouse Electric Corporation tested the capability of the ice bed to withstand the blowdown energy release at their Waltz Mill Facility and documented the results for each plant (Ref. 14-18).

The long-term containment pressurization analysis is performed using the two-dimensional Westinghouse Long Term Ice Condenser Containment (LOTIC) analysis code (the three-dimensional GOTHIC analysis code is used for the Duke plants). The long-term analysis evaluates containment pressurization beginning with reactor coolant system blowdown, and continues through ice bed melt-out and subsequent containment building pressurization control using the containment spray and residual heat removal systems. The analysis is used to confirm that the peak containment pressure remains below the design limit at all times following a large-break LOCA. The long-term analysis assumes an initial ice mass in the ice condenser that suppresses containment pressurization as the ice bed melts. At the time that sections of the ice bed begin to completely melt out, the emergency core cooling systems are realigned from the refueling water storage tank to the containment recirculation sump. Following complete ice bed melt-out of all sections, containment spray systems and injection systems suppress containment pressurization with active heat removal being provided by emergency core cooling heat exchanger(s). The assumed ice mass in the LOTIC/GOTHIC analyses must be sufficient to limit the peak containment pressure below the design basis limit following ice bed melt-out, and typically also delay melt-out of complete sections of the ice bed until emergency core cooling systems are aligned to the containment sump. One of the fundamental assumptions of the two-dimensional LOTIC model is that only a minimal amount of the mass and energy released in the lower containment bypasses the ice condenser until the time of ice bed melt-out of complete sections. While it is understood that the ice bed will not likely melt out evenly over the course of the DBA, early melt-through of sections of the ice condenser could reduce the modeled efficiency of the ice condenser, resulting in increased containment pressurization. Early melt-through of the ice bed will not occur as long as 1) the ice condenser and related structures maintain their structural integrity (as demonstrated by the short-term TMD containment analysis), and 2) enough ice mass is sufficiently distributed such that localized degraded regions of mass do not exist in the ice bed. In this manner, the LOTIC/GOTHIC analyses assumptions and methodology establish the design basis requirements for total ice mass.

Historically, an as-left ice mass surveillance was used to verify that the design basis parameters would be met throughout the coming fuel cycle. The as-left Technical Specification ice mass requirement contained an added sublimation allowance for anticipated ice loss through the cycle, and an additional conservative allowance to account for mass determination uncertainty.

Original Ice Mass Technical Specification Requirements

Based on historical industry experience (references 1 and 2), a 144-basket sample size resulted from two separate increases. D.C. Cook Nuclear Plant Unit 1 was the first ice condenser containment to operate, and ice mass was closely monitored. For two years in the mid-1970s, ice mass was obtained and analyzed at three- or four-month intervals (references 3 – 7). The first ice mass Technical Specification, supplied by Westinghouse Electric Corporation as an experimental version, required that a total of 60 ice baskets be weighed from the ice bed parent population. After the initial evaluation program was complete in 1975, ice bed sublimation patterns were recognized as significant; the sample size was increased from 60 to 96 and created a *representative sample*, with one basket each taken from radial rows 2, 4, 6, and 8 in each of the 24 bays. Then, in 1976, technological advances allowed the inner and outer radial rows (rows 1 and 9) to be lifted, which resulted in additional ice mass data collection. Evaluation of the data indicated that the most active sublimation occurred in these two radial rows. The technical specification was again revised in 1977, increasing the sample size from 96 to 144 ice baskets to add samples from the two outer radial rows. The 144-basket sample configuration was considered representative of the parent population and included six baskets from each of the 24 ice condenser bays, consisting of one basket from each of radial rows 1, 2, 4, 6, 8, and 9 per bay.

This representative sample was used to calculate the total ice bed mass with a 95% level of confidence, as determined by ensuring that each individual basket mass in the sample group was in compliance with the surveillance requirement's per-basket limit. The individual sample basket masses were also used to ensure the *azimuthal* distribution of ice was reasonably uniform. This was accomplished by subdividing the ice bed into Row-Groups, and ensuring the limit per basket for each was met. The Groups were defined as follows:

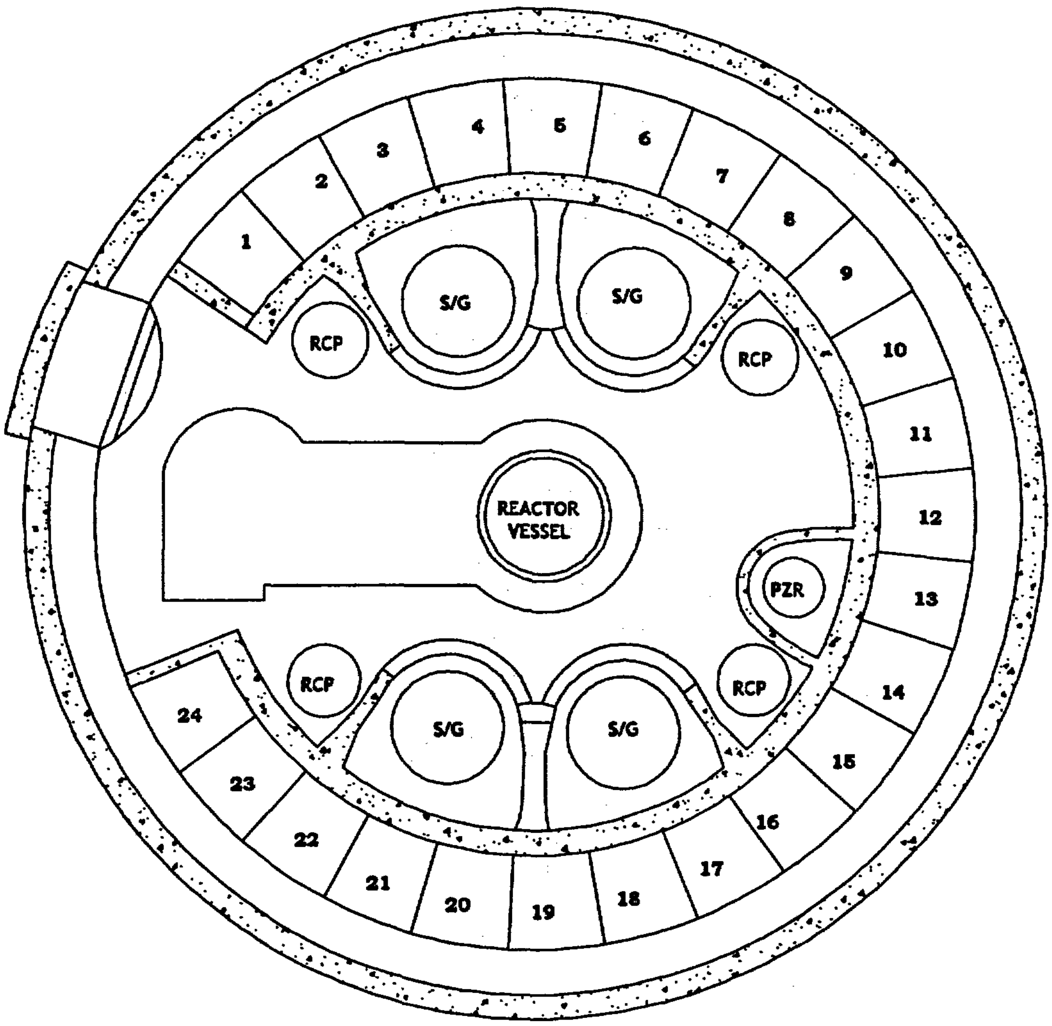
Group 1 - bays 1 through 8

Group 2 - bays 9 through 16

Group 3 - bays 17 through 24

These groups align with the location of the Steam Generator compartments, the Pressurizer compartment, and the Reactor Coolant Pumps as shown in Figure 1-1. The groups are also consistent with the sectored initial ice loading strategy employed by the D.C. Cook plant in 1974.

Figure 1-1. Typical Plan View of Containment Building



As noted previously, the original ice mass technical specification required individual sampled basket masses meet the surveillance requirement limit in order to verify total mass. In addition, these masses were used as the verification that a degraded localized region did not exist in the ice bed that would challenge the DBA pressure response. If a basket in the 144-basket statistical sample was found to weigh less than the required individual limit (described as "light"), the sample was to be increased in the localized region (i.e., the affected Bay) by 20 baskets. The averaged mass of the 20 additional baskets and the "light" basket was then required to meet the surveillance limit.

Historical Data

In the effort to revise the original Ice Mass Technical Specification, the industry agreed to evaluate historical data to develop a surveillance that is consistent with evolved maintenance techniques and operating experience. Since most domestic ice condenser plants have implemented the use of the trending software ICEMAN™, which was developed by Duke Energy Corporation and Framatome ANP, it will be used to compile historical industry data.

The ICEMAN™ program is an ICE condenser MANagement system that provides for scheduling and managing ice condenser maintenance activities such as ice mass determination, ice basket replenishing, basket maintenance, and flow channel inspection and cleaning. It also provides technical specification analysis methodology and specific reports required by maintenance procedures, regulations, and administration. ICEMAN™ maintains a record of each basket's historical "life", which aids in active management of the ice bed mass.

For this development, historical ice basket sublimation data was taken from each plant's ICEMAN™ database and averaged to represent typical ice basket sublimation rates. This was accomplished by first defining valid data from each unit's database. Valid ice basket mass data, for the purposes of analysis, is considered to be individual baskets having more than 1,400 recent consecutive days (about three cycles) of sublimation information. These criteria ensure that cycle-to-cycle variances are not dominant and the effects of AIMM practice are included. Then, ice baskets with valid data were combined into a single database, providing each basket with as many as seven sublimation rate entries (one for each ice condenser unit of record). Sublimation rates were then averaged resulting in one data set containing 1,944 ice baskets, each with an associated industry mean basket sublimation rate. For clarity, ice baskets that have only one entry were assumed to be the industry average.

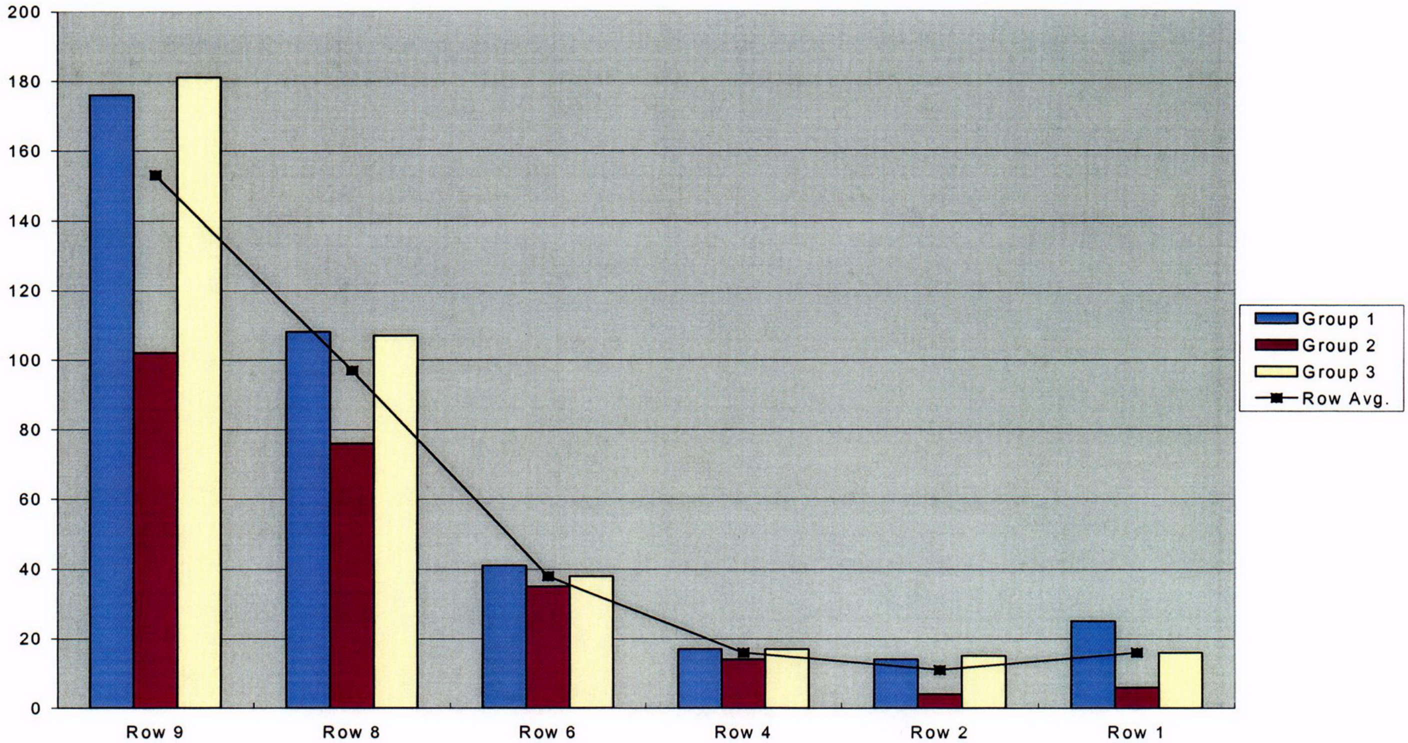
Historical Data Analysis

Historical technical specification data (which excluded baskets in radial rows 3, 5, and 7 from the sample group) was used as the basis for a normal operating cycle sublimation analysis, since industry data for these rows is the most complete. Industry mean basket sublimation rates were applied to the previously defined Row-Groups, and the Row-Group mean sublimation rates and associated standard deviation from a population of 72 baskets per group calculated. Table 1-1 shows a comparison of the mean sublimation rates for each Row-Group and each radial row, where row 9 represents the row adjacent to the inner Crane Wall and row 1, the outer Containment Wall. The mean radial row sublimation rates shown in Table 1-1 are based on a row population of 216 baskets. Figure 1-2 is a graphical representation of the same data.

Table 1-1. Row-Group Sublimation Rates

Radial Row		Mean Sublimation Rate (lb/18 month)	Standard Deviation (lb/18 month)
9	Row	153	56
	Group 1	176	42
	Group 2	102	36
	Group 3	181	51
8	Row	97	22
	Group 1	107	19
	Group 2	76	12
	Group 3	107	14
6	Row	38	10
	Group 1	41	11
	Group 2	35	7
	Group 3	38	11
4	Row	16	12
	Group 1	17	12
	Group 2	14	4
	Group 3	17	16
2	Row	11	25
	Group 1	14	25
	Group 2	4	7
	Group 3	15	33
1	Row	16	30
	Group 1	25	35
	Group 2	6	13
	Group 3	16	34

Figure 1-2. Row-Group Sublimation Rates



As shown in Table 1-1 and Figure 1-2, historical industry sublimation data indicates effects in both the radial and the azimuthal directions across the bed, an expected behavior primarily due to the proximity of heat sources in Containment. While the end wall bays (bays 1 and 24) and Groups immediately adjacent to the Steam Generator and Pressurizer compartments (Groups 1 and 3) show some azimuthal variance, these groups represent two-thirds of the ice bed. As a result, no individual bay exhibits a significantly disproportionate trend due to the azimuthal variance.

If the ice mass surveillance is performed on an as-found (pre-maintenance) basis, then the sublimation allowance is no longer needed in the technical specification and it can be moved to plant maintenance procedures that are maintained per the requirements of 10CFR50, Appendix B and 10CFR50.59. This allows ice baskets to be serviced in the plant maintenance program based on their individual basket sublimation rates, as opposed to assuming all baskets sublimate uniformly across the bed (an assumption clearly dismissed by the industry operating experience depicted in Figure 1-2). The practice of managing individual basket sublimation in order to maintain a relative distribution of ice across the bed is the foundation of the Active Ice Mass Management (AIMM) concept.

AIMM Methodology

In order to perform appropriate replenishment activities on the ice bed each outage, the number of baskets needing to be serviced must be identified. Replenishment "triggers" vary from plant to plant due to variations in specific sublimation rates, but at all plants the as-found ice mass in each basket of the bed must be assessed prior to assigning replenishment scope. As shown in Figure 1-2, there are a significant number of baskets that will not need ice replenishment every outage (such as those in rows 1-6). However, the current mass of ice in these baskets must still be determined in order to predict *when* they will need replenishment in the future. This process (assigning replenishment scope to the current and future outages based on current basket mass and known sublimation trends) is an active management

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process, requiring that plants know the specifics behind their ice bed's behavior patterns. In most cases, each individual basket in the ice bed has a known sublimation behavior pattern associated with it, based on its specific location. Upon determining the as-found ice mass for a basket in the bed, plant personnel then compare that value to the required safety analysis mean value and apply that basket's sublimation trend to project its mass forward through the coming cycle. Any individual basket's ice mass that is projected to sublimate to or below the safety analysis mean mass value is serviced during the current outage. This is how AIMM practice maintains the ice mass in each individual basket above the required safety analysis mean.

Determination of Basket Mass In AIMM Practice

As noted previously, the preferred method for basket mass determination is via a load cell due to this method's relative speed and accuracy. As it requires the baskets to be free to be lifted, the use of this method is limited in areas of the bed where frequent servicing has rendered some baskets unliftable. In these areas, either historical sublimation trends are used to project a basket's mass to the present, or it is visually inspected (full length via camera) and its mass estimated. Since the historical technical specification surveillance requirements were performed in the *as-left* condition, all baskets used in satisfying the surveillance after servicing were required to be free so that a load cell could be used. In many cases, this resulted in the use of alternate selections in the areas where stuck baskets are common. The technical specification approach supported by this topical report is an *as-found* surveillance, providing an opportunity for the industry to document these alternate methods of mass determination for satisfying the surveillance requirements. This is discussed in more detail in Section II.

The Radial Zone Concept

Technological advances (such as ICEMAN™) have allowed the industry to further develop AIMM methodology by simplifying the evaluation of empirical data and depicting long-term ice bed behavior. As was done previously in Table 1-1 with defined azimuthal Groups, mean industry data can be used to show the radial row mean sublimation rates for each radial row (see Table 1-2). These sublimation rates are based on a population of 216 baskets per radial row and is consistent with data presented in Table 1-1, where radial row 9 designates the row adjacent to the Crane Wall. The data is shown graphically in Figure 1-3.

Table 1-2. Radial Row Sublimation Rates

Radial Row	Mean Sublimation Rate (lbs/18 months)	Standard Deviation (lbs/18 months)
9	153	56
8	97	22
7	60	10
6	38	10
5	24	18
4	16	12
3	11	18
2	14	25
1	16	30

Figure 1-3. Radial Row Sublimation Rates (lbs/18 months)

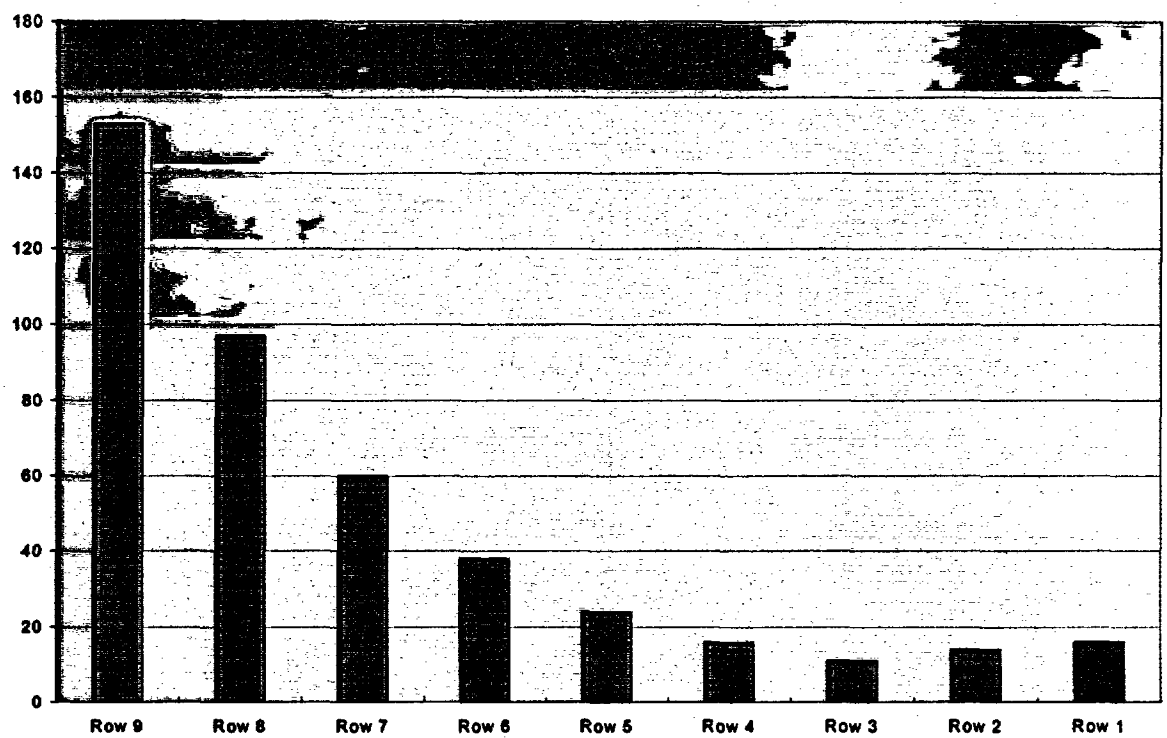


Figure 1-3 clearly shows that certain radial rows sublimate at markedly different rates than other rows, with the most pronounced effect in the innermost radial rows 7, 8, and 9. The industry recognized that isolating these three radial rows would provide a "radial zone" that behaved, for all intents and purposes, as a separate entity. Through AIMM practice, the baskets in radial rows 7, 8, and 9 are the most frequently serviced due to this sublimation rate difference, but not all rows are serviced at the same time (i.e., the same outage). It became apparent that because of this inherent replenishment schedule, these three rows contained similar mean mass at any given point in time. With radial row 9 serviced the most frequently, and rows 7 and 8 serviced less frequently, every ice basket in the "radial zone" could be used as a reasonable as-found (pre-maintenance) representative of the zone. The new ice mass surveillance, then, could easily be defined in terms of Radial Zones, where each Radial Zone was comprised of rows of ice baskets that historically conveyed similar mean mass for analysis purposes.

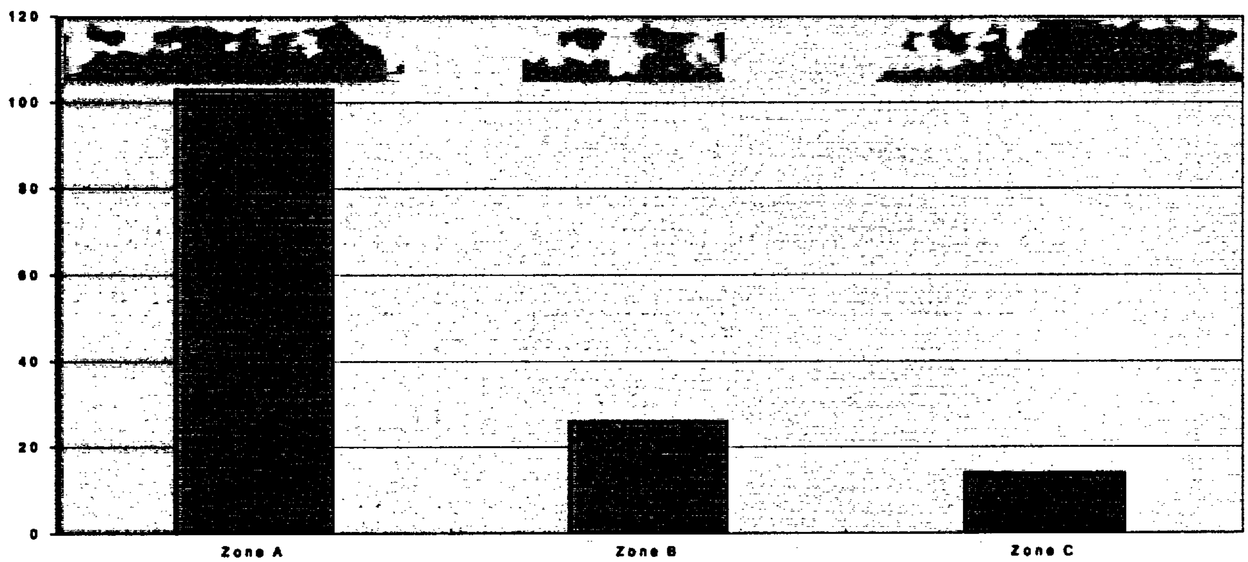
The Radial Zone concept was further supported by the idea that statistical analysis could be performed on individual Radial Zones to determine total ice bed mass with 95% confidence, which would considerably simplify the surveillance requirements. This led to a generic three sequential radial row, three Radial Zone configuration, which was based on the data depicted in Figure 1-3. It is noted, however, that this configuration is not the only one that will work; other, more refined approaches can be made with a similar technical basis.

To illustrate the adopted generic configuration, Radial Zones are defined such that Zone A contains Rows 9, 8, and 7; Zone B contains Rows 6, 5, and 4, and Zone C contains Rows 3, 2, and 1. Applying this concept to industry historical data results in a profile of mean sublimation rates, as shown in Table 1-3 and Figure 1-4.

Table 1-3. Radial Zone Sublimation Rates

Radial Zone	Mean Sublimation Rate (lb/18 months)	Standard Deviation (lbs/18 months)
A	103	52
B	26	14
C	14	25

Figure 1-4. Radial Zone Sublimation Rates



The concept of Radial Zones is also applied to the alternate basket selection criteria, which provides for an alternate basket selection for the statistical analysis in the event an initial sample selection cannot be accessed. Since each Radial Zone consists of baskets having similar mean mass, all baskets in that Radial Zone are considered to be statistically representative for sampling purposes. This approach is discussed further in Section III.

Regions of Localized Degraded Mass

A surveillance that requires a minimum total ice mass in each Radial Zone assures the initial conditions of the DBA analyses, and also assures that the ice mass is appropriately distributed across the three Radial Zones. A separate surveillance, addressing the potential effects of a localized area of baskets with degraded mass, adds assurance that AIMM practice is being implemented appropriately. As described previously, through AIMM methodology individual basket mass is managed above the required safety analysis mean value. The AIMM methodology provides defense in depth in complying with the surveillance requirement and minimizing any occurrences of baskets with ice mass less than the required safety analysis mean. The original licensing basis for the ice bed provides the concept that the DBA containment pressure response is relatively insensitive to variations in ice mass (Ref. 19). This concept is evident by the original Technical Specification provision for the treatment of "light baskets."

In an effort to provide quantitative bases to link this concept to DBA safety analysis, Duke Energy ran a series of three-dimensional GOTHIC sensitivity runs (Ref. 21) using the McGuire Nuclear Station containment model. For the purposes of showing containment pressure response sensitivity to localized degraded mass conditions of varying severity, the GOTHIC results can be applied to all domestic ice beds.

For each of these sensitivity runs, an entire end sector of ice baskets (2.75 ice condenser bays side-by-side at the far end of the bed) was degraded, and the worst postulated DBA break positioned right under this region. As the GOTHIC analysis is a three-dimensional model and allows cross-flow between bays, choosing the end sector limited the advantage of steam cross-flow to only one adjacent sector after the degraded region melted through during the analyzed DBA transient. Three separate cases were defined:

- **Case 1:** All baskets in Radial Zone A bounded by the far-end GOTHIC sector (2.75 bays) contain 600 lb of ice each at the onset of the DBA. This represents 75 baskets, all grouped together, positioned over the break location. The results for this run showed that the resulting peak containment pressure was essentially unchanged, staying within about ½ % of the baseline case for McGuire.
- **Case 2:** All baskets in Radial Zone A bounded by the far-end GOTHIC sector (2.75 bays) contain 400 lb of ice each at the onset of the DBA. This represents 75 baskets, all grouped together, positioned over the break location. The results for this run showed that the resulting peak containment pressure increased, but was within about 2 % of the baseline case for McGuire.
- **Case 3:** All baskets bounded by the far-end GOTHIC sector (2.75 bays) contain 400 lb of ice each at the onset of the DBA. This represents 225 baskets (all three Radial Zones), all grouped together, positioned over the break location. The results for this run showed that the resulting peak containment pressure increased, but was within about 2½ % of the baseline case for McGuire.

These results quantify the relative insensitivity of the ice condenser DBA containment pressure response to extreme ice mass variances, including worst-case break and mass variance locations. As described previously, via AIMM methodology each basket is managed above the required safety analysis mean mass, so that variances of this severity due to maintenance practices are highly unlikely. Given this, a plant transient significant enough to open the Lower Inlet Doors is the only mechanism that might create the extent of degraded conditions depicted by these runs, and a transient significant enough to open the Lower Inlet Doors would be annunciated in the Control Room, initiating prompt corrective action. However, because the sample baskets randomly selected in a Radial Zone are statistically averaged to satisfy the surveillance requirement for mean total ice mass, the Technical Specification technically allows some individual baskets to be below the safety analysis mean provided there are other higher-mass baskets in the sample to account for them. Therefore, a limit is established on the minimum allowed ice mass in any basket to assure that the potential for melt-through of any localized area of the ice bed will be consistent with the original DBA analysis concepts. For this reason, a minimum individual basket mass limit of 600 lb per basket is established as a separate operability requirement, such that there are essentially no effects on DBA containment pressure response. This as-found surveillance for minimum ice mass in any individual basket assures the bed condition is at all times consistent with the initial conditions of the DBA analyses, by limiting localized degradation that might challenge the DBA containment pressure response.

Conclusions

Existing ice condenser design basis requirements show that the ice mass technical specification is satisfied as long as both the short-term and long-term phases of the DBA are accommodated by sufficient ice mass in the bed. Therefore, the new Ice Mass Technical Specification contains surveillance requirements that provide assurance the ice mass present in the ice bed at any given time, with a 95% level of confidence, is sufficient to mitigate the overall DBA response. Specifically, the operability surveillances will be performed when necessary in the as-found (pre-maintenance) condition.

The minimum individual basket mass surveillance requirement is based on the minimum amount of ice needed in each basket to avoid localized regions of degradation in the ice bed that might challenge the DBA pressure response. This limit is derived from sensitivity runs performed using the three-dimensional GOTHIC analytical code. Concurrent assurance that localized regions of gross degradation do not exist in the ice bed is given via Active Ice Mass Management (AIMM) methodology, which is based on current industry maintenance practice and asserts that the ice mass in each basket in the ice bed will be managed above the required safety analysis mean, and serviced prior to reaching this limit. Therefore, the methodology for the requirement of minimum individual basket mass has two elements: 1) active maintenance practice (AIMM) that manages each basket to the required safety analysis mean, and 2) a defined surveillance minimum limit of 600 lb per basket.

Assessment of total ice mass and distribution in the ice bed is facilitated by segregating the ice bed into Radial Zones, which provides basket sub-populations with similar characteristics. Individual baskets can, as a result, sublimate according to their relative position in the bed and remain operable provided minimum individual basket mass limits are maintained and the total ice bed mass requirements met. The generic Radial Zone configuration adopted by the industry is a three-Radial Zone, three sequential row array based on historical sublimation and mass data from the plants, and in addition to providing enhanced mass assessment provides assurance of appropriate mass distribution.

An as-found (pre-maintenance) surveillance that verifies the total ice mass needed to mitigate a design basis accident will require that each plant be cognizant of ice basket sublimation rates and the accuracy of mass determination methodology. Sublimation allowances for upcoming cycles and treatment of mass determination uncertainty will be maintained procedurally at each site.

II

Ice Basket Mass Determination Methodology

Purpose/Scope

This Section describes the methods utilized to determine individual ice basket mass for the Ice Mass Technical Specification surveillance requirements, and provides a standard for developing, quantifying and maintaining the uncertainty for each of these methods. A description of available mass determination techniques is provided, along with a generic estimate of each technique's uncertainty based on analyzed industry data, which supports their use in the Statistical Sampling Plan (Section III) and in establishing a 95% level of confidence in the total ice bed mass. The methods analytically considered are manual lifting, basket mass projection using historical data and trending software (i.e., Excel spreadsheets, ICEMAN™, or other), and visual inspection. The treatment in this Section of the uncertainty in the mass determination techniques provides a large range within which other methodologies can be developed as the industry's experience grows. The quantitative details regarding the determination of ice basket mass and associated uncertainty are based on the accumulation of actual field data and therefore must be maintained in plant-specific procedures in accordance with 10CFR50, Appendix B. This topical report provides the associated methodologies that are the standard within the industry.

The generic analysis herein is based on ice mass data (collected via lifting, visual inspections and software projections) from the last refueling outage at any plant prior to February 2001. As noted previously basket mass data and mass determination technique uncertainties for subsequent plant outages will necessarily change; however, the general trends and conclusions remain valid.

Discussion

Preferred Ice Mass Determination Method

Historically, the determination of ice basket mass and the collection of ice mass data have been accomplished through manual lifting of the basket. This method provides the fastest and most direct way of determining ice mass. In this process, the ice basket is raised by its top with a lifting rig, which is attached to a load-measuring cell (for indication of the mass). For most baskets, a hoist is used for the lift; a hydraulic cylinder is used for less accessible basket locations. The load cells are calibrated via plant procedures conforming to 10CFR50, Appendix B requirements.

The manual method works well unless the basket selected is stuck and cannot be lifted without exceeding established maximum lifting force limits. For ice baskets that are stuck, either the mass of the selected basket must be ascertained by some alternative means, or a representative alternate basket selected within the guidelines and limitations discussed in Section III. If an alternate mass determination technique can ascertain the mass of ice in a basket, then the presence of stuck ice baskets is not relevant to the surveillance requirements.

Alternate Ice Mass Determination Methods

In general, a valid alternate basket mass determination technique must have the following three qualities:

1. The technique must be *predictable*, showing that the uncertainty associated with the methodology is based on sound analysis that is maintained to account for current experience levels, including actual accumulated field data,

2. The technique must be *repeatable*, showing that its continued use does not generate values consistently outside the established uncertainty of the method, and
3. The technique must be shown to *apply to the specific ice bed under surveillance*, showing that the methodology is supported by valid local data.

As noted in Section I, ICEMAN™ is a software program that trends ice basket mass histories and can be utilized to project future ice basket mass based on individual sublimation rates and previous ice basket mass data. Likewise, other software applications can be used, such as Excel spreadsheets or similar commercially available products. Any of these utilized applications are maintained on a plant-specific basis in accordance with the requirements of 10CFR50, Appendix B.

The projection technique has been used successfully for many years at Duke Energy's McGuire and Catawba Nuclear Stations to predict outage maintenance scope. As an alternate mass determination technique, it represents the most precise technology outside the manual lifting method, but requires a significant amount of accurate historical ice mass data in order to generate projections. This technique entails observing the mass of individual ice baskets over a period of time (many cycles), and, through successive end-of-cycle weighings of the basket, determining the total ice loss that occurs over the period. From this information, a sublimation rate is calculated, and when a projection of the basket's mass is required (i.e., if the basket were to become stuck), the sublimation is extrapolated to the desired date (e.g., the end of the current cycle) from the last known lifted mass. This technique requires a data validity criterion (described later), which limits the use of the most historically distant data in projecting a current basket's mass and also limits the number of times a given basket's mass can be projected successively before a lifted mass on the basket is required. It also requires that the uncertainty calculation be updated with newly obtained data after each outage to reflect the most recent sublimation trends in the ice bed. The end-of-cycle mass data, being obtained by manual lifting, limits the technique's capabilities as an as-found surveillance tool where a large number of stuck baskets have existed for some time. In this case, Licensees have the option of getting these stuck ice baskets free (e.g., via labor-intensive means) and keeping them free for several successive cycles to refresh the sublimation trend, or not using the projection technique. In the latter case another mass determination method would be required.

Sequoyah Nuclear Plant has developed and employed a procedure for performing a visual inspection of the ice basket column in order to determine its mass. This method involves a camera inspection over the length of the ice basket while estimating the amount of ice mass missing from the column in the form of linear gaps, shaped voids, and annular "shrink-back" from the ice basket mesh. The mass of missing ice from the various voids is totaled and the result subtracted from the known mass of a full basket, providing an estimate of the actual ice mass in the basket. This technique has been utilized successfully over several outages at Sequoyah as a scoping technique for outage maintenance, and is used in areas of the ice bed where stuck baskets are typically found (e.g., Radial Zone A). Experience with the visual estimation technique has shown that a reasonable assessment of ice basket mass can be made; some ice baskets found stuck and their mass estimated using this technique have been subsequently freed and manually lifted, giving a direct comparison for analytical purposes. In addition, ice baskets recently lifted have been visually estimated to provide additional data. As with the mass projection method described previously, this method of mass estimation requires a validity criterion requiring comparative determination of ice mass using the lifting method in order to maintain a quantifiable uncertainty. As the most subjective of the three methods defined so far, visual estimation of basket mass, used on a large scale, will likely require Licensees utilizing it to maintain more ice in their ice bed due to the greater uncertainty associated with this method.

In order to assess the viability of other alternate mass determination methods, TVA commissioned a study through an independent consulting company to investigate new technologies for non-intrusive inspection of the ice column profile in the ice baskets. The goal of the study was to find a technology that would provide an estimation of the volume of the column and therefore the mass of the ice in the column. Based on the results of the investigation it was concluded that the use of ultrasonic measurement techniques was best suited to this application, with laser technology also recommended. In both cases, inspection of the ice column requires a scanning device to be sent along the length and periphery of the ice column. The delivery system and hardware pose a significant challenge in developing this technology. TVA elected to proceed with the development of the ultrasonic measurement technique. A prototype system was assembled and given a proof-of-concept test at the Watts Bar Nuclear Plant; the test concluded that the prototype system was able to profile the surface of the ice in a basket and that the data could be recorded for future analysis. However, challenges identified with the delivery mechanism for the ultrasonic probe and the retrieval of the data collected from the scan need to be resolved before this technique can be successfully utilized as an alternate mass determination method.

For any of the alternate mass determination methods described herein (or for methods subsequently developed), quantitative validation of the technique will be maintained on a plant-specific basis in documents developed under the auspices of 10CFR50, Appendix B and 10CFR50.59. Quantitative validation determines the specific uncertainty of the methodology, and identifies the associated measures of relative standing (e.g., systematic bias and random error). Individual ice basket masses determined using an alternate technique are quantified using a standard method agreed upon by the industry, which facilitates the determining of total ice bed mass as described in the Statistical Sampling Plan (Section III). In addition, this method provides for showing the predictability and repeatability of the techniques, as well as documenting the plant-specific data used to develop them.

Standards: Ice Basket Mass Determination Uncertainty

This section considers the error and uncertainty in measurements and calculations performed while determining the mass of individual ice baskets, and provides a model by which the uncertainties inherent in different methodologies for determining individual ice basket mass can be defined.

As discussed previously, there are three documented methods used for determining the mass of an ice basket:

1. Direct lifting of the basket with a lifting rig utilizing a calibrated load cell,

2. Projection of the basket's expected mass from historical data and calculated sublimation rates (determined using mass data obtained by load cell), and

3. Visual approximation of the basket's mass made from a full-length inspection of the ice basket using a video camera.

All of these methods rely, to some degree, on basket mass data obtained through the use of a load cell device. Methods 2) and 3) were uniquely developed to facilitate determining the mass of baskets that cannot be directly lifted due to obstruction or ice build-up around the basket's periphery, a situation that occasionally occurs in some baskets that were initially free to lift. For each of these methods, the uncertainty in the mass determinations must be defined prior to their use in satisfying technical specification surveillance total ice bed mass requirements. The application of these individual uncertainties to the appropriate surveillance requirements is discussed in detail in Section III.

Concepts regarding uncertainty

- Every measurement has an uncertainty associated with it, unless it is an exact, counted integer.

- Uncertainty arises from *errors* introduced into the measurement process, and errors arise from both *systematic bias* and *precision*-related issues.

- Every calculated result also has an uncertainty, related to the uncertainty in the measured data used to calculate it.

- The numerical value of a ± uncertainty value provides the range of the result. For example, an ice basket mass identified as 1,465 ± 15 lb means that there is some degree of confidence that the true value falls between 1,450 lb and 1,480 lb.

Error

The error in a measurement is the difference between the measurement and the actual or true value of the quantity observed. Since the true value is often not known, the exact error is also unknown.

Errors are typically divided into two types: *systematic* and *random*. Systematic errors (also known as *bias*) can result from fundamental flaws in the equipment, the performer, or in the use of the equipment. For example, a load cell may always read 5 lb light due to being zeroed incorrectly. Similarly, a member of a weighing crew may consistently overestimate a visual estimation of ice mass in a basket. This type of error, if it cannot be calibrated out (as might be the case with a mass measurement made by visual estimate or sublimation projection rather than an instrument), must be identified and included in any measurement uncertainty.

Random errors vary in a completely non-reproducible way from measurement to measurement. However, random errors can be treated statistically, making it possible to relate the precision of a calculated result to the precision with which each of the measured variables (such as individual basket mass) is known. Random error is typically estimated by the standard deviation (denoted by σ) of a group of repeated measurements centered about a mean.

To assist in recognizing types of error, consider the task of measuring the distance between two parallel vertical lines drawn on a piece of paper. Typical technique would be to use a ruler, aligning one end of the ruler with one line, and reading off the distance to the next. Random errors might arise from two sources:

1. Instrumental error (e.g., ruler calibration, spacing and size of the ruler's graduations), and
2. Uncertainties in the lines (e.g., thickness of lines, temperature and humidity effects on the paper).

A third source of error also exists, however, related to how any measuring device is used. In this case, the error might be made aligning one end of the ruler with one line. The ruler should be placed on the first line randomly (but as perpendicular to the lines as possible), the position of each line on the ruler noted, and the two readings then subtracted. This should be repeated several times, and the differences averaged. This process eliminates the systematic bias (i.e., the error that occurs in each measurement as a result of the measuring process itself) that aligning one end with one line introduces.

A final type of error must be mentioned as well: *erratic error* (or a *blunder*). These errors are the result of a significant mistake in the procedure, either by the performer or by the instrument. An example would be misreading the numbers on a load cell read-out and entering incorrect information into the basket mass history database. Another example would be unnoticed excessive friction between the sides of a basket and the lattice steel while using a lifting rig with a load cell. The load cell itself might produce a blunder if a poor electrical connection causes the display to read an occasional incorrect value. If the mistake is caught at the time of the procedure, the result should be discounted and the measurement repeated correctly. If the mistake is missed, blunders can be difficult to trace and can give rise to much larger error than random errors. If a result differs widely from a known (or expected) value or has low accuracy, a blunder may be the cause. If a result differs widely from the results of other performed measurements, a blunder may also be to blame. The best way to detect blunders is to repeat all measurements at least once and compare to known or expected (benchmark) values, if available. Blunders can also be avoided through careful application of procedural controls for the measurement process.

Precision of Instrument Readings and Raw Data

The first step in uncertainty determination for a process or calculation is to estimate the precision of the raw data used in the calculation. Consider three mass determinations made on the same ice basket using a load cell w/digital read-out as follows (all are basket + ice):

1st weighing = 1,652.1 lb
2nd weighing = 1,654.3 lb
3rd weighing = 1,656.2 lb

The average, or mean, mass of the ice basket is therefore:

$$M_{mean} = \frac{1{,}652.1 + 1{,}654.3 + 1{,}656.2}{3} = \mathbf{1{,}654.2\ lb}$$

In this example, the precision or reproducibility of the measurement is ± 2 lb. All three measurements can be included in the statement that the basket has a mass of 1,654 ± 2 lb. The load cell read-out in this example allows direct reading to one decimal place, and since the precision is roughly 2 lb, the load cell has the necessary sensitivity for this measurement.

At this point, there is little knowledge of the *accuracy* of the mean basket mass, 1,654 ± 2 lb. The accuracy of the weighing process depends on the accuracy of the internal strain gauges in the load cell as well as on other instrumental calibration factors. The manufacturer's stated accuracy for this load cell is ± 0.3% of full scale, which for a 0-5000 lb scale is about ± 15 lb. This is verified every time the load cell is calibrated, and often the accuracy achieved is better than that stated by the manufacturer. Since the measurements are also being made well within the full scale range of the load cell, it can be expected that a correctly calibrated instrument, used according to procedure, will give an accurate result. Therefore, in this example the precision displayed by the measurements is well within the expected calibrated uncertainty of the load cell. The high precision of the three measurements (± 2 lb) indicates that a blunder has not been made, and in addition shows a reduced likelihood of significant systematic bias.

Quantifying Measurement Uncertainty

For simplicity of presentation a single number (some combination of systematic bias and random error) is needed to express a reasonable limit for uncertainty. The single number must have a simple interpretation (the largest error reasonably expected) and be useful without complex explanation. It is not feasible to define a single rigorous statistic, because systematic bias is an upper limit based on judgment and experience with a particular process which has generally unknown characteristics. The function, then, must be a hybrid combination of an unknown quantity (systematic bias) and a statistic (random error).

At this point, the adoption of a standard for defining basic uncertainty is appropriate. The standard most frequently used is the *bias limit* plus a *multiple of the random error*. This method is recommended by the National Bureau of Standards and has been widely used in many industries. Utilizing this standard, uncertainty may be centered about an individual measurement and defined as:

$$U = \pm [B + (t_{95} \times \sigma)]$$

Where B is the systematic bias limit, σ is the random error, and t_{95} is the 95th percentile point for the two-sided Student's "t" distribution. The value of t_{95} is a function of the *degrees of freedom* (or sample size) used in calculating σ. For small sample groups, t_{95} will be large, and for larger sample groups, t_{95} will be smaller, approaching 1.96 as a lower limit (for sample groups > 500). The use of t_{95} arbitrarily inflates the uncertainty U to reduce the risk of underestimating σ when a small sample is used to calculate it. In essence, the 95^{th} percentile points in a two-sided distribution capture 95% of the population of measurements centered about the mean value.

In view of the above discussion, clarification is needed regarding the proper quantification of individual ice basket mass determination uncertainty values that are to be used in satisfying legal technical specification surveillance requirements. Because of the nature of the technical specification limits (i.e., a *minimum* allowable ice mass for legal operability), it is industry convention to use a *one-sided* interval for uncertainty, to ensure only conservative (i.e., *lower*) values of basket mass are included in the calculations. For example, an ice basket mass of 1,642 ± 15 lb would propagate to the surveillance requirements as 1,627 lb (in actual practice the tare weight of the ice basket would also be removed in order to reflect the ice mass available for pressure mitigation alone). In the case of a *biased* uncertainty (where B $\neq 0$), a non-conservative bias component (i.e., one that *raises* the apparent mass determined using that process) would **not** be included in the uncertainty, while a conservative bias component (i.e., one that *lowers* the apparent mass determined using that process) would be included.

Because of the one-sided convention, the quantification of uncertainty for ice mass determinations will take the form:

$$U = -[B + (t_{95} \times \sigma)]$$

The value of t_{95} will also change to the value corresponding to a **one-sided** test, which approaches 1.645 as a lower limit (for sample sizes > 1000). Standard tables for the critical values of t for one- and two-sided tests and for various sample sizes are available in Reference 25, or in any statistics text.

For the load cell (an instrument calibrated in a standards laboratory prior to being used), the stated measurement uncertainty should contain no systematic bias components. Repeating individual basket mass measurements in the field will further reduce the risk of inserting procedure-related systematic bias into the process. Therefore, in the three-basket mass determination example described previously, the basket mass would be quantified as 1,642 ± 15 lb (or whatever the *calibrated* accuracy of the load cell turned out to be).

For more subjective basket mass determination methods other than direct lifting, such as the mass sublimation projection and visual estimation processes, it is imperative that uncertainty components (systematic bias, random error, and degrees of freedom) be defined and available in supporting documentation. These three components will be required to: 1) substantiate and explain the uncertainty value, and 2) provide a sound technical basis for improved measurements. In addition, the individual uncertainty components are applied independently to the required 95% confidence interval calculation of ice mass (as described in Section III) in the technical specification surveillance requirements, and documenting them in this manner facilitates that usage.

Historical Data Validity – Alternate Ice Mass Determination Methods

The two currently defined alternate techniques for determining individual ice basket mass are:

1. Projection of a basket's future mass via a sublimation trend calculated using accumulated data from historical load-cell determined values for that basket, and

2. Visually estimating a basket's mass by accounting for the voids present in the sublimated basket, and subtracting the associated "missing mass" from a pre-defined full basket mass value.

Since neither of these techniques directly involves a measuring instrument, "calibration" occurs through data analysis and refinement of the techniques. Applying an uncertainty value to either of these techniques using outdated historical data is not an acceptable way to verify that the procedure is a valid alternate mass determination process. Therefore, the following is the industry standard for refreshing the historical data used to validate these two methodologies:

Table 2-1. Alternate Mass Determination Technique Data Refreshment Criteria

Mass data used for uncertainty calculations must derive from: • ≥ 3 of the last 6 operating cycles, ***or*** • 2 out of the last 3 operating cycles.

For the mass sublimation projection technique, this represents 1,500 to 3,000 days of current sublimation data or about 1,000 days of the most recent data for the associated basket to determine average sublimation rates. For the visual estimation method, this criterion links the data used in the analyzed distribution to the most recent experience with the technique, and limits the number of successive times the technique can be used on an individual basket before a benchmark lifted mass on the basket is obtained.

Another important aspect of data validity involves the qualification of personnel trained to perform alternate mass determination techniques. In the case of mass sublimation projection, extrapolation of a point from historical data is much less subjective than accounting for visually estimated voids in an ice basket. For this reason, the latter methodology would be expected to require a rigorous training and testing protocol to ensure that accumulated data used to identify and ultimately refine process uncertainty has the highest practical quality. An efficient way of handling this is through a standardized "test" that displays the most commonly observed void characteristics in a sublimated ice basket, and depicts those voids in actual ice bed conditions (e.g., low lighting, less than ideal camera focus, space limitations). Video tapes, *in situ* estimations during scheduled outages, and practice with mock-ups are all appropriate for establishing this quality. In addition, a visual acuity test would be required to ascertain the ability of the performer to evaluate these voids in the ice bed, and qualification of the equipment provided to perform the procedure (i.e., camera, lighting) must be made.

By defining the historical data validity standard in this way, plants can ensure consistent documentation and application of the uncertainty values used in satisfying the legal technical specification surveillance requirements. This standard is applied through incorporation in plant-specific procedures that are maintained in accordance with 10CFR50, Appendix B.

Examples

The following two examples illustrate the statistical analysis of historical data for both the sublimation projection and visual estimation alternate ice basket mass determination techniques. The data analyses are performed to identify the uncertainty components for each method, and provide an outline by which plant documentation can be generated that conforms to the standard model presented herein. In these examples, the actual data sets (i.e., the individual basket mass measurements) are not shown due to their size, but represent typical industry data nonetheless. It can be assumed that all data were collected/calculated via established procedures by personnel qualified to perform them.

Mass Sublimation Projection Using Historical Data
There are several different ways to determine the sublimation rate of an individual basket using historical data. The method used primarily by the industry involves reviewing up to six previous operating cycles' worth of data for a basket (in accordance with the criteria established previously) and determining, from successive load cell mass determinations on the basket, the total quantity of ice loss that has occurred over the period. The result is a linear depiction of sublimation, with the rate of sublimation represented by the slope of the line. The unbiased uncertainty (e.g., ± 15 lb) involved in the individual measurements of mass made over this period using the load cell is typically a constant and therefore does not change this slope, but does affect the location of the line. If the next point along the line is to be projected (extrapolated using the slope) rather than identified via load cell, an uncertainty is inserted because the slope is an *approximation* of sublimation based on many varying parameters, such as operating cycle transients, air handler unit performance, and even seasonal factors. At the outcome of this projection, the historical load cell uncertainty is added to the projection uncertainty, as it becomes a "known" form of systematic bias.

For this example, mass data for 1,024 ice baskets were collected over six consecutive outages in a particular ice condenser. At the end of the last operating cycle, these baskets were weighed with the load cell and their mass also individually projected using the sublimation rate determined by this historical data. The two values for basket mass were then compared and the differences between them categorized into "ranges" of mass difference as follows:

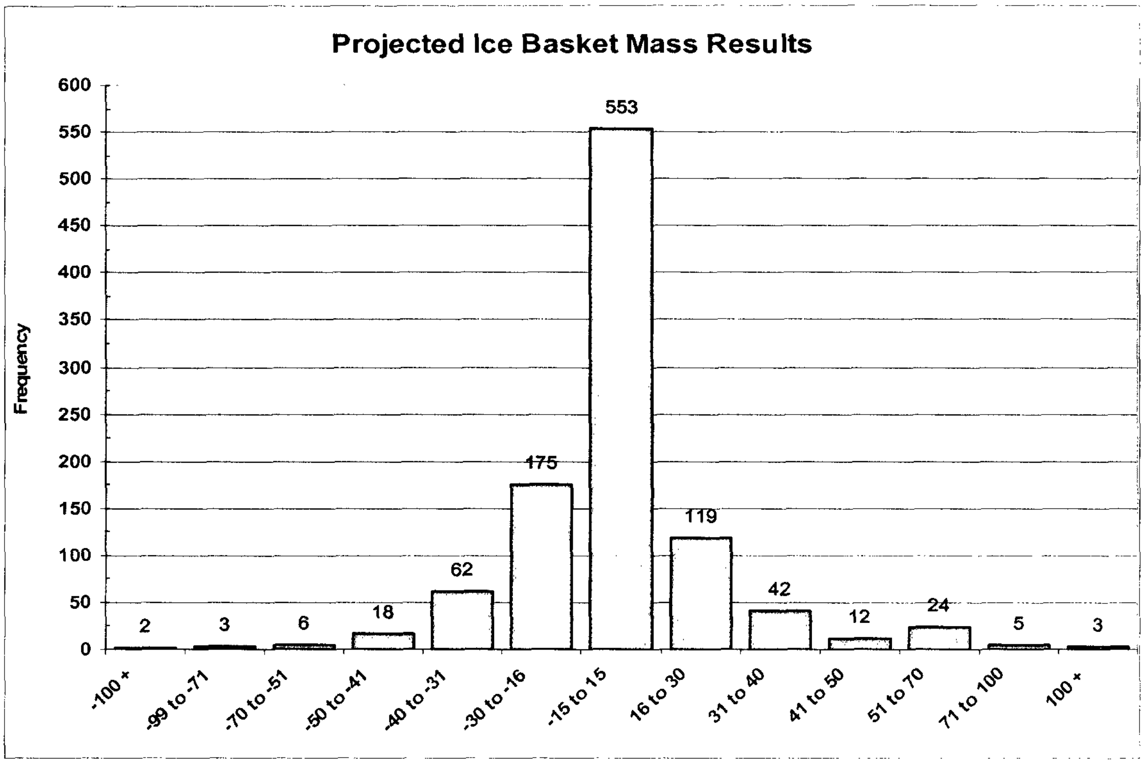
Table 2-2. Projection Method Example Data

(Projected Mass) – (Lifted Mass) Results	
Range (lb)	*Frequency (# baskets in range)*
-100 +	2
-99 to -71	3
-70 to -51	6
-50 to -41	18
-40 to -31	62
-30 to -16	175
-15 to 15	553
16 to 30	119
31 to 40	42
41 to 50	12
51 to 70	24
71 to 100	5
100 +	3
Total	1,024

Ranges were chosen based on an inspection of the data spread and on those groupings that would facilitate insight into comparison with load cell accuracy.

From this table of results, it can be seen that a fairly symmetric distribution of points exists, centered about the range -15 to + 15 lb. Note also that a positive difference (> 0 lb) is representative of a non-conservative projection of mass, that is, the projection was higher (indicated more mass) than the benchmarked load cell data point, which is considered more accurate. In terms of *uncertainty*, however, this is conservative, since it increases the error band. Graphically, this data can be represented as:

Figure 2-1. Projection Method Example Chart



In order to determine the expected uncertainty to be included for baskets using this technique based on the collected data, recall from the previous discussion that the *systematic bias*, *random error*, and the *degrees of freedom* (sample size) must be identified.

The systematic bias and random error can be determined from the comparison data by calculating the mean difference and its standard deviation. Performing these statistics operations (the actual 1,024 compared data points are not presented here for clarity) yields:

Mean Difference = -1.7 lb = **-2 lb**

Standard Deviation = σ = 24.5 lb = **25 lb**

"Rounding" (conservative measure based on knowledge of the data and associated significant figures) is used here since these values were computed from individual basket mass measurements that have an explicit uncertainty of ± 15 lb (the calibrated, unbiased load cell accuracy). The *implicit* accuracy of the load cell measurements is to three significant figures (e.g., 1,642 ± 15 lb would be written 1,640 lb). As such, recording these two statistics to ± 0.1 lb, while technically allowed, is not practical.

For the calculation of the systematic bias, B, two values will need to be applied: the calculated mean difference of the data set and the offset associated with the accuracy of the benchmark value. If the mean difference is negative (i.e., non-conservative), then it is set to zero, and the benchmark value (load cell error) assumed for the value of B. If the mean difference is positive (i.e., conservative for uncertainty), then the load cell error and mean difference are added together to determine the systematic bias component.

The sample size in this case is 1,024 baskets, which corresponds to the lowest *one-sided* test value for t_{95} (the 95th percentile point for infinite degrees of freedom). So, from the tabulated values in Reference 3:

$$t_{95} = 1.645$$

From this analytical observation of the collected data points, the uncertainty for this mass projection technique can be calculated as:

$$U = -[B + (t_{95} \times \sigma)]$$

$$U = -[B + (1.645 \times 25)]$$

Since the mean difference is negative in this case, which is *non-conservative* in terms of uncertainty, set B = 15 lb (the propagated load cell error), and:

$$U = -[15 + (1.645 \times 25)] = -[15 + 41]$$

U = - 56 lb

This is an example of the quantified uncertainty that would be included when utilizing projection of ice basket mass. The minus sign indicates that, for analytical applications regarding compliance with the technical specifications, the mass is always reduced.

Visual Estimation of Ice Basket Mass

Estimating the mass of an individual basket via visual inspection of the voids in the ice contained therein is a somewhat more subjective procedure than sublimation projection. Along with the previously described variables, the visual estimation technique contains other sources of error such as lighting, camera resolution, blockage of view due to frost build-up on the basket surface, and the procedural convention of assuming voids are symmetric, among others. It should be expected, then, that this technique will yield uncertainties that are larger, due to the increased likelihood of systematic bias and a wider distribution of data around the mean (random error). In addition, the mass of an ice basket is determined by subtracting the mass represented by the inspected voids from a "full" basket mass, which introduces further chance for error by requiring an assumed constant density of compacted flaked ice (to determine mass from volume measurements).

It is beneficial to accumulate as much individual basket mass data as possible using a consistent, well-written visual estimation procedure performed by personnel qualified to a standard test, and to obtain load cell data on these same baskets as a correlation. Having established that, and verifying that the data being analyzed for uncertainty determination conforms to the standard set for validity discussed previously, the statistical approach can be used to isolate the required measures of relative standing of the data set to determine the uncertainty as was done for the mass sublimation projection technique.

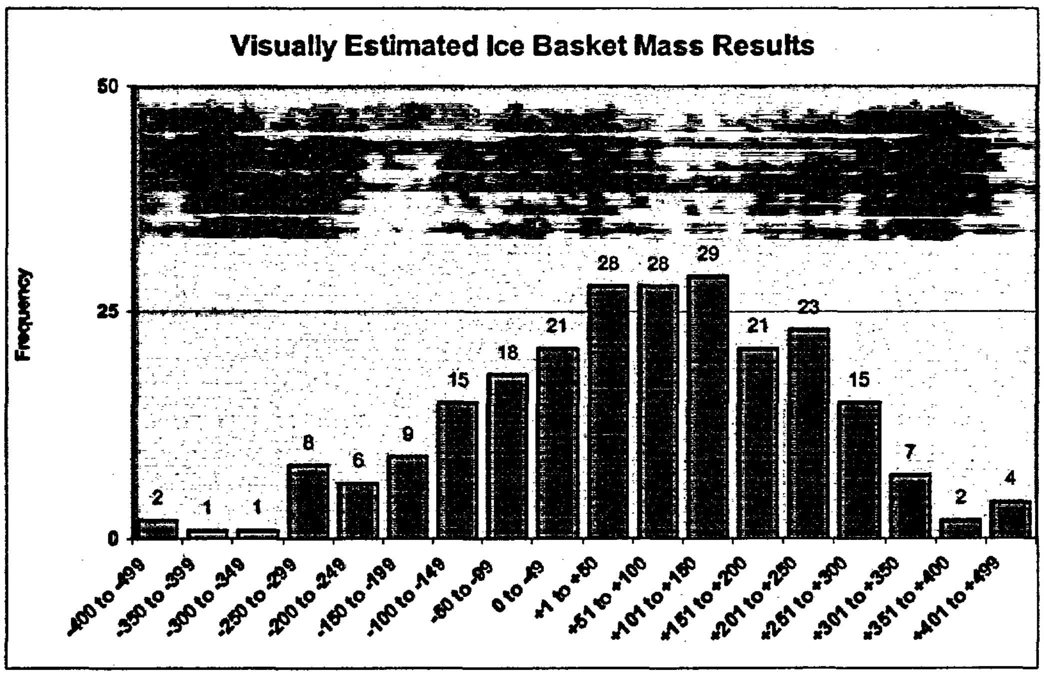
For this example, 238 individual basket mass data points were collected over two of the last three cycles for a particular ice condenser. Each of these baskets was visually estimated by established procedure *and* had a corresponding mass determined via load cell (with an unbiased uncertainty of ± 15 lb). Using the same style of presentation as the projected mass example earlier, the following table of compared values was generated:

Table 2-3. Visual Estimation Method Example Data

(Visually Estimated Mass) – (Lifted Mass) Results	
Range (lb)	*Frequency (# baskets in range)*
-400 to -499	2
-350 to -399	1
-300 to -349	1
-250 to -299	8
-200 to -249	6
-150 to -199	9
-100 to -149	15
-50 to -99	18
0 to -49	21
+1 to +50	28
+51 to +100	28
+101 to +150	29
+151 to +200	21
+201 to +250	23
+251 to +300	15
+301 to +350	7
+351 to +400	2
+401 to +499	4
Total	238

Again, it can be seen that a fairly symmetric distribution exists for this data, though it appears to be biased non-conservatively for the basket mass determinations (i.e., it tends to show more ice mass than is actually present). This indicates that a positive bias will add to the uncertainty, unlike in the previous example. Graphically depicted, the comparative results for the visual estimation technique look like this:

Figure 2-2. Visual Estimation Method Example Chart



From the comparison data (again not presented here for clarity), the systematic bias, random error and degrees of freedom are determined:

Mean Difference = 57.7 lb = + **58 lb**

Load cell (correlation) uncertainty = **± 15 lb**

Standard Deviation = σ = 166.7 lb = **167 lb**

Degrees of freedom (sample size) = **238**

Note that the mean difference and random error values are again rounded conservatively.

For a sample size of 238, the one-sided distribution 95th percentile point is defined by a t_{95} value equal to 1.65. Therefore:

$$U = -[B + (t_{95} \times \sigma)]$$

$$U = -[B + (1.65 \times 167)] = -[(58 + 15) + 276] = -[73 + 276]$$

U = - 349 lb

In this case, the uncertainty is a true combination of bias (73 lb) and random error (276 lb). Again, the minus sign indicates the conservative convention for the one-sided interval; however, when applying this uncertainty to the surveillance requirement calculations for estimating total ice bed mass, the bias and random error components are accommodated separately.

Example Summary

These examples illustrate a statistical method of identifying the uncertainty due to systematic bias and random errors in the determination of individual ice basket mass. As expected, the uncertainty value for the visual estimation mass determination technique in the example is significantly higher: six times that predicted by the sublimation projection technique example, and over twenty times that determined by a typical load cell measurement made by direct lifting. This spread in the uncertainty values properly reflects the inherent subjective nature of the alternate mass determination techniques. In order to reduce the uncertainty of these methods, there are several approaches that can be taken:

1. Minimize the t_{95} value by keeping the comparative sample size large. This requires the accumulation of large quantities of basket mass data using the alternate techniques, an effort that will provide experience with the techniques as well as recent, valid information in accordance with the standard.
2. Refine the subjective measurement techniques, thereby eliminating sources of bias and random error that are introduced. Experience through outage data collection as well as through practice on mock-ups all provide opportunities for process refinement. Also, improvement in the tooling used (such as cameras and lighting) will be beneficial.
3. Improve the accuracy of the benchmark by calibrating the load cell to a higher standard. The load cells used in the industry can generally be calibrated better than the manufacturer's stated accuracy.
4. Improve the consistency of the input data (i.e., the individual basket mass data) for the more subjective measurement techniques. This can be accomplished by qualifying each performer of

the visual estimation technique to a rigorous test standard, and by providing a well-written estimation procedure.

Conclusions

The manual lifting technique provides the fastest and most accurate method of determining ice mass. For baskets that are stuck, there are two alternate ice mass determination methods that have industry standards developed. These are:

1. Projection of ice basket mass using software and historical data, and
2. Visual inspection of the ice basket.

In general, the software projection technique provides the most accurate alternate mass determination method, but it requires several sets of quality data in order to provide valid results. Further, its projections for a given ice basket are invalidated if the subject basket becomes stuck (unliftable) and is serviced anyway, thereby creating an unsubstantiated change in the mass of ice in the basket. The accuracy and consistency of software projections is dependent upon population and replenishment of the database with recent ice mass data (as required by the data validity standard) obtained via manual lifting.

The visual inspection technique offers another method of ice basket mass determination, useful due to its ability to estimate the mass of stuck baskets, most notably during an as-found surveillance. Like the software projection method, the accuracy of this technique is a function of the amount of data that has been collected, but it has other influences as well, such as procedural experience and basket surface ice. Based on the subjective nature of the estimation process involved and as depicted by the examples, the visual inspection method typically has a lower accuracy than the ICEMAN™ projection. However, once the uncertainty in the methodology has been defined in accordance with the industry standard, it can be utilized on an ice basket to estimate its mass, and represents an acceptable alternative approach to assessing ice basket mass for the purposes of the surveillance. As discussed in Section III, the larger uncertainty involved with this methodology may necessitate larger initial statistical sample groups in affected Radial Zones in order to adequately assess the minimum mass requirement (i.e., reduce the statistical penalty associated with taking a smaller sample), and will likely also require the Licensee to maintain more ice in these Radial Zones to account for the technique's lower accuracy.

The hierarchy of techniques, as described in this Section and outlined in Figure O-1, is as follows:

1. Upon randomly selecting an ice basket for the surveillance, attempt to lift the basket using a lifting rig and an attached load cell device. If this is unsuccessful (i.e., if the basket is stuck or otherwise obstructed), Licensees have the choice of an alternate mass determination technique (if their plant procedures document one), or selecting an alternate basket for the surveillance subject to the given limitations (discussed in Section III).
2. If an alternate mass determination technique is available and utilized, the documented uncertainty is applied to the measurement in accordance with the established uncertainty standard, and this result carried through to the statistical sampling plan (outlined in Section III).
3. If the mass of the randomly selected basket for the surveillance cannot be ascertained by any available means, an alternate selection must be made subject to the given limitations (discussed in Section III).

As with all subjective techniques, proper training of personnel, well-written procedures, and proper qualification of associated equipment are required to properly document the alternate mass determination methodologies and reduce the uncertainties associated with them. The plant-specific documentation of mass determination technique uncertainty values will include the uncertainty calculations and associated valid data from that plant in accordance with the standard established herein, as well as supporting procedures and training/equipment qualifications in accordance with 10CFR50, Appendix B.

III

Ice Mass Statistical Sampling Plan

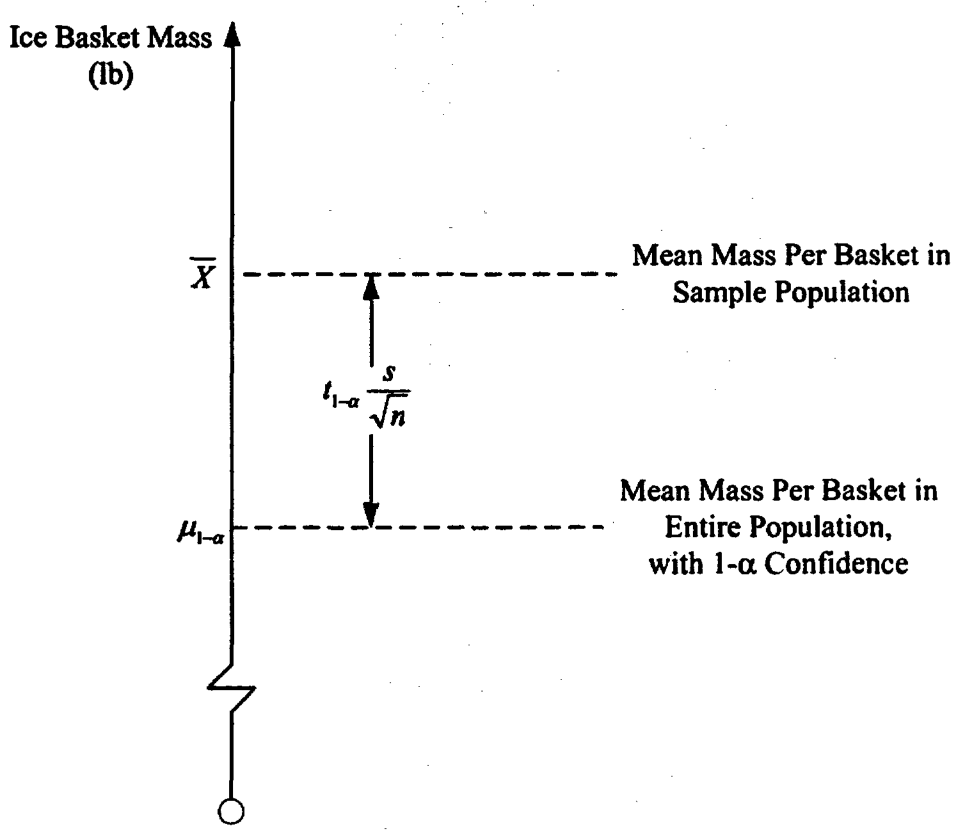
Purpose/Scope

The purpose of this Section is to provide the basis for the statistical sampling plan that will be used to demonstrate that adequate ice mass is maintained in the ice bed throughout the operating cycle. The statistical sampling plan, as developed herein, addresses the sample size, statistical approach, the effect of mass determination uncertainty, and the selection of alternate sample baskets.

Ice Mass Statistical Strategy

The objective is to estimate the total mass of all of the ice baskets in the ice bed based on a sample of those baskets. Since the standard deviation of the true individual masses of the ice baskets is not known and the number of samples taken is relatively small, the statistical "Student's t-test" applies (Section 3.5.2 of Reference 11, and Chapter 8 of Reference 12). The Student's t-test is used to establish how much the actual mean ice basket mass (μ) could be less than the mean ice basket mass observed in the sample ($\overline{X}$). A confidence level ($1-\alpha$) is associated with this lower bound ($\mu_{1-\alpha}$). For the mean basket mass, a confidence level of 95% has been selected. Using the t-test, it can be established that there is 95% confidence that the actual mean ice basket mass is greater than some value, $\mu_{1-\alpha}$. Figure 3-1 provides an illustration of the Student's t-test.

Figure 3-1. Illustration of Student's t-Test



Using the "Student's t-test," with 1-α confidence, the mean individual ice basket mass is at least:

$$\mu_{1-\alpha} = \overline{X} - t_{1-\alpha}\left[\frac{s^2}{n} \times CF\right]^{\frac{1}{2}} \qquad \text{(Equation 3.1)}$$

Where:

$\mu_{1-\alpha}$ = Mean mass per basket of the total population with 1-α confidence

$\overline{X}$ = Mean mass per basket of the sample group of size n

$t_{1-\alpha}$ = critical value of t that is a function of the confidence interval 1-α and the degrees of freedom in the sample (n-1). This value can be obtained from References 9, 11, and 12.

1-α = confidence interval = the fraction of the estimated intervals (calculated from all possible sample populations and using Equation 3.1) that can be expected to include the true or actual average of the total population (Section 3.5, Reference 11)

s = standard deviation of the sample group = $\sqrt{\dfrac{\sum_{1}^{n}(X_i - \overline{X})^2}{n-1}}$

X_i = mass of i-th sample (corrected for systematic bias)

$CF = \left(\dfrac{N-n}{N}\right)$ = Correction factor for a finite population (References 8, 11, and 13)

n = total number of baskets in sample

N = total number of baskets in the population represented by the sample

The second term in Equation 3.1 represents the *error of the mean.* This error represents the fact that the mean mass per ice basket calculated from a sample group may differ from the actual mean mass of the parent population. To obtain the total mass of the ice bed with 95% confidence, the individual mean ice basket mass determined from the sample group, $\mu_{1-\alpha}$, is multiplied by the total number of baskets in the parent population.

Equation 3.1 is the standard approach, used for analyzing a distribution of mass data that does not require addressing the uncertainty in individual measurements. The use of Equation 3.1 would require measurement uncertainty to be addressed generically elsewhere, such as in the surveillance limit. In cases where the accuracy of the mass determination methodology used is low or varies, it must be accounted for in the calculation of the *error of the mean.* This would be the case when methods other than direct lifting using a scale or load cell are used in determining individual ice basket mass. As such, the following equation derived from the discussion in Section 8.3.1.1 of Reference 11 will be used to calculate the lower bound of the mean individual ice basket mass:

$$\mu_{1-\alpha} = \overline{X} - t_{1-\alpha}\left[\left(\frac{s^2}{n} \times CF\right) + \frac{\sum_{i=1}^{j} n_i \sigma_i^2}{n^2}\right]^{\frac{1}{2}} \qquad \text{(Equation 3.2)}$$

Where:

j = number of mass determination methods used

n_i = number of baskets within the sample whose mass is determined by method i

σ_i = the *random error* of the mass determination method i

With this approach of accounting for the *random error* of the mass determination method (i.e., the *variation of the measurement*), any systematic bias (an error which remains constant over replicate measurements; see Table 14.1, Reference 11) of the mass determination method is applied to the individual basket mass values prior to calculating the mean basket mass and standard deviation of the sample group. In other words, the mass of a given ice basket is adjusted for the systematic bias of the mass determination method used, before the mass value is used as an input to Equation 3.2. The *random error* of the mass determination method (σ_i), should be equivalent to one standard deviation.

In this equation, the *variation of the process* (as compared to the *variation of the measurement*) is represented by the observed sample standard deviation, *s*. It is important to note that this will insert some conservatism because the observed sample standard deviation will include effects of the measurement variation, which will, to some degree, be expected to increase the standard deviation.

For the purposes of the Ice Mass Technical Specification supported by this topical report, Equation 3.2 will be the assessment method.

Sample Size

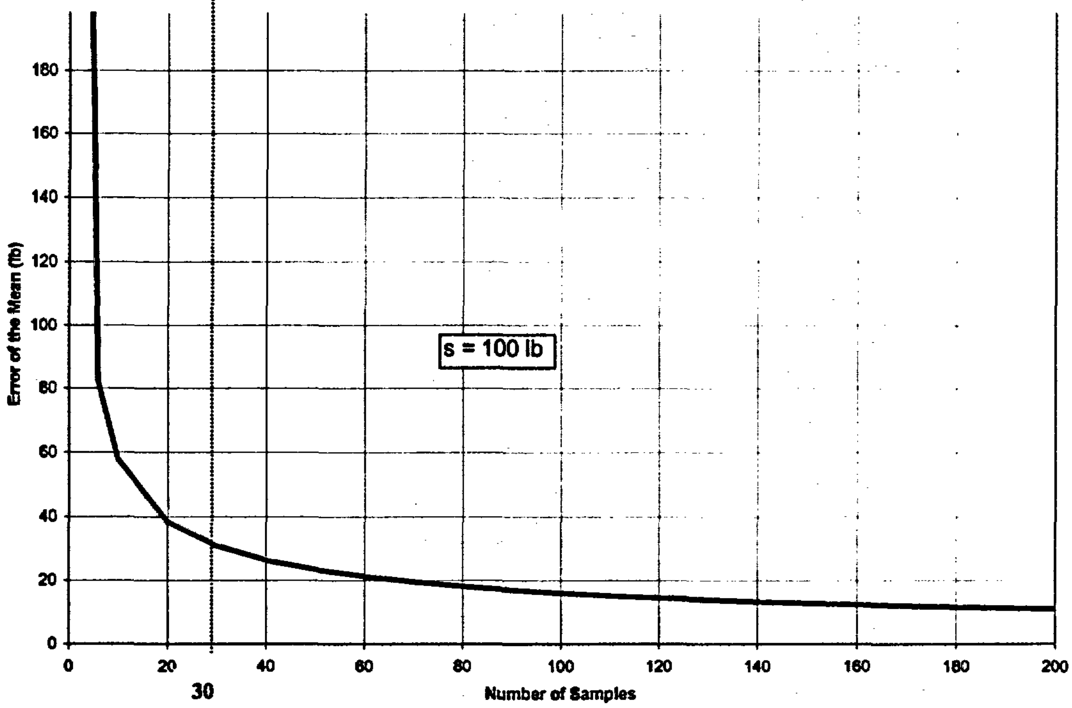
In using Equation 3.2, the sample size *n* considers the following:

1. The "Student's t-test" is based on a normal distribution. However, Reference 9 indicates that unless the number of samples is less than about ten, the assumption that the subject population follows a normal distribution will not significantly affect the validity of the results obtained, even if a normal distribution is not present.
2. The desired interval, or in this case the lower bound of the mean basket mass, will affect the sample size since typically the more samples taken, the narrower the interval tends to become.
3. The sample size is generally selected independent of the population size, if the population size is sufficiently large. However, the population may be *stratified* or broken into groups that are expected to have similar characteristics (e.g., mean and standard deviation). If this approach is used, the sample size is defined in terms of the stratified population group (such as *n* samples out of all ice baskets in a defined Radial Zone as a fraction of the 1,944 baskets in the entire ice bed, as discussed in Section I).

While it is not considered necessary, the normality of a sample may be verified by using the methodology given in Reference 10. Random, statistically representative samples will generally result in fairly normal distributions. However, as mentioned previously, even if the sample is not normal, the "Student's t-test" will provide valid results as long as a sufficient number of samples are taken.

Figure 3-2 provides an illustration of the relationship between number of samples and the *error of the mean*, assuming for the purpose of the example that there is no error in the measurement technique, and the standard deviation of the sample group is 100 pounds (which was selected considering typical standard deviations seen in ice condenser basket populations). In reality, there would be uncertainty in the measurement technique, and the curve in Figure 3-2 would be shifted upward. The figure demonstrates that once the number of samples is increased beyond approximately 30, the reduction in the error of the mean levels out. However, further reduction as a result of taking more samples may still be beneficial.

Figure 3-2. Effect of Sample Size on the Error of the Mean
(assume s = 100 lb and no measurement technique error)



Experience has shown that a *representative sample*, such as the one utilized in the original Ice Mass Technical Specification and described in Section I, could provide more useful information than a blind random sample. Therefore, the overall sample size may be driven more by obtaining a representative sample than by meeting minimum sample size requirements. For example, a representative sample may be generated by taking the same number of samples per row in the ice bed. However, when performing *stratified sampling*, it is noted that minimum sample size criteria must be met when the focus is on a sub-population of the ice bed.

The initial sample group can be expanded as necessary (such as when the calculated total mean mass of the ice bed is below the minimum required total mean ice mass); however, the initial sample population must be retained and the additional samples added to build the sample group as follows:

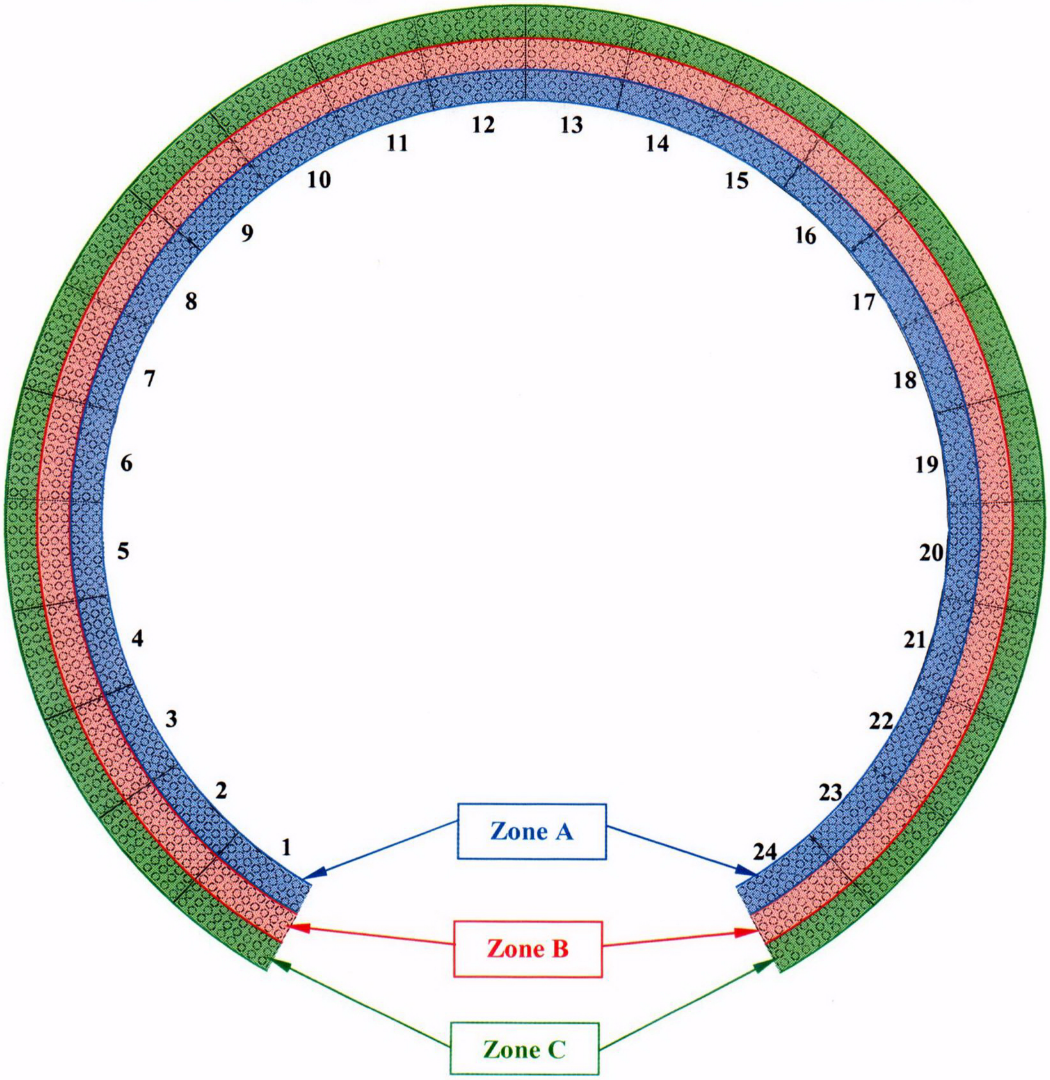
n_a = initial sample group
n_b = expanded sample group = $n_a + n_c$
n_c = additional samples taken

Note that the initial sample group is not discarded; rather, it becomes an element of the expanded sample group. This concept is based on Stein's Procedure in Chapter 8 of Reference 12.

Stratified Sampling

Since, as shown in Section I, there is appreciable radial mass variation between some individual baskets in the ice bed population, *stratified sampling* is beneficial as it minimizes the risk that a small random sample will contain a disproportionate number of a minority group. Stratified sampling involves dividing the total population into groups of items that are expected to have similar characteristics (particularly the characteristic of interest), such as, in the case of the ice bed, mean basket mass and sublimation rates. As discussed in Section I, Radial Zones may be defined in the ice bed as groups of rows such that Zone A contains rows 7, 8, and 9; Zone B contains rows 4, 5, and 6, and Zone C contains rows 1, 2, and 3 (see Figures 3-3 and A-1) where each Radial Zone may even have different minimum design basis mass requirements. The total mass of ice in the ice bed with 95% confidence is obtained by summing the total masses of each stratified sub-population (or Radial Zone). The total mass of each Radial Zone is determined with 95% confidence by multiplying the mean calculated individual basket mass for the sample in that Zone by the total number of baskets in that Zone.

Figure 3-3. Illustrative Plan View of Ice Bed, Showing Three Radial Zone Groupings of Ice Baskets (648 baskets each)



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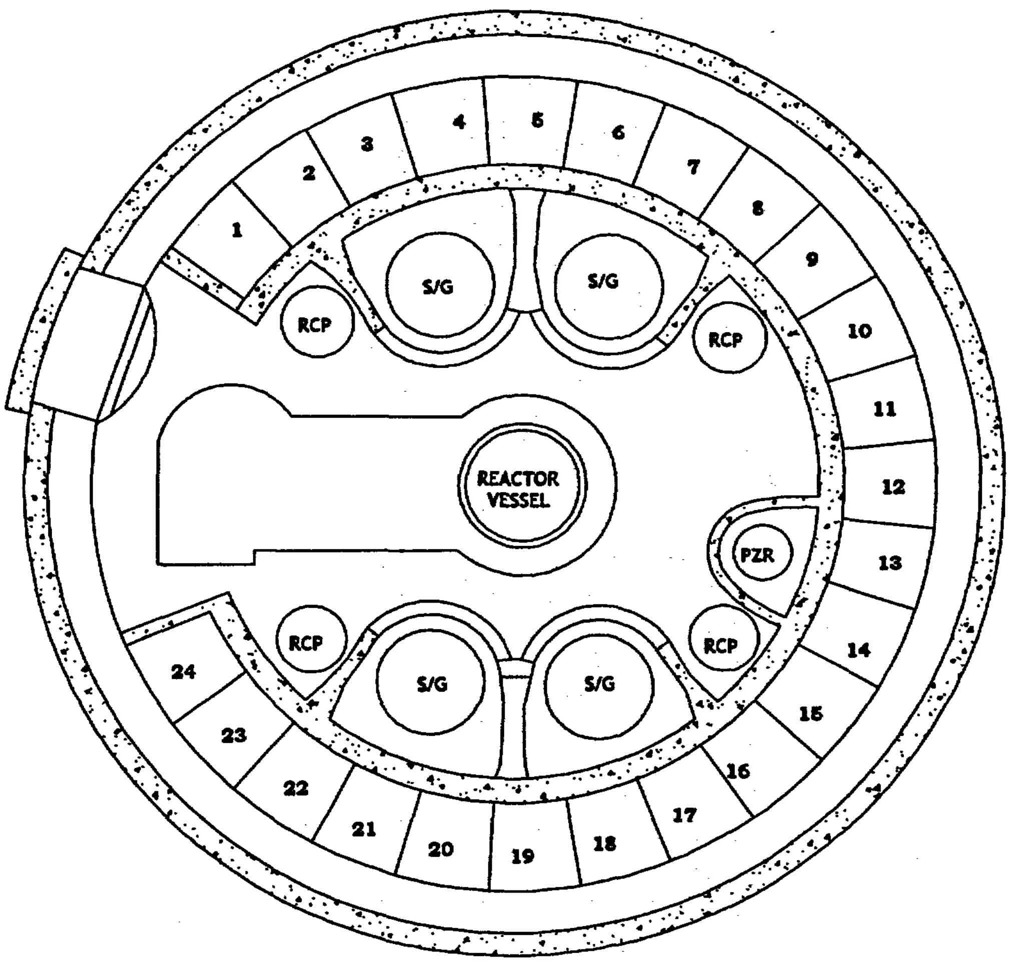
Assurance that the ice in the ice bed is both evenly distributed and the total ice mass meets a specified limit is provided by stratified sampling, since all regions (or stratified sub-populations of the ice bed) are equally represented and evaluated. Further, the baskets within a Radial Zone would have a fairly normal distribution, to which the sampling plan can be applied.

Examination of recent historical data from various ice condenser plants (reference Section I) indicates that certain radial rows consistently sublimate at markedly different rates than others. The innermost crane wall rows sublimate at a higher rate than the outer rows as a function of their proximity to heat sources (Figure 3-4). Depending on ice bed and containment temperatures (and other characteristics unique to each plant), general radial sublimation rates will vary from plant to plant, but the overall trend is the same. Therefore, stratified sampling is applied to the generic case by grouping these Radial zones based on industry-wide historical sublimation and ice mass data.

Figure 3-4. Plan View of Containment Building, Showing Proximity of Steam Generator and Pressurizer Compartments to Ice Condenser Bays



It is also noted that when random sampling without replacement is used (where each basket in the sample can appear only once, with each basket in the total population having the same probability of being selected), the sample will generally result in the various regions of the ice bed being well represented. The *azimuthal* (as opposed to *radial*) distribution of ice (see Figures 3-3 and 3-4) does not need to be verified via stratification if the overall azimuthal sublimation rate of the ice bed is not expected to vary significantly. As described in Section I, historical industry and plant-specific data show that azimuthal variances would not preclude a random sample from being representative of the ice bed.

Alternate Mass Determination Methods

To show compliance with the ice mass technical specification surveillance requirements, the mass of the individual sample ice baskets is typically determined by lifting the basket with a lifting rig and an attached scale or load cell. The accuracy of the scale has been treated conservatively in the past as a systematic bias and accounted for in as-left (pre-maintenance) ice mass surveillance requirement limits. However, some baskets have a tendency to become stuck (i.e., frozen in place) as a result of surface ice accumulation, and cannot be physically lifted. To address this in the sampling plan, alternate mass determination methods will be utilized. Alternate mass determination methods are expected to have a lower accuracy than the lifting rig method, but will provide a reasonable assessment of ice mass when a sample selection is initially found to be stuck. As described in Section II, there are three primary methods designed by the industry to determine individual ice basket mass: direct lifting using a scale or load cell, software projection of the ice basket mass using basket mass histories and sublimation rates, and a visual inspection/estimation process. The uncertainty of a given method is a combination of the method's systematic bias and random error. As discussed previously, the individual observed ice basket masses are adjusted for systematic bias *before* the mass value is used as an input to Equations 3.2. Approximate measurement random error for these three methods are recalled from Section II (adjusted for clarity):

Table 3-1. Ice Basket Mass Measurement Random Error

Mass Determination Method	Measurement Random Error (See Notes)
Manual Lifting Using Scale	± 15 lb
Trending Using ICEMAN™ Code	± 40 lb
Visual Inspection	± 300 lb

Notes:

1. The error given for these measurement techniques is approximate and listed for reference only. Plant-specific maintenance procedures will qualify the processes used.
2. The error values shown may not be equal to the one-sigma random error defined in Equation 3.2. Plant-specific procedures will determine the appropriate value to use in Equation 3.2 and will normally represent about two standard deviations for any alternate mass determination method.

The effect of varying uncertainty when utilizing different mass determination methods can be accounted for in several ways:

1. The measurement random error can be conservatively treated as a bias and either deducted from the measured basket mass or added to the minimum required total mean mass (as was done historically).
2. The *error of the mean* can be utilized, which more realistically deals with the error. The variation of each measurement made consists of a combination of the actual variation in the population (i.e.,

the variation of the process) and the variation due to the measurement error (i.e., *the variation of the measurement*). In this approach, the error of the measurement technique propagates to the standard *error of the mean* (see Equation 3.2). As discussed previously, the effect of errors associated with ice mass determination is conservatively accounted for in Equation 3.2, since the equation assumes the standard deviation of the sample, s, is the true value. The value of s calculated, however, will very likely be greater (more conservative) because it has some contribution from the measurement error.

An example calculation using a representative ice basket mass distribution illustrates the effect of different mass determination methods on the total ice mass estimated by the statistical sampling plan for a typical ice bed Radial Zone (Zone A is considered for this example). The results are provided in Table 3-2, which illustrates:

- The effect of using the visual inspection mass determination method.
- The effect of using an expanded sample.

Table 3-2. Illustration of Effects of Alternate Mass Determination Methods and Expanded Sample – Radial Zone A

Case	Change In Total Ice Mass for Radial Zone
All 30 sample baskets lifted with scale	Base
Individual ice basket mass determined by combination of mass determination methods (50% lifted with scale, 50% estimated visually)	-19443 lb
Individual ice basket mass determined by visual method only:	
30-basket sample (initial)	-33724 lb
60-basket sample (expanded by 30)	-12123 lb.
90-basket sample (expanded by 60)	-2807 lb

Note: This illustration assumes the mean mass of the sample baskets remains constant and the standard deviation of the sample(s) remains constant at $s = s_{30} = s_{60} = s_{90} = 184.5$ lb (which is taken from the example calculation in Appendix A for a stratified sample size of 30 ice baskets in Zone A). Therefore, the number of samples and the percentage of the sample masses determined *visually* vary in this example. In reality, the expanded sample mean and standard deviation would differ from the initial sample mean and standard deviation.

Alternate Basket Selection Strategy

In the event that an ice basket selected for the initial sample is found to be obstructed or stuck in such a way that its mass cannot be determined by any available method, an alternate basket can be selected as a direct replacement for the obstructed basket in the sample group. An alternate selection will not affect the validity of the sample, provided that it is chosen randomly from the same Radial Zone and in the same vicinity as the initial selection. In addition, there must be limits placed on the repeat use of alternate selections to ensure that the same alternate basket is not always selected as a result of all other candidate baskets being obstructed. To be a representative replacement for the initial sample basket, the alternate selection must meet the following criteria:

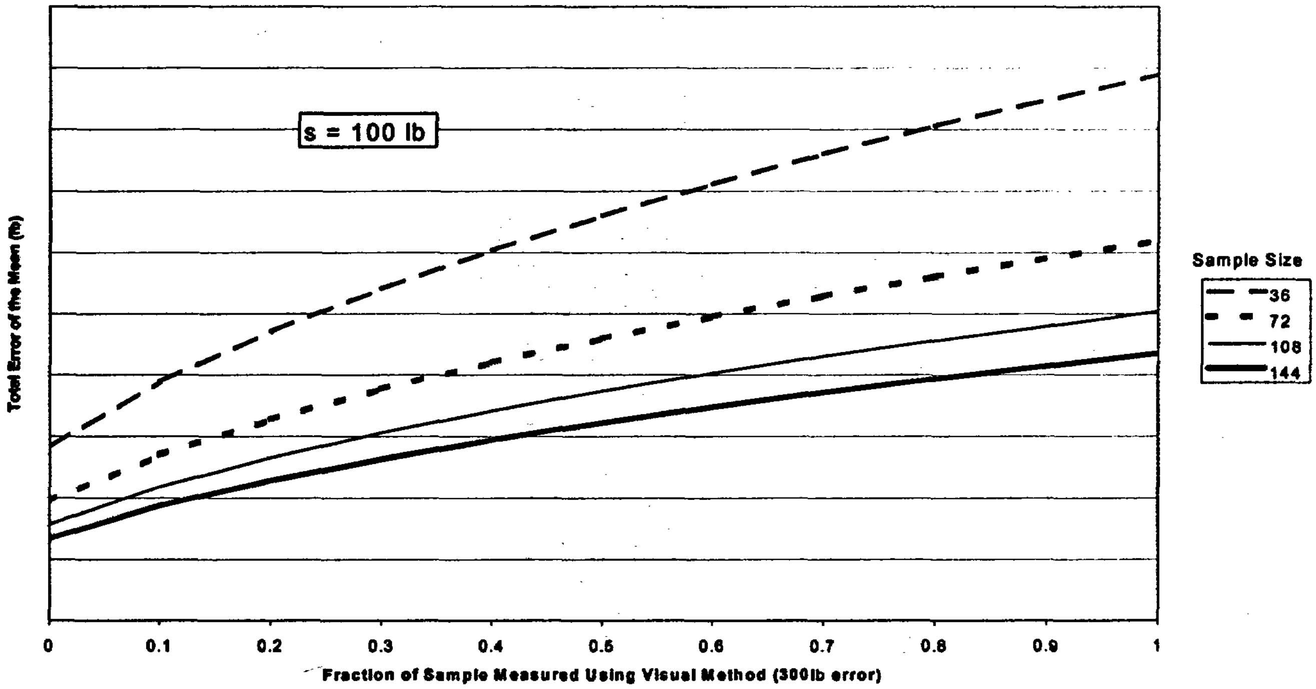
1. The alternate sample selection must be from the same Radial Zone (e.g., Zone A, B, or C) as the initial sample selection.
2. The alternate sample selection must be from the same Bay as the initial sample selection.
3. An alternate selection cannot be a repeated selection in the current surveillance, and cannot have been used as an analyzed alternate selection in the three most recent previous surveillances that included the Bay-Zone involved.

As discussed in Section I, this approach is reasonable since ice baskets in the same Radial Zone have similar mean mass characteristics and therefore may be considered statistically similar for ice mass sampling purposes. It further notes that maintenance of the ice bed using AIMM methodology ensures that extreme differences in ice basket masses across a given Radial Zone will not be realized. Therefore, baskets within the same Radial Zone will be considered representative of one another. Also, note that baskets within the same Radial Zone have the same probability of being selected as a primary sample. Though the probability of being selected as an alternate is different than the probability of being selected as a primary, the 95% confidence interval for the Radial Zone is not invalidated. Restricting the baskets from which an alternate may be selected to the same Bay, and restricting the frequency with which a basket may serve as an alternate, reduces the likelihood that a large region of obstructed baskets is excluded from the surveillance sample. This approach for selecting alternate baskets also prevents regions of the ice bed (such as problematic radial rows) from being systematically eliminated from the parent population.

Applications of Sampling Plan

Figure 3-5 provides the *error of the mean* (see Equation 3.2) as a function of the fraction of the sample basket population measured by the visual inspection method for various sample sizes, assuming a standard deviation of 100 lb (which was selected considering typical values seen in ice condenser basket populations). The remaining fraction of the sample is measured by the lifting rig/scale method. These two methods were chosen because they envelope the error resulting from the ICEMAN™ prediction, and thus provide conservative results. Note that while the error for visual inspection methodology is relatively large (±300 lb), its effect on the *error of the mean* relative to typical mean ice basket masses (between 1000 and 1500 lb of ice), is small. However, if the calculated mean ice basket mass of the sample propagates to a value near the minimum required total mean ice basket mass for a Radial Zone, the mass determination error and/or the sample size can make a significant difference.

Figure 3-5. Effect of Visual Estimation Measurement Error on the Error of the Mean for Various Sample Sizes



An example of the utilization of the ice mass statistical sampling plan is provided in Appendix A. The ice bed mean mass is determined for a hypothetical ice condenser plant as follows:

- Sample sizes of 36, 72, 90, 108 and 144, with each sample group containing the subset of the next smaller sample group. The sample group is provided in Table 3-4 and repeated in Appendix A. Note that the basket mass values given in Table 3-4 and Appendix A are assumed to have already been adjusted for systematic bias.
- With and without stratified sampling (using three Radial Zones comprised of three sequential rows each).
- Various ice mass determination methods, assuming the values shown in Table 3-1 are equivalent to the one standard deviation random error (σ_i).
- As-found (pre-maintenance) individual ice basket mass is used.

The actual total ice bed mass in the example is 2,485,268 lb as calculated by totaling the individual ice basket masses (determined using various methods). Note from Table 3-3 that this value is greater than all of the total ice bed masses calculated with 95% confidence from the sample group. The example demonstrates that the total ice bed mass with 95% confidence will generally increase (getting closer to the actual total ice bed mass) with increased sample size. However, as can be seen from the non-stratified mass for the 108-basket sample size, this is not always the case, depending on the individual ice mass of the samples selected. Also, non-stratified sampling will result in a higher total mass than stratified sampling. This is due to the smaller sample size used in the calculation of the mean ice mass for the stratified group.

The selection of sample size, sample configuration, and mass determination methods depends largely on how much *error of the mean* can be tolerated while still meeting specific technical specification criteria.

Table 3-3. Ice Bed Masses from Sample Group

Sample Size	Type of Sampling	Total Ice Bed Mass at 95% Confidence (Note 2)
36	Not Stratified	2,447,985 lb
	Stratified (Note 1)	2,372,078 lb
72	Not Stratified	2,463,030 lb
	Stratified (Note 1)	2,410,530 lb
90	Not Stratified	2,456,726 lb
	Stratified (Note 1)	2,409,810 lb
108	Not Stratified	2,458,818 lb
	Stratified (Note 1)	2,417,634 lb
144	Not Stratified	2,475,670 lb
	Stratified (Note 1)	2,440,296 lb

Notes:

(1) Uses three Radial Zones with three sequential rows in each Zone. The same number of samples are taken from each Zone.

(2) Actual total ice bed mass is 2,485,268 lb as determined by totaling the individual ice basket masses (which were determined using various methods). See Appendix A for the parent population ice basket data, which was based on basket mass data from the seven units of record.

Table 3-4. Ice Mass Sample Group

Basket Number	Row	Column	Bay	Radial Zone	Mass	Method
124	1	7	14	C	1350	Visual
158	1	5	18	C	1325	Visual
127	1	1	15	C	1532	Scale
26	1	8	03	C	1050	Visual
92	1	2	11	C	1322	Visual
178	1	7	20	C	1538	ICEMAN™
86	1	5	10	C	1678	ICEMAN™
163	1	1	19	C	1101	Visual
105	1	6	12	C	1356	Scale
171	1	9	19	C	1278	Visual
195	1	6	22	C	1500	Visual
73	1	1	09	C	1365	Visual
29	1	2	04	C	1884	Scale
14	1	5	02	C	1145	Visual
22	1	4	03	C	1300	Visual
149	1	5	17	C	1400	Visual
265	2	4	06	C	1500	Visual
334	2	1	14	C	1468	ICEMAN™
337	2	4	14	C	1433	ICEMAN™
425	2	2	24	C	1198	Scale
386	2	8	19	C	1412	Visual
264	2	3	06	C	1643	ICEMAN™
221	2	5	01	C	1374	Scale
322	2	7	12	C	1485	Scale
364	2	4	17	C	1283	Visual
226	2	1	02	C	1100	Visual
391	2	4	20	C	1383	Scale
379	2	1	19	C	1199	Visual
310	2	4	11	C	1356	Visual
292	2	4	09	C	1245	Visual
332	2	8	13	C	1436	Scale
287	2	8	08	C	1347	Scale
478	3	1	06	C	1516	ICEMAN™
492	3	6	07	C	1478	Scale
628	3	7	22	C	1413	Scale
487	3	1	07	C	1450	Scale
463	3	4	04	C	1426	Scale
456	3	6	03	C	1506	Scale
605	3	2	20	C	1421	Scale
450	3	9	02	C	1329	Scale
638	3	8	23	C	1458	Scale
542	3	2	13	C	1334	Scale
620	3	8	21	C	1367	Scale
501	3	6	08	C	1392	Scale
625	3	4	22	C	1503	Scale
464	3	5	04	C	1415	Scale

Table 3-4. Ice Mass Sample Group (continued)

Basket Number	Row	Column	Bay	Radial Zone	Mass	Method
519	3	6	10	C	1438	Scale
534	3	3	12	C	1425	Scale
811	4	1	19	B	1411	Scale
777	4	3	15	B	1218	Scale
823	4	4	20	B	1243	Scale
756	4	9	12	B	1298	Scale
842	4	5	22	B	1345	Scale
688	4	4	05	B	1264	Scale
725	4	5	09	B	1255	Scale
651	4	3	01	B	1306	Scale
702	4	9	06	B	1291	Scale
746	4	8	11	B	1397	Scale
714	4	3	08	B	1207	Scale
788	4	5	16	B	1247	Scale
805	4	4	18	B	1211	Scale
650	4	2	01	B	1320	Scale
778	4	4	15	B	1202	Scale
706	4	4	07	B	1344	Scale
883	5	1	03	B	1366	Scale
867	5	3	01	B	1248	Scale
935	5	8	08	B	1195	Scale
994	5	4	15	B	1265	Scale
936	5	9	08	B	1326	Scale
975	5	3	13	B	1329	Scale
990	5	9	14	B	1233	Visual
934	5	7	08	B	1170	Scale
917	5	8	06	B	1233	Scale
1022	5	5	18	B	1244	Scale
952	5	7	10	B	1305	Scale
887	5	5	03	B	1314	Scale
987	5	6	14	B	1246	Scale
898	5	7	04	B	1190	Scale
939	5	3	09	B	1185	Scale
1059	5	6	22	B	1207	Scale
1183	6	4	12	B	1258	Scale
1244	6	2	19	B	1230	Scale
1146	6	3	08	B	1159	Scale
1181	6	2	12	B	1225	Scale
1267	6	7	21	B	1110	Scale
1258	6	7	20	B	1192	Scale
1136	6	2	07	B	1183	Scale
1167	6	6	10	B	1363	Scale
1132	6	7	06	B	1338	Scale
1173	6	3	11	B	1212	Scale
1121	6	5	05	B	1218	Scale
1267	6	7	21	B	1110	Scale

Table 3-4. Ice Mass Sample Group (continued)

Basket Number	Row	Column	Bay	Radial Zone	Mass	Method
1256	6	5	20	B	1149	Scale
1175	6	5	11	B	1288	Scale
1163	6	2	10	B	1198	Scale
1273	6	4	22	B	1342	Scale
1490	7	5	22	A	1383	Visual
1510	7	7	24	A	1292	Scale
1342	7	1	06	A	1277	Visual
1487	7	2	22	A	1216	Scale
1397	7	2	12	A	1267	Visual
1378	7	1	10	A	1267	Visual
1498	7	4	23	A	1284	Scale
1436	7	5	16	A	1172	Visual
1368	7	9	08	A	1278	Visual
1301	7	5	01	A	1311	Scale
1371	7	3	09	A	1193	Scale
1506	7	3	24	A	1130	Scale
1323	7	9	03	A	1130	Scale
1466	7	8	19	A	1209	Visual
1421	7	8	14	A	1739	ICEMAN™
1367	7	8	08	A	1445	Visual
1604	8	2	11	A	1497	Visual
1625	8	5	13	A	1362	Visual
1709	8	8	22	A	1449	Scale
1664	8	8	17	A	1406	Visual
1536	8	6	03	A	904	Visual
1571	8	5	07	A	1358	Visual
1528	8	7	02	A	838	Scale
1660	8	4	17	A	1378	Visual
1520	8	8	01	A	770	Scale
1636	8	7	14	A	1330	Scale
1650	8	3	16	A	1202	Scale
1514	8	2	01	A	1429	Visual
1634	8	5	14	A	1181	Visual
1519	8	7	01	A	1090	Scale
1606	8	4	11	A	1376	Visual
1594	8	1	10	A	1240	Scale
1803	9	3	09	A	1286	Scale
1909	9	1	21	A	1243	Visual
1767	9	3	05	A	1367	Visual
1743	9	6	02	A	938	Visual
1802	9	2	09	A	1121	Visual
1731	9	3	01	A	1536	Visual
1934	9	8	23	A	1159	Visual
1886	9	5	18	A	1434	Visual
1939	9	4	24	A	1349	Visual
1932	9	6	23	A	1297	Visual

Table 3-4. Ice Mass Sample Group (continued)

Basket Number	Row	Column	Bay	Radial Zone	Mass	Method
1846	9	1	14	A	1291	Visual
1757	9	2	04	A	1230	Scale
1875	9	3	17	A	1414	Visual
1905	9	6	20	A	902	Scale
1799	9	8	08	A	1448	Visual
1775	9	2	06	A	1500	Visual

Summary

Based on the statistical sampling plan discussion and the evaluations of applications of the plan, the recommendations for the Ice Mass Technical Specification Statistical Sampling Plan are as shown in Table 3-5.

Table 3-5. Ice Mass Sampling Plan Recommendations

Recommendation	Basis
1. Perform stratified sampling using defined Radial Zones, with each zone containing rows of ice baskets that exhibit similar characteristics.	Stratified sampling allows sub-populations to be defined and results in conservative estimates of total ice mass. The evaluations in Section I show that ice baskets within Radial Zones A, B, and C (Figure 3-3) have similar mean mass characteristics.
2. Use at least 30 ice baskets in the initial sample for each Radial Zone.	As shown in Figure 3-2, 30 samples results in a reasonable value for the *error of the mean* for the sample (i.e., it is at the "knee" in the curve.)
3. If the minimum ice mass requirement in a Radial Zone cannot be met with the initial 30-basket sample, expand the sample in the Radial Zone as necessary (including the original 30 baskets).	The approach is consistent with the sampling plan methodology and the expanded sample will provide a reduction in *error of the mean* as determined by Equation 3.2.
4. If the mass cannot be determined for a selected sample basket using any available method, randomly select an alternate basket from the vicinity of the initial selection as a direct replacement in the sample.	As discussed in Section I, due to similar mean mass, baskets from the same Radial Zone may be considered representative of one another for the purposes of sampling. AIMM methodology ensures that extreme differences in basket masses within a Radial Zone will not occur. By also limiting the population of qualified alternates to the same Bay as the initial selection and limiting the frequency with which a basket can serve as an alternate, the likelihood that a large region of obstructed baskets will be excluded from the surveillance sample over time will be reduced.

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Appendix A

- Figure A-1. Typical Ice Bed Arrangement and Identification
- Figure A-2. Typical Bay Map and Basket Identification
- Table A-1. Example Ice Bed Data
- Table A-2. Ice Mass Sample Group
- Table A-3. Example Calculations
- Original WOG Standard Technical Specification – Ice Bed

Figure A-1. Typical Bay Arrangement and Identification

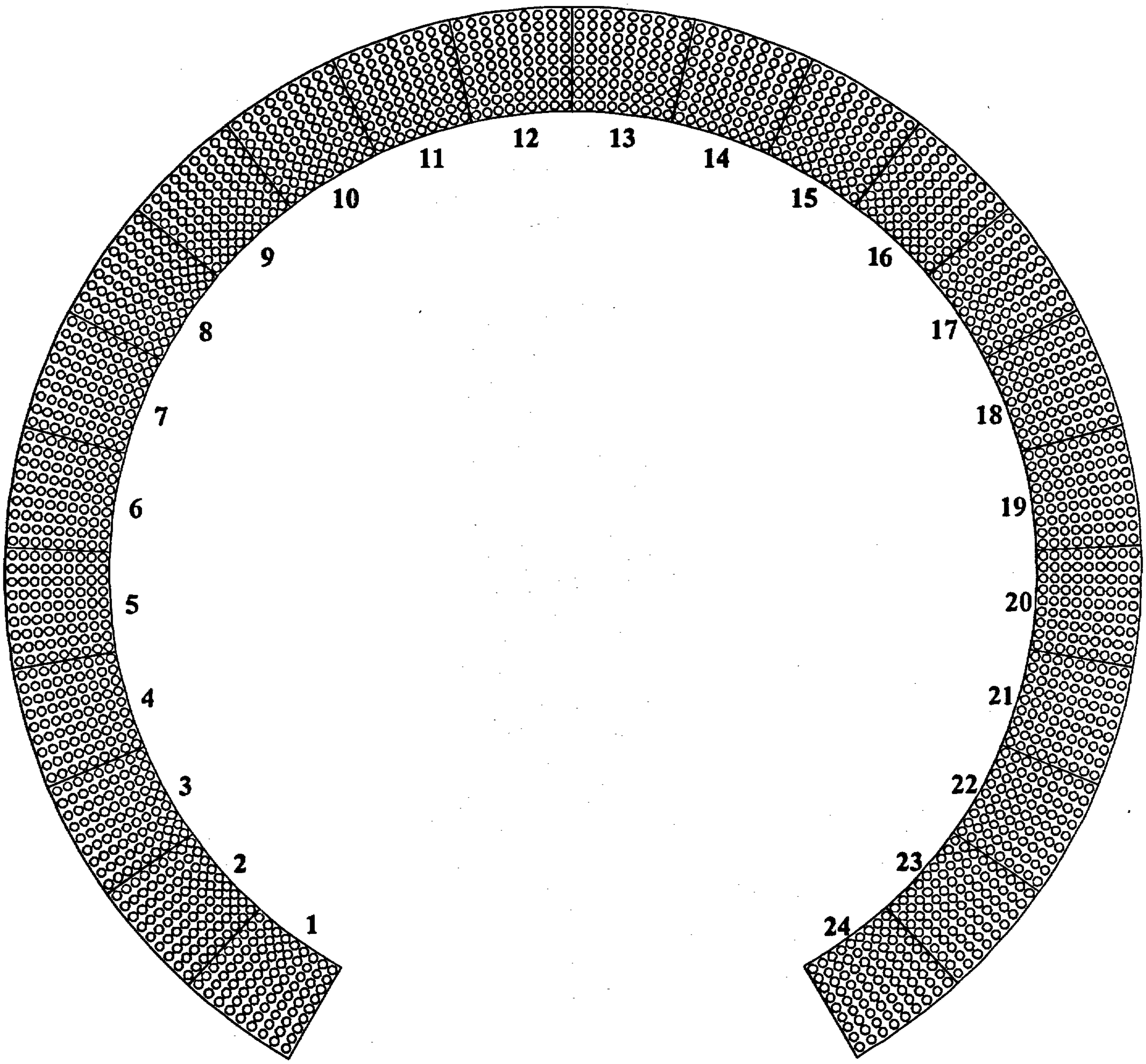
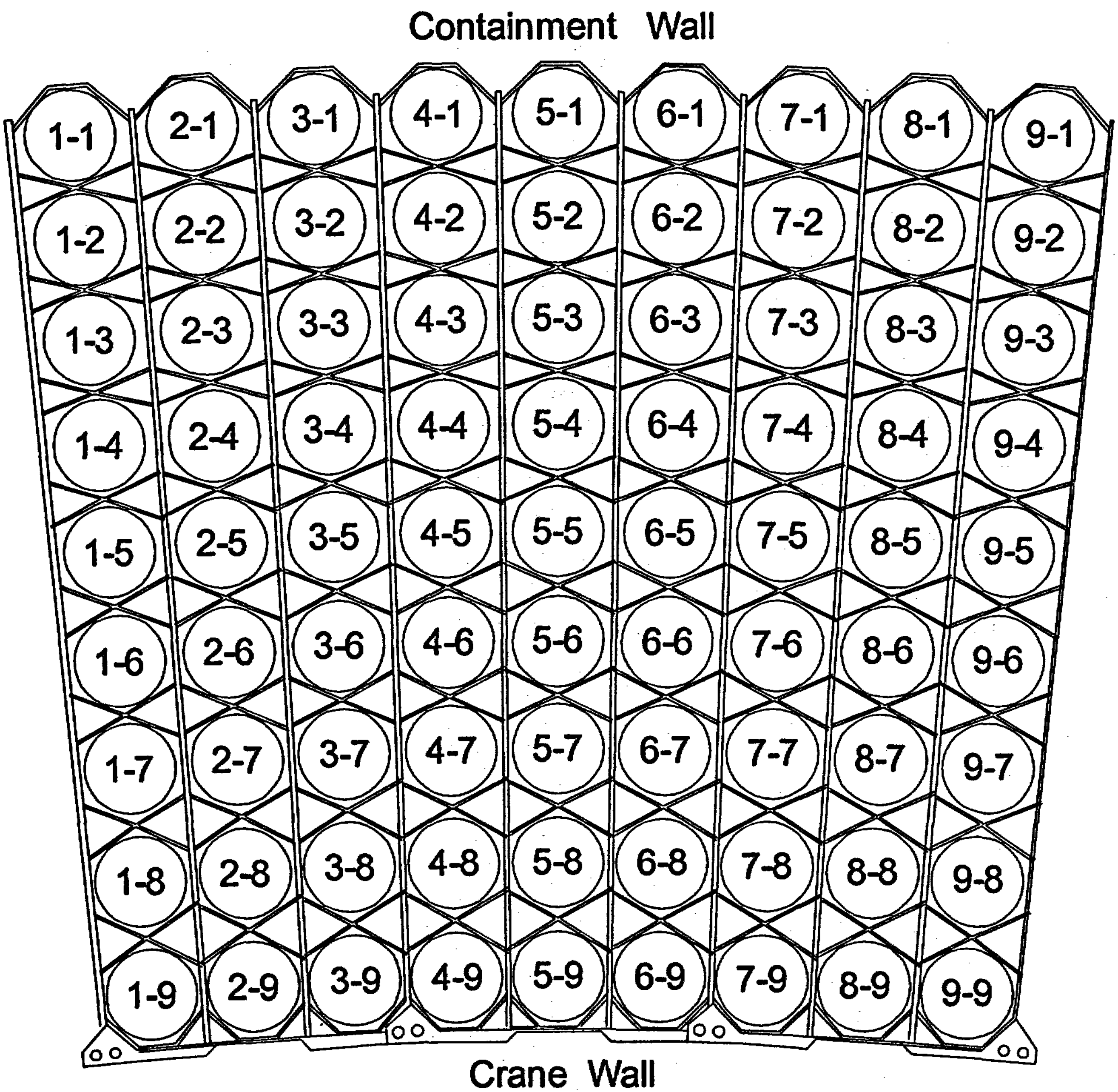


Figure A-2. Typical Bay Map and Basket Identification



Basket ID is Column - Row

Table A-1. Example Ice Bed Data

FOR REFERENCE ONLY

(Parent population for Section III example)

Basket ID	Row	Basket Number	As-Found Mass (lb)	ICEMAN™ Projected Mass (lb)	VISUAL Estimated Mass (lb)	Mass to Use (lb)	Method Used
2-01-1-1	1	1	Frozen		1150	1150	Visual
2-01-1-2	1	2	Frozen		1200	1200	Visual
2-01-1-3	1	3	Frozen	1479		1479	ICEMAN™
2-01-1-4	1	4	1328	1201		1328	Scale
2-01-1-5	1	5	1290			1290	Scale
2-01-1-6	1	6	909	1173		909	Scale
2-01-1-7	1	7	860	1183		860	Scale
2-01-1-8	1	8	680	1390		680	Scale
2-01-1-9	1	9	545	938		545	Scale
2-02-1-1	1	10	Frozen		1040	1040	Visual
2-02-1-2	1	11	Frozen		976	976	Visual
2-02-1-3	1	12	Frozen	1565		1565	ICEMAN™
2-02-1-4	1	13	Frozen	1619		1619	ICEMAN™
2-02-1-5	1	14	Frozen		1145	1145	Visual
2-02-1-6	1	15	Frozen		1200	1200	Visual
2-02-1-7	1	16	1233	1692		1233	Scale
2-02-1-8	1	17	Frozen	1534		1534	ICEMAN™
2-02-1-9	1	18	Frozen	1755		1755	ICEMAN™
2-03-1-1	1	19	Frozen		1005	1005	Visual
2-03-1-2	1	20	Frozen	1582		1582	ICEMAN™
2-03-1-3	1	21	Frozen		1400	1400	Visual
2-03-1-4	1	22	Frozen		1300	1300	Visual
2-03-1-5	1	23	Frozen		1100	1100	Visual
2-03-1-6	1	24	Frozen		1200	1200	Visual
2-03-1-7	1	25	Frozen		1350	1350	Visual
2-03-1-8	1	26	Frozen		1050	1050	Visual
2-03-1-9	1	27	Frozen		1120	1120	Visual
2-04-1-1	1	28	Frozen		1034	1034	Visual
2-04-1-2	1	29	1884	1739		1884	Scale
2-04-1-3	1	30	Frozen		1400	1400	Visual
2-04-1-4	1	31	Frozen		1376	1376	Visual
2-04-1-5	1	32	Frozen		1256	1256	Visual
2-04-1-6	1	33	Frozen		1234	1234	Visual
2-04-1-7	1	34	Frozen		1300	1300	Visual
2-04-1-8	1	35	Frozen		1006	1006	Visual
2-04-1-9	1	36	Frozen		1100	1100	Visual
2-05-1-1	1	37	Frozen		1104	1104	Visual
2-05-1-2	1	38	1884			1884	Scale
2-05-1-3	1	39	1588			1588	Scale
2-05-1-4	1	40	Frozen		1301	1301	Visual
2-05-1-5	1	41	Frozen		1178	1178	Visual
2-05-1-6	1	42	Frozen		1256	1256	Visual
2-05-1-7	1	43	Frozen		1345	1345	Visual
2-05-1-8	1	44	Frozen	1527		1527	ICEMAN™
2-05-1-9	1	45	Frozen		1234	1234	Visual
2-06-1-1	1	46	Frozen		1123	1123	Visual
2-06-1-2	1	47	Frozen		1056	1056	Visual
2-06-1-3	1	48	Frozen		1087	1087	Visual
2-06-1-4	1	49	Frozen		1400	1400	Visual

2-06-1-5	1	50	Frozen		1450	1450	Visual
2-06-1-6	1	51	Frozen		1200	1200	Visual
2-06-1-7	1	52	Frozen		1300	1300	Visual
2-06-1-8	1	53	Frozen		1256	1256	Visual
2-06-1-9	1	54	Frozen		1398	1398	Visual
2-07-1-1	1	55	Frozen		1304	1304	Visual
2-07-1-2	1	56	Frozen		1298	1298	Visual
2-07-1-3	1	57	Frozen		1259	1259	Visual
2-07-1-4	1	58	Frozen		1199	1199	Visual
2-07-1-5	1	59	Frozen		1245	1245	Visual
2-07-1-6	1	60	Frozen		1300	1300	Visual
2-07-1-7	1	61	Frozen		1325	1325	Visual
2-07-1-8	1	62	Frozen	1523		1523	ICEMAN™
2-07-1-9	1	63	Frozen		1340	1340	Visual
2-08-1-1	1	64	1382			1382	Scale
2-08-1-2	1	65	1200	1218		1200	Scale
2-08-1-3	1	66	1100	1155		1100	Scale
2-08-1-4	1	67	1214			1214	Scale
2-08-1-5	1	68	890			890	Scale
2-08-1-6	1	69	1202			1202	Scale
2-08-1-7	1	70	1326			1326	Scale
2-08-1-8	1	71	1251			1251	Scale
2-08-1-9	1	72	Frozen		1456	1456	Visual
2-09-1-1	1	73	Frozen		1365	1365	Visual
2-09-1-2	1	74	Frozen		1367	1367	Visual
2-09-1-3	1	75	Frozen		1298	1298	Visual
2-09-1-4	1	76	Frozen		1200	1200	Visual
2-09-1-5	1	77	Frozen		1378	1378	Visual
2-09-1-6	1	78	Frozen		1000	1000	Visual
2-09-1-7	1	79	Frozen	1562		1562	ICEMAN™
2-09-1-8	1	80	1609	1679		1609	Scale
2-09-1-9	1	81	1427	1643		1427	Scale
2-10-1-1	1	82	Frozen		1245	1245	Visual
2-10-1-2	1	83	1704	1665		1704	Scale
2-10-1-3	1	84	1558	1617		1558	Scale
2-10-1-4	1	85	1487	1699		1487	Scale
2-10-1-5	1	86	Frozen	1678		1678	ICEMAN™
2-10-1-6	1	87	1504	1449		1504	Scale
2-10-1-7	1	88	Frozen	1640		1640	ICEMAN™
2-10-1-8	1	89	Frozen	1669		1669	ICEMAN™
2-10-1-9	1	90	Frozen		1456	1456	Visual
2-11-1-1	1	91	Frozen		1400	1400	Visual
2-11-1-2	1	92	Frozen		1322	1322	Visual
2-11-1-3	1	93	Frozen		1256	1256	Visual
2-11-1-4	1	94	Frozen		1205	1205	Visual
2-11-1-5	1	95	Frozen		1156	1156	Visual
2-11-1-6	1	96	Frozen		987	987	Visual
2-11-1-7	1	97	Frozen	1457		1457	ICEMAN™
2-11-1-8	1	98	Frozen		945	945	Visual
2-11-1-9	1	99	Frozen		1467	1467	Visual
2-12-1-1	1	100	Frozen		1500	1500	Visual
2-12-1-2	1	101	1445	1492		1445	Scale

2-12-1-3	1	102	Frozen	1452		1452	ICEMAN™
2-12-1-4	1	103	Frozen		1300	1300	Visual
2-12-1-5	1	104	Frozen		1117	1117	Visual
2-12-1-6	1	105	1356	1556		1356	Scale
2-12-1-7	1	106	Frozen		1302	1302	Visual
2-12-1-8	1	107	Frozen		1101	1101	Visual
2-12-1-9	1	108	Frozen		1034	1034	Visual
2-13-1-1	1	109	Frozen		1001	1001	Visual
2-13-1-2	1	110	1534	1514		1534	Scale
2-13-1-3	1	111	1300	1206		1300	Scale
2-13-1-4	1	112	1340	1326		1340	Scale
2-13-1-5	1	113	Frozen		1234	1234	Visual
2-13-1-6	1	114	Frozen		1002	1002	Visual
2-13-1-7	1	115	Frozen	1464		1464	ICEMAN™
2-13-1-8	1	116	Frozen		1156	1156	Visual
2-13-1-9	1	117	Frozen		1400	1400	Visual
2-14-1-1	1	118	1485			1485	Scale
2-14-1-2	1	119	1399	1471		1399	Scale
2-14-1-3	1	120	1389	1344		1389	Scale
2-14-1-4	1	121	1302	1313		1302	Scale
2-14-1-5	1	122	Frozen		1250	1250	Visual
2-14-1-6	1	123	Frozen		1200	1200	Visual
2-14-1-7	1	124	Frozen		1350	1350	Visual
2-14-1-8	1	125	Frozen		1000	1000	Visual
2-14-1-9	1	126	Frozen		1400	1400	Visual
2-15-1-1	1	127	1532	1662		1532	Scale
2-15-1-2	1	128	1632	1690		1632	Scale
2-15-1-3	1	129	1579	1622		1579	Scale
2-15-1-4	1	130	1473	1402		1473	Scale
2-15-1-5	1	131	1455	1378		1455	Scale
2-15-1-6	1	132	1437	1426		1437	Scale
2-15-1-7	1	133	1416	1424		1416	Scale
2-15-1-8	1	134	1509	1538		1509	Scale
2-15-1-9	1	135	1498	1475		1498	Scale
2-16-1-1	1	136	Frozen		1221	1221	Visual
2-16-1-2	1	137	Frozen	1574		1574	ICEMAN™
2-16-1-3	1	138	Frozen		1256	1256	Visual
2-16-1-4	1	139	Frozen		1302	1302	Visual
2-16-1-5	1	140	Frozen		1102	1102	Visual
2-16-1-6	1	141	Frozen		1267	1267	Visual
2-16-1-7	1	142	Frozen		1410	1410	Visual
2-16-1-8	1	143	1620	1768		1620	Scale
2-16-1-9	1	144	Frozen		1342	1342	Visual
2-17-1-1	1	145	Frozen		1266	1266	Visual
2-17-1-2	1	146	Frozen		1234	1234	Visual
2-17-1-3	1	147	Frozen		1256	1256	Visual
2-17-1-4	1	148	Frozen		1187	1187	Visual
2-17-1-5	1	149	Frozen		1400	1400	Visual
2-17-1-6	1	150	Frozen		1205	1205	Visual
2-17-1-7	1	151	Frozen	1398		1398	ICEMAN™
2-17-1-8	1	152	Frozen	1473		1473	ICEMAN™
2-17-1-9	1	153	Frozen		1233	1233	Visual

2-18-1-1	1	154	Frozen		1475	1475	Visual
2-18-1-2	1	155	Frozen		1098	1098	Visual
2-18-1-3	1	156	1518	1591		1518	Scale
2-18-1-4	1	157	Frozen		1300	1300	Visual
2-18-1-5	1	158	Frozen		1325	1325	Visual
2-18-1-6	1	159	Frozen		1203	1203	Visual
2-18-1-7	1	160	Frozen		1175	1175	Visual
2-18-1-8	1	161	Frozen		1434	1434	Visual
2-18-1-9	1	162	Frozen		1400	1400	Visual
2-19-1-1	1	163	Frozen		1101	1101	Visual
2-19-1-2	1	164	1600	1531		1600	Scale
2-19-1-3	1	165	Frozen		1236	1236	Visual
2-19-1-4	1	166	Frozen		1056	1056	Visual
2-19-1-5	1	167	Frozen		1500	1500	Visual
2-19-1-6	1	168	Frozen		1456	1456	Visual
2-19-1-7	1	169	Frozen		1300	1300	Visual
2-19-1-8	1	170	Frozen	1757		1757	ICEMAN™
2-19-1-9	1	171	Frozen		1278	1278	Visual
2-20-1-1	1	172	Frozen		1334	1334	Visual
2-20-1-2	1	173	1518	1485		1518	Scale
2-20-1-3	1	174	1500	1296		1500	Scale
2-20-1-4	1	175	Frozen		1233	1233	Visual
2-20-1-5	1	176	Frozen	1544		1544	ICEMAN™
2-20-1-6	1	177	Frozen	1306		1306	ICEMAN™
2-20-1-7	1	178	Frozen	1538		1538	ICEMAN™
2-20-1-8	1	179	Frozen	1590		1590	ICEMAN™
2-20-1-9	1	180	Frozen	1640		1640	ICEMAN™
2-21-1-1	1	181	1256	1344		1256	Scale
2-21-1-2	1	182	1251	1401		1251	Scale
2-21-1-3	1	183	1156	1172		1156	Scale
2-21-1-4	1	184	1172	991		1172	Scale
2-21-1-5	1	185	897	1097		897	Scale
2-21-1-6	1	186	1158	1144		1158	Scale
2-21-1-7	1	187	1512	1507		1512	Scale
2-21-1-8	1	188	Frozen	1432		1432	ICEMAN™
2-21-1-9	1	189	Frozen		1256	1256	Visual
2-22-1-1	1	190	Frozen		1234	1234	Visual
2-22-1-2	1	191	Frozen		1075	1075	Visual
2-22-1-3	1	192	Frozen		1104	1104	Visual
2-22-1-4	1	193	Frozen		1189	1189	Visual
2-22-1-5	1	194	Frozen		1400	1400	Visual
2-22-1-6	1	195	Frozen		1500	1500	Visual
2-22-1-7	1	196	Frozen	1614		1614	ICEMAN™
2-22-1-8	1	197	Frozen		1536	1536	Visual
2-22-1-9	1	198	1347			1347	Scale
2-23-1-1	1	199	Frozen		1500	1500	Visual
2-23-1-2	1	200	Frozen		1467	1467	Visual
2-23-1-3	1	201	Frozen	1536		1536	ICEMAN™
2-23-1-4	1	202	Frozen	1523		1523	ICEMAN™
2-23-1-5	1	203	Frozen	1421		1421	ICEMAN™
2-23-1-6	1	204	Frozen		1420	1420	Visual
2-23-1-7	1	205	Frozen		1500	1500	Visual

2-23-1-8	1	206	Frozen		1221	1221	Visual
2-23-1-9	1	207	Frozen		1122	1122	Visual
2-24-1-1	1	208	1320	1371		1320	Scale
2-24-1-2	1	209	1150	1155		1150	Scale
2-24-1-3	1	210	1264	1190		1264	Scale
2-24-1-4	1	211	Frozen		1145	1145	Visual
2-24-1-5	1	212	Frozen		1278	1278	Visual
2-24-1-6	1	213	Frozen		1007	1007	Visual
2-24-1-7	1	214	Frozen		985	985	Visual
2-24-1-8	1	215	Frozen		1200	1200	Visual
2-24-1-9	1	216	Frozen		1365	1365	Visual
2-01-2-1	2	217	Frozen		1345	1345	Visual
2-01-2-2	2	218	Frozen		1202	1202	Visual
2-01-2-3	2	219	1388	1687		1388	Scale
2-01-2-4	2	220	1436	1211		1436	Scale
2-01-2-5	2	221	1374	1532		1374	Scale
2-01-2-6	2	222	Frozen		1245	1245	Visual
2-01-2-7	2	223	1002	1200		1002	Scale
2-01-2-8	2	224	1082	1186		1082	Scale
2-01-2-9	2	225	1180	1136		1180	Scale
2-02-2-1	2	226	Frozen		1100	1100	Visual
2-02-2-2	2	227	1357	1308		1357	Scale
2-02-2-3	2	228	1271	1266		1271	Scale
2-02-2-4	2	229	1305	1268		1305	Scale
2-02-2-5	2	230	1090	1214		1090	Scale
2-02-2-6	2	231	Frozen		1123	1123	Visual
2-02-2-7	2	232	1267	1286		1267	Scale
2-02-2-8	2	233	1371	1336		1371	Scale
2-02-2-9	2	234	1387	1355		1387	Scale
2-03-2-1	2	235	Frozen		1003	1003	Visual
2-03-2-2	2	236	1602	1491		1602	Scale
2-03-2-3	2	237	Frozen		1174	1174	Visual
2-03-2-4	2	238	Frozen		1009	1009	Visual
2-03-2-5	2	239	Frozen		1300	1300	Visual
2-03-2-6	2	240	Frozen		1477	1477	Visual
2-03-2-7	2	241	Frozen		1468	1468	Visual
2-03-2-8	2	242	Frozen		1512	1512	Visual
2-03-2-9	2	243	Frozen		958	958	Visual
2-04-2-1	2	244	Frozen		1189	1189	Visual
2-04-2-2	2	245	1595	1628		1595	Scale
2-04-2-3	2	246	Frozen		1484	1484	Visual
2-04-2-4	2	247	Frozen		1233	1233	Visual
2-04-2-5	2	248	Frozen		1528	1528	Visual
2-04-2-6	2	249	Frozen		1101	1101	Visual
2-04-2-7	2	250	Frozen		1135	1135	Visual
2-04-2-8	2	251	Frozen		1182	1182	Visual
2-04-2-9	2	252	Frozen	1620		1620	ICEMAN™
2-05-2-1	2	253	Frozen		1400	1400	Visual
2-05-2-2	2	254	1434	1434		1434	Scale
2-05-2-3	2	255	1528	1461		1528	Scale
2-05-2-4	2	256	1439	1391		1439	Scale
2-05-2-5	2	257	Frozen		1345	1345	Visual

2-05-2-6	2	258	Frozen		1398	1398	Visual
2-05-2-7	2	259	1494	1457		1494	Scale
2-05-2-8	2	260	1396	1576		1396	Scale
2-05-2-9	2	261	1433	1438		1433	Scale
2-06-2-1	2	262	Frozen		1467	1467	Visual
2-06-2-2	2	263	Frozen		1536	1536	Visual
2-06-2-3	2	264	Frozen	1643		1643	ICEMAN™
2-06-2-4	2	265	Frozen		1500	1500	Visual
2-06-2-5	2	266	Frozen		1512	1512	Visual
2-06-2-6	2	267	Frozen		1434	1434	Visual
2-06-2-7	2	268	Frozen		1365	1365	Visual
2-06-2-8	2	269	Frozen	1599		1599	ICEMAN™
2-06-2-9	2	270	Frozen		1200	1200	Visual
2-07-2-1	2	271	Frozen		1340	1340	Visual
2-07-2-2	2	272	Frozen		1134	1134	Visual
2-07-2-3	2	273	Frozen		1176	1176	Visual
2-07-2-4	2	274	Frozen	1186		1186	ICEMAN™
2-07-2-5	2	275	Frozen		1204	1204	Visual
2-07-2-6	2	276	Frozen		1330	1330	Visual
2-07-2-7	2	277	1612	1538		1612	Scale
2-07-2-8	2	278	1540	1516		1540	Scale
2-07-2-9	2	279	Frozen	1480		1480	ICEMAN™
2-08-2-1	2	280	1437	1383		1437	Scale
2-08-2-2	2	281	1284	1267		1284	Scale
2-08-2-3	2	282	1193	1214		1193	Scale
2-08-2-4	2	283	1182			1182	Scale
2-08-2-5	2	284	1067			1067	Scale
2-08-2-6	2	285	1149			1149	Scale
2-08-2-7	2	286	1211	1252		1211	Scale
2-08-2-8	2	287	1347	1356		1347	Scale
2-08-2-9	2	288	1389	1422		1389	Scale
2-09-2-1	2	289	Frozen	1607		1607	ICEMAN™
2-09-2-2	2	290	1546	1634		1546	Scale
2-09-2-3	2	291	1600	1554		1600	Scale
2-09-2-4	2	292	Frozen		1245	1245	Visual
2-09-2-5	2	293	Frozen		1400	1400	Visual
2-09-2-6	2	294	Frozen		1502	1502	Visual
2-09-2-7	2	295	1500	1560		1500	Scale
2-09-2-8	2	296	1465	1472		1465	Scale
2-09-2-9	2	297	1404	1593		1404	Scale
2-10-2-1	2	298	Frozen		1499	1499	Visual
2-10-2-2	2	299	1618	1607		1618	Scale
2-10-2-3	2	300	1472	1660		1472	Scale
2-10-2-4	2	301	1446	1440		1446	Scale
2-10-2-5	2	302	1270	1279		1270	Scale
2-10-2-6	2	303	1437	1473		1437	Scale
2-10-2-7	2	304	1583	1616		1583	Scale
2-10-2-8	2	305	1552	1556		1552	Scale
2-10-2-9	2	306	Frozen		1345	1345	Visual
2-11-2-1	2	307	Frozen		1288	1288	Visual
2-11-2-2	2	308	1542			1542	Scale
2-11-2-3	2	309	Frozen		1378	1378	Visual

2-11-2-4	2	310	Frozen		1356	1356	Visual
2-11-2-5	2	311	Frozen		1645	1645	Visual
2-11-2-6	2	312	Frozen		1233	1233	Visual
2-11-2-7	2	313	1590	1639		1590	Scale
2-11-2-8	2	314	1568	1605		1568	Scale
2-11-2-9	2	315	Frozen	1642		1642	ICEMAN™
2-12-2-1	2	316	Frozen	1445		1445	ICEMAN™
2-12-2-2	2	317	1542	1540		1542	Scale
2-12-2-3	2	318	Frozen	1645		1645	ICEMAN™
2-12-2-4	2	319	Frozen		1500	1500	Visual
2-12-2-5	2	320	Frozen		1400	1400	Visual
2-12-2-6	2	321	1507	1544		1507	Scale
2-12-2-7	2	322	1485	1567		1485	Scale
2-12-2-8	2	323	1555	1574		1555	Scale
2-12-2-9	2	324	Frozen		1305	1305	Visual
2-13-2-1	2	325	Frozen		1243	1243	Visual
2-13-2-2	2	326	1488	1533		1488	Scale
2-13-2-3	2	327	1476	1502		1476	Scale
2-13-2-4	2	328	1442	1515		1442	Scale
2-13-2-5	2	329	Frozen	1451		1451	ICEMAN™
2-13-2-6	2	330	1446	1506		1446	Scale
2-13-2-7	2	331	1442	1514		1442	Scale
2-13-2-8	2	332	1436	1462		1436	Scale
2-13-2-9	2	333	Frozen		1259	1259	Visual
2-14-2-1	2	334	Frozen	1468		1468	ICEMAN™
2-14-2-2	2	335	1340	1359		1340	Scale
2-14-2-3	2	336	1233	1412		1233	Scale
2-14-2-4	2	337	Frozen	1433		1433	ICEMAN™
2-14-2-5	2	338	Frozen		1134	1134	Visual
2-14-2-6	2	339	1393			1393	Scale
2-14-2-7	2	340	1311	1297		1311	Scale
2-14-2-8	2	341	1340	1398		1340	Scale
2-14-2-9	2	342	1360			1360	Scale
2-15-2-1	2	343	1501	1620		1501	Scale
2-15-2-2	2	344	1471	1523		1471	Scale
2-15-2-3	2	345	1431	1471		1431	Scale
2-15-2-4	2	346	1366	1309		1366	Scale
2-15-2-5	2	347	1253	1279		1253	Scale
2-15-2-6	2	348	1327	1371		1327	Scale
2-15-2-7	2	349	1382	1381		1382	Scale
2-15-2-8	2	350	1486	1432		1486	Scale
2-15-2-9	2	351	1407	1290		1407	Scale
2-16-2-1	2	352	1573			1573	Scale
2-16-2-2	2	353	1495	1565		1495	Scale
2-16-2-3	2	354	1521			1521	Scale
2-16-2-4	2	355	1453			1453	Scale
2-16-2-5	2	356	Frozen		1504	1504	Visual
2-16-2-6	2	357	Frozen		1403	1403	Visual
2-16-2-7	2	358	1760			1760	Scale
2-16-2-8	2	359	1663	1509		1663	Scale
2-16-2-9	2	360	Frozen		1400	1400	Visual
2-17-2-1	2	361	Frozen		1348	1348	Visual

2-17-2-2	2	362	1714	1516		1714	Scale
2-17-2-3	2	363	Frozen		1328	1328	Visual
2-17-2-4	2	364	Frozen		1283	1283	Visual
2-17-2-5	2	365	Frozen		1292	1292	Visual
2-17-2-6	2	366	1382	1504		1382	Scale
2-17-2-7	2	367	1440	1468		1440	Scale
2-17-2-8	2	368	1395	1444		1395	Scale
2-17-2-9	2	369	Frozen		1277	1277	Visual
2-18-2-1	2	370	1542			1542	Scale
2-18-2-2	2	371	1530			1530	Scale
2-18-2-3	2	372	Frozen		1304	1304	Visual
2-18-2-4	2	373	Frozen		1467	1467	Visual
2-18-2-5	2	374	Frozen		1134	1134	Visual
2-18-2-6	2	375	Frozen		1345	1345	Visual
2-18-2-7	2	376	Frozen	1507		1507	ICEMAN™
2-18-2-8	2	377	Frozen		1239	1239	Visual
2-18-2-9	2	378	Frozen		1143	1143	Visual
2-19-2-1	2	379	Frozen		1199	1199	Visual
2-19-2-2	2	380	1570	1615		1570	Scale
2-19-2-3	2	381	Frozen		1478	1478	Visual
2-19-2-4	2	382	Frozen		1456	1456	Visual
2-19-2-5	2	383	Frozen		1395	1395	Visual
2-19-2-6	2	384	Frozen		1362	1362	Visual
2-19-2-7	2	385	1585		1287	1585	Scale
2-19-2-8	2	386	Frozen		1412	1412	Visual
2-19-2-9	2	387	Frozen		1254	1254	Visual
2-20-2-1	2	388	1428	1567		1428	Scale
2-20-2-2	2	389	1406	1539		1406	Scale
2-20-2-3	2	390	1440	1458		1440	Scale
2-20-2-4	2	391	1383	1414		1383	Scale
2-20-2-5	2	392	1194	1274		1194	Scale
2-20-2-6	2	393	1436	1342		1436	Scale
2-20-2-7	2	394	1478	1544		1478	Scale
2-20-2-8	2	395	1493	1495		1493	Scale
2-20-2-9	2	396	1574	1574		1574	Scale
2-21-2-1	2	397	1252	1258		1252	Scale
2-21-2-2	2	398	1206	1219		1206	Scale
2-21-2-3	2	399	1133	1161		1133	Scale
2-21-2-4	2	400	1212	1210		1212	Scale
2-21-2-5	2	401	1127	1138		1127	Scale
2-21-2-6	2	402	1158	1191		1158	Scale
2-21-2-7	2	403	1287	1385		1287	Scale
2-21-2-8	2	404	1432	1434		1432	Scale
2-21-2-9	2	405	Frozen		1235	1235	Visual
2-22-2-1	2	406	Frozen		1478	1478	Visual
2-22-2-2	2	407	1500	1494		1500	Scale
2-22-2-3	2	408	Frozen		1476	1476	Visual
2-22-2-4	2	409	Frozen		1401	1401	Visual
2-22-2-5	2	410	Frozen		1341	1341	Visual
2-22-2-6	2	411	Frozen		1222	1222	Visual
2-22-2-7	2	412	1538	1529		1538	Scale
2-22-2-8	2	413	1485			1485	Scale

2-22-2-9	2	414	1472			1472	Scale
2-23-2-1	2	415	1521			1521	Scale
2-23-2-2	2	416	1564			1564	Scale
2-23-2-3	2	417	1550	1593		1550	Scale
2-23-2-4	2	418	1489	1497		1489	Scale
2-23-2-5	2	419	1360	1366		1360	Scale
2-23-2-6	2	420	1454	1448		1454	Scale
2-23-2-7	2	421	Frozen	1584		1584	ICEMAN™
2-23-2-8	2	422	1537	1544		1537	Scale
2-23-2-9	2	423	Frozen		1145	1145	Visual
2-24-2-1	2	424	946	980		946	Scale
2-24-2-2	2	425	1198	1171		1198	Scale
2-24-2-3	2	426	1248	1329		1248	Scale
2-24-2-4	2	427	1254	1266		1254	Scale
2-24-2-5	2	428	1384			1384	Scale
2-24-2-6	2	429	Frozen		1134	1134	Visual
2-24-2-7	2	430	Frozen		1151	1151	Visual
2-24-2-8	2	431	Frozen		1074	1074	Visual
2-24-2-9	2	432	Frozen		921	921	Visual
2-01-3-1	3	433	1424	1282		1424	Scale
2-01-3-2	3	434	1518	1512		1518	Scale
2-01-3-3	3	435	1468	1476		1468	Scale
2-01-3-4	3	436	1374	1357		1374	Scale
2-01-3-5	3	437	1227	1285		1227	Scale
2-01-3-6	3	438	1163	1312		1163	Scale
2-01-3-7	3	439	1216	1221		1216	Scale
2-01-3-8	3	440	1122	1216		1122	Scale
2-01-3-9	3	441	909	923		909	Scale
2-02-3-1	3	442	Frozen		934	934	Visual
2-02-3-2	3	443	1200	1195		1200	Scale
2-02-3-3	3	444	1216	1208		1216	Scale
2-02-3-4	3	445	1398	1406		1398	Scale
2-02-3-5	3	446	1165	1238		1165	Scale
2-02-3-6	3	447	1182	1203		1182	Scale
2-02-3-7	3	448	1192	1212		1192	Scale
2-02-3-8	3	449	1240	1225		1240	Scale
2-02-3-9	3	450	1329	1339		1329	Scale
2-03-3-1	3	451	Frozen		1146	1146	Visual
2-03-3-2	3	452	1435	1426		1435	Scale
2-03-3-3	3	453	1434	1424		1434	Scale
2-03-3-4	3	454	1395	1351		1395	Scale
2-03-3-5	3	455	1508		1438	1508	Scale
2-03-3-6	3	456	1506	1523		1506	Scale
2-03-3-7	3	457	1491	1432		1491	Scale
2-03-3-8	3	458	1462	1424		1462	Scale
2-03-3-9	3	459	Frozen		1378	1378	Visual
2-04-3-1	3	460	1439	1487		1439	Scale
2-04-3-2	3	461	1502	1478		1502	Scale
2-04-3-3	3	462	1530	1461		1530	Scale
2-04-3-4	3	463	1426	1445		1426	Scale
2-04-3-5	3	464	1415	1475		1415	Scale
2-04-3-6	3	465	1444	1485		1444	Scale

2-04-3-7	3	466	1468	1501		1468	Scale
2-04-3-8	3	467	1458	1486		1458	Scale
2-04-3-9	3	468	1362	1419		1362	Scale
2-05-3-1	3	469	Frozen	1389		1389	ICEMAN™
2-05-3-2	3	470	1440	1466		1440	Scale
2-05-3-3	3	471	1356	1391		1356	Scale
2-05-3-4	3	472	1380	1467		1380	Scale
2-05-3-5	3	473	Frozen		1411	1411	Visual
2-05-3-6	3	474	1398	1433		1398	Scale
2-05-3-7	3	475	1322	1421		1322	Scale
2-05-3-8	3	476	1439	1452		1439	Scale
2-05-3-9	3	477	1392	1360		1392	Scale
2-06-3-1	3	478	Frozen	1516		1516	ICEMAN™
2-06-3-2	3	479	1419	1551		1419	Scale
2-06-3-3	3	480	1580	1589		1580	Scale
2-06-3-4	3	481	Frozen		1500	1500	Visual
2-06-3-5	3	482	Frozen	1508		1508	ICEMAN™
2-06-3-6	3	483	1454	1505		1454	Scale
2-06-3-7	3	484	1374	1565		1374	Scale
2-06-3-8	3	485	1530	1579		1530	Scale
2-06-3-9	3	486	Frozen		1453	1453	Visual
2-07-3-1	3	487	1450			1450	Scale
2-07-3-2	3	488	1502	1510		1502	Scale
2-07-3-3	3	489	1487	1503		1487	Scale
2-07-3-4	3	490	1474	1472		1474	Scale
2-07-3-5	3	491	1485	1422		1485	Scale
2-07-3-6	3	492	1478	1477		1478	Scale
2-07-3-7	3	493	1493	1499		1493	Scale
2-07-3-8	3	494	1500	1527		1500	Scale
2-07-3-9	3	495	1480	1523		1480	Scale
2-08-3-1	3	496	1350	1405		1350	Scale
2-08-3-2	3	497	1256	1296		1256	Scale
2-08-3-3	3	498	1270	1317		1270	Scale
2-08-3-4	3	499	1078	1120		1078	Scale
2-08-3-5	3	500	1126	1182		1126	Scale
2-08-3-6	3	501	1392			1392	Scale
2-08-3-7	3	502	1257	1252		1257	Scale
2-08-3-8	3	503	1310	1332		1310	Scale
2-08-3-9	3	504	1440	1200		1440	Scale
2-09-3-1	3	505	1480	1589		1480	Scale
2-09-3-2	3	506	1507	1487		1507	Scale
2-09-3-3	3	507	1540	1573		1540	Scale
2-09-3-4	3	508	1507	1620		1507	Scale
2-09-3-5	3	509	1435			1435	Scale
2-09-3-6	3	510	1454	1370		1454	Scale
2-09-3-7	3	511	1408	1434		1408	Scale
2-09-3-8	3	512	1404	1418		1404	Scale
2-09-3-9	3	513	Frozen		1240	1240	Visual
2-10-3-1	3	514	1560	1553		1560	Scale
2-10-3-2	3	515	1498	1502		1498	Scale
2-10-3-3	3	516	1474	1479		1474	Scale
2-10-3-4	3	517	1407	1404		1407	Scale

2-10-3-5	3	518	1369	1342		1369	Scale
2-10-3-6	3	519	1438	1457		1438	Scale
2-10-3-7	3	520	1468	1422		1468	Scale
2-10-3-8	3	521	1542	1514		1542	Scale
2-10-3-9	3	522	Frozen		1490	1490	Visual
2-11-3-1	3	523	1252	1514		1252	Scale
2-11-3-2	3	524	1494	1506		1494	Scale
2-11-3-3	3	525	1512	1511		1512	Scale
2-11-3-4	3	526	1531	1555		1531	Scale
2-11-3-5	3	527	Frozen		1283	1283	Visual
2-11-3-6	3	528	1523	1517		1523	Scale
2-11-3-7	3	529	1545	1557		1545	Scale
2-11-3-8	3	530	1544	1554		1544	Scale
2-11-3-9	3	531	1551	1572		1551	Scale
2-12-3-1	3	532	1470	1417		1470	Scale
2-12-3-2	3	533	1446	1470		1446	Scale
2-12-3-3	3	534	1425	1475		1425	Scale
2-12-3-4	3	535	1406	1402		1406	Scale
2-12-3-5	3	536	1390			1390	Scale
2-12-3-6	3	537	1384	1407		1384	Scale
2-12-3-7	3	538	1410	1428		1410	Scale
2-12-3-8	3	539	1454	1471		1454	Scale
2-12-3-9	3	540	1450	1385		1450	Scale
2-13-3-1	3	541	1297	1267		1297	Scale
2-13-3-2	3	542	1334	1374		1334	Scale
2-13-3-3	3	543	1362	1389		1362	Scale
2-13-3-4	3	544	1320	1378		1320	Scale
2-13-3-5	3	545	1338	1386		1338	Scale
2-13-3-6	3	546	1329	1368		1329	Scale
2-13-3-7	3	547	1318	1354		1318	Scale
2-13-3-8	3	548	1384	1451		1384	Scale
2-13-3-9	3	549	Frozen		1402	1402	Visual
2-14-3-1	3	550	1220	1375		1220	Scale
2-14-3-2	3	551	1302	1339		1302	Scale
2-14-3-3	3	552	1238	1330		1238	Scale
2-14-3-4	3	553	1238	1256		1238	Scale
2-14-3-5	3	554	Frozen		1440	1440	Visual
2-14-3-6	3	555	1176	1216		1176	Scale
2-14-3-7	3	556	1220	1271		1220	Scale
2-14-3-8	3	557	1277	1318		1277	Scale
2-14-3-9	3	558	Frozen	1207		1207	ICEMAN™
2-15-3-1	3	559	1406	1425		1406	Scale
2-15-3-2	3	560	1367	1383		1367	Scale
2-15-3-3	3	561	1315	1344		1315	Scale
2-15-3-4	3	562	1243	1278		1243	Scale
2-15-3-5	3	563	1228	1270		1228	Scale
2-15-3-6	3	564	1278	1300		1278	Scale
2-15-3-7	3	565	1287	1319		1287	Scale
2-15-3-8	3	566	1304	1338		1304	Scale
2-15-3-9	3	567	1345	1378		1345	Scale
2-16-3-1	3	568	1544	1375		1544	Scale
2-16-3-2	3	569	1370	1452		1370	Scale

2-16-3-3	3	570	1400	1449		1400	Scale
2-16-3-4	3	571	1374	1442		1374	Scale
2-16-3-5	3	572	1392	1468		1392	Scale
2-16-3-6	3	573	1354	1400		1354	Scale
2-16-3-7	3	574	1402	1431		1402	Scale
2-16-3-8	3	575	1326	1369		1326	Scale
2-16-3-9	3	576	1391	1427		1391	Scale
2-17-3-1	3	577	1622	1406		1622	Scale
2-17-3-2	3	578	1548	1409		1548	Scale
2-17-3-3	3	579	1366	1389		1366	Scale
2-17-3-4	3	580	1337	1383		1337	Scale
2-17-3-5	3	581	1345	1384		1345	Scale
2-17-3-6	3	582	1387	1407		1387	Scale
2-17-3-7	3	583	1377	1405		1377	Scale
2-17-3-8	3	584	1372	1400		1372	Scale
2-17-3-9	3	585	1421	1523		1421	Scale
2-18-3-1	3	586	1480			1480	Scale
2-18-3-2	3	587	1425			1425	Scale
2-18-3-3	3	588	1411	1472		1411	Scale
2-18-3-4	3	589	1310	1375		1310	Scale
2-18-3-5	3	590	1396	1413		1396	Scale
2-18-3-6	3	591	1382	1422		1382	Scale
2-18-3-7	3	592	1449	1390		1449	Scale
2-18-3-8	3	593	1524	1497		1524	Scale
2-18-3-9	3	594	1552			1552	Scale
2-19-3-1	3	595	Frozen		1337	1337	Visual
2-19-3-2	3	596	1496	1528		1496	Scale
2-19-3-3	3	597	1484	1523		1484	Scale
2-19-3-4	3	598	1498	1518		1498	Scale
2-19-3-5	3	599	Frozen		1487	1487	Visual
2-19-3-6	3	600	1478	1504		1478	Scale
2-19-3-7	3	601	1474	1490		1474	Scale
2-19-3-8	3	602	1510	1558		1510	Scale
2-19-3-9	3	603	1436	1522		1436	Scale
2-20-3-1	3	604	1438	1477		1438	Scale
2-20-3-2	3	605	1421	1457		1421	Scale
2-20-3-3	3	606	1365	1408		1365	Scale
2-20-3-4	3	607	1271	1306		1271	Scale
2-20-3-5	3	608	1288	1313		1288	Scale
2-20-3-6	3	609	1345	1371		1345	Scale
2-20-3-7	3	610	1399	1416		1399	Scale
2-20-3-8	3	611	1446	1452		1446	Scale
2-20-3-9	3	612	1291	1490		1291	Scale
2-21-3-1	3	613	1252	1259		1252	Scale
2-21-3-2	3	614	1205	1230		1205	Scale
2-21-3-3	3	615	1390	1392		1390	Scale
2-21-3-4	3	616	1341	1376		1341	Scale
2-21-3-5	3	617	1179	1212		1179	Scale
2-21-3-6	3	618	1167	1203		1167	Scale
2-21-3-7	3	619	1262	1290		1262	Scale
2-21-3-8	3	620	1367	1372		1367	Scale
2-21-3-9	3	621	Frozen		1254	1254	Visual

2-22-3-1	3	622	1440			1440	Scale
2-22-3-2	3	623	1494	1584		1494	Scale
2-22-3-3	3	624	1465	1508		1465	Scale
2-22-3-4	3	625	1503	1426		1503	Scale
2-22-3-5	3	626	1464			1464	Scale
2-22-3-6	3	627	1420	1444		1420	Scale
2-22-3-7	3	628	1413	1435		1413	Scale
2-22-3-8	3	629	1370	1394		1370	Scale
2-22-3-9	3	630	1396	1482		1396	Scale
2-23-3-1	3	631	1414			1414	Scale
2-23-3-2	3	632	1445	1451		1445	Scale
2-23-3-3	3	633	1437	1437		1437	Scale
2-23-3-4	3	634	1406	1426		1406	Scale
2-23-3-5	3	635	1356	1367		1356	Scale
2-23-3-6	3	636	1392	1399		1392	Scale
2-23-3-7	3	637	1442	1451		1442	Scale
2-23-3-8	3	638	1458	1471		1458	Scale
2-23-3-9	3	639	1424	1401		1424	Scale
2-24-3-1	3	640	1136	1131		1136	Scale
2-24-3-2	3	641	1229	1262		1229	Scale
2-24-3-3	3	642	1156	1142		1156	Scale
2-24-3-4	3	643	1274	1302		1274	Scale
2-24-3-5	3	644	1281	1306		1281	Scale
2-24-3-6	3	645	1250	1255		1250	Scale
2-24-3-7	3	646	1348	1414		1348	Scale
2-24-3-8	3	647	1495	1485		1495	Scale
2-24-3-9	3	648	1442			1442	Scale
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2-01-4-2	4	650	1320	1267		1320	Scale
2-01-4-3	4	651	1306	1265		1306	Scale
2-01-4-4	4	652	1306	1312		1306	Scale
2-01-4-5	4	653	1223	1263		1223	Scale
2-01-4-6	4	654	1277	1311		1277	Scale
2-01-4-7	4	655	1209	1231		1209	Scale
2-01-4-8	4	656	1078	1205		1078	Scale
2-01-4-9	4	657	1054	1105		1054	Scale
2-02-4-1	4	658	1165	1279		1165	Scale
2-02-4-2	4	659	1185	1163		1185	Scale
2-02-4-3	4	660	1197	1212		1197	Scale
2-02-4-4	4	661	1328	1339		1328	Scale
2-02-4-5	4	662	1339			1339	Scale
2-02-4-6	4	663	1310	1328		1310	Scale
2-02-4-7	4	664	1396	1415		1396	Scale
2-02-4-8	4	665	1140	1182		1140	Scale
2-02-4-9	4	666	1322	1322		1322	Scale
2-03-4-1	4	667	1242			1242	Scale
2-03-4-2	4	668	1218	1254		1218	Scale
2-03-4-3	4	669	1274	1279		1274	Scale
2-03-4-4	4	670	1215	1248		1215	Scale
2-03-4-5	4	671	1328	1286		1328	Scale
2-03-4-6	4	672	1268	1262		1268	Scale
2-03-4-7	4	673	1350	1298		1350	Scale

2-03-4-8	4	674	1465			1465	Scale
2-03-4-9	4	675	1219	1134		1219	Scale
2-04-4-1	4	676	1294	1302		1294	Scale
2-04-4-2	4	677	1284	1302		1284	Scale
2-04-4-3	4	678	1288	1325		1288	Scale
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2-04-4-5	4	680	1302	1300		1302	Scale
2-04-4-6	4	681	1268	1286		1268	Scale
2-04-4-7	4	682	1268	1267		1268	Scale
2-04-4-8	4	683	1255	1274		1255	Scale
2-04-4-9	4	684	1209	1191		1209	Scale
2-05-4-1	4	685	1313	1252		1313	Scale
2-05-4-2	4	686	1308	1324		1308	Scale
2-05-4-3	4	687	1266	1293		1266	Scale
2-05-4-4	4	688	1264	1253		1264	Scale
2-05-4-5	4	689	1340			1340	Scale
2-05-4-6	4	690	1293	1251		1293	Scale
2-05-4-7	4	691	1320	1268		1320	Scale
2-05-4-8	4	692	1332	1403		1332	Scale
2-05-4-9	4	693	1380	1429		1380	Scale
2-06-4-1	4	694	1377	1375		1377	Scale
2-06-4-2	4	695	1386	1399		1386	Scale
2-06-4-3	4	696	1416	1432		1416	Scale
2-06-4-4	4	697	1405	1446		1405	Scale
2-06-4-5	4	698	1470	1388		1470	Scale
2-06-4-6	4	699	1405	1425		1405	Scale
2-06-4-7	4	700	1414	1441		1414	Scale
2-06-4-8	4	701	1428	1455		1428	Scale
2-06-4-9	4	702	1291	1380		1291	Scale
2-07-4-1	4	703	1280	1320		1280	Scale
2-07-4-2	4	704	1305	1329		1305	Scale
2-07-4-3	4	705	1389	1346		1389	Scale
2-07-4-4	4	706	1344	1331		1344	Scale
2-07-4-5	4	707	1342	1334		1342	Scale
2-07-4-6	4	708	1322	1364		1322	Scale
2-07-4-7	4	709	1347	1334		1347	Scale
2-07-4-8	4	710	1338	1355		1338	Scale
2-07-4-9	4	711	1362	1386		1362	Scale
2-08-4-1	4	712	1322	1351		1322	Scale
2-08-4-2	4	713	1206	1222		1206	Scale
2-08-4-3	4	714	1207	1240		1207	Scale
2-08-4-4	4	715	1128	1162		1128	Scale
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2-08-4-6	4	717	1348	1443		1348	Scale
2-08-4-7	4	718	1182	1212		1182	Scale
2-08-4-8	4	719	1223	1245		1223	Scale
2-08-4-9	4	720	1295	1279		1295	Scale
2-09-4-1	4	721	1462	1336		1462	Scale
2-09-4-2	4	722	1379	1379		1379	Scale
2-09-4-3	4	723	1354	1377		1354	Scale
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2-09-4-7	4	727	1342	1328		1342	Scale
2-09-4-8	4	728	1349	1353		1349	Scale
2-09-4-9	4	729	1356	1397		1356	Scale
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2-10-4-3	4	732	1347	1348		1347	Scale
2-10-4-4	4	733	1340	1347		1340	Scale
2-10-4-5	4	734	1344	1308		1344	Scale
2-10-4-6	4	735	1360	1377		1360	Scale
2-10-4-7	4	736	1385	1399		1385	Scale
2-10-4-8	4	737	1430	1434		1430	Scale
2-10-4-9	4	738	Frozen		1463	1463	Visual
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2-11-4-4	4	742	1444	1473		1444	Scale
2-11-4-5	4	743	1478	1491		1478	Scale
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2-11-4-8	4	746	1397	1416		1397	Scale
2-11-4-9	4	747	1432	1463		1432	Scale
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2-12-4-2	4	749	1332	1386		1332	Scale
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2-12-4-9	4	756	1298	1317		1298	Scale
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2-13-4-2	4	758	1219	1228		1219	Scale
2-13-4-3	4	759	1245	1264		1245	Scale
2-13-4-4	4	760	1247	1277		1247	Scale
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2-13-4-7	4	763	1314	1338		1314	Scale
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2-14-4-7	4	772	1204	1230		1204	Scale
2-14-4-8	4	773	1209	1204		1209	Scale
2-14-4-9	4	774	Frozen		1456	1456	Visual
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2-15-4-7	4	781	1238	1270		1238	Scale
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2-11-5-1	5	955	Frozen		1237	1237	Visual
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2-21-5-1	5	1045	1294	1336		1294	Scale
2-21-5-2	5	1046	1130			1130	Scale
2-21-5-3	5	1047	1246	1203		1246	Scale
2-21-5-4	5	1048	1150	1164		1150	Scale
2-21-5-5	5	1049	1084			1084	Scale
2-21-5-6	5	1050	1248	1301		1248	Scale
2-21-5-7	5	1051	1184	1214		1184	Scale
2-21-5-8	5	1052	1194	1205		1194	Scale
2-21-5-9	5	1053	1154	1238		1154	Scale
2-22-5-1	5	1054	1275			1275	Scale
2-22-5-2	5	1055	1336	1357		1336	Scale
2-22-5-3	5	1056	1292	1288		1292	Scale
2-22-5-4	5	1057	1227	1250		1227	Scale
2-22-5-5	5	1058	1235	1266		1235	Scale
2-22-5-6	5	1059	1207	1235		1207	Scale
2-22-5-7	5	1060	1365	1371		1365	Scale
2-22-5-8	5	1061	1321	1334		1321	Scale
2-22-5-9	5	1062	1255	1272		1255	Scale
2-23-5-1	5	1063	1308	1323		1308	Scale
2-23-5-2	5	1064	1368	1408		1368	Scale
2-23-5-3	5	1065	1190	1215		1190	Scale
2-23-5-4	5	1066	1217	1220		1217	Scale
2-23-5-5	5	1067	1190	1201		1190	Scale
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2-24-5-2	5	1073	1238	1301		1238	Scale
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2-24-5-8	5	1079	1176	1192		1176	Scale
2-24-5-9	5	1080	1158	1349		1158	Scale
2-01-6-1	6	1081	1396	1411		1396	Scale
2-01-6-2	6	1082	1214	1199		1214	Scale
2-01-6-3	6	1083	1239	1273		1239	Scale
2-01-6-4	6	1084	1268	1241		1268	Scale
2-01-6-5	6	1085	1213	1216		1213	Scale
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2-01-6-7	6	1087	1093	1147		1093	Scale
2-01-6-8	6	1088	1172	1253		1172	Scale
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2-02-6-4	6	1093	1144	1238		1144	Scale
2-02-6-5	6	1094	882	998		882	Scale
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2-02-6-9	6	1098	1088	1108		1088	Scale
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2-03-6-3	6	1101	1200	1207		1200	Scale
2-03-6-4	6	1102	1310	1307		1310	Scale
2-03-6-5	6	1103	1140	1109		1140	Scale
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2-03-6-7	6	1105	1194	1125		1194	Scale
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2-03-6-9	6	1107	1213	1085		1213	Scale
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2-04-6-3	6	1110	1169	1214		1169	Scale
2-04-6-4	6	1111	1211	1235		1211	Scale
2-04-6-5	6	1112	1268	1345		1268	Scale
2-04-6-6	6	1113	1175	1217		1175	Scale
2-04-6-7	6	1114	1134	1158		1134	Scale
2-04-6-8	6	1115	1145	1162		1145	Scale
2-04-6-9	6	1116	1275	1199		1275	Scale
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2-05-6-7	6	1123	1394	1469		1394	Scale
2-05-6-8	6	1124	1173	1244		1173	Scale
2-05-6-9	6	1125	1168	1166		1168	Scale
2-06-6-1	6	1126	1272	1269		1272	Scale
2-06-6-2	6	1127	1319	1335		1319	Scale
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2-06-6-4	6	1129	Frozen	1358		1358	ICEMAN™
2-06-6-5	6	1130	1413	1435		1413	Scale
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2-06-6-7	6	1132	1338	1366		1338	Scale
2-06-6-8	6	1133	1298	1318		1298	Scale
2-06-6-9	6	1134	1258			1258	Scale
2-07-6-1	6	1135	1221	1221		1221	Scale
2-07-6-2	6	1136	1183	1155		1183	Scale
2-07-6-3	6	1137	1243	1201		1243	Scale
2-07-6-4	6	1138	1272	1536		1272	Scale
2-07-6-5	6	1139	1236	1233		1236	Scale
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2-07-6-9	6	1143	1186	1194		1186	Scale
2-08-6-1	6	1144	1201			1201	Scale
2-08-6-2	6	1145	1158	1179		1158	Scale
2-08-6-3	6	1146	1159	1174		1159	Scale
2-08-6-4	6	1147	1228	1258		1228	Scale
2-08-6-5	6	1148	1248	1255		1248	Scale
2-08-6-6	6	1149	1188	1201		1188	Scale
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2-08-6-8	6	1151	1114	1127		1114	Scale
2-08-6-9	6	1152	Frozen		1108	1108	Visual
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2-09-6-3	6	1155	1265	1268		1265	Scale
2-09-6-4	6	1156	1328	1330		1328	Scale
2-09-6-5	6	1157	1163			1163	Scale
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2-09-6-7	6	1159	1190	1201		1190	Scale
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2-10-6-5	6	1166	1185	1199		1185	Scale
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2-10-6-8	6	1169	1252	1254		1252	Scale
2-10-6-9	6	1170	Frozen		1182	1182	Visual
2-11-6-1	6	1171	Frozen		1345	1345	Visual
2-11-6-2	6	1172	1320	1339		1320	Scale
2-11-6-3	6	1173	1212	1224		1212	Scale
2-11-6-4	6	1174	1269	1277		1269	Scale
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2-11-6-8	6	1178	1282	1317		1282	Scale
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2-12-6-1	6	1180	Frozen		1336	1336	Visual
2-12-6-2	6	1181	1225	1254		1225	Scale
2-12-6-3	6	1182	1194	1208		1194	Scale
2-12-6-4	6	1183	1258	1309		1258	Scale
2-12-6-5	6	1184	Frozen		1103	1103	Visual
2-12-6-6	6	1185	1148	1195		1148	Scale
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2-12-6-8	6	1187	1298	1439		1298	Scale
2-12-6-9	6	1188	1328	1379		1328	Scale
2-13-6-1	6	1189	Frozen		1401	1401	Visual
2-13-6-2	6	1190	1302	1312		1302	Scale
2-13-6-3	6	1191	1291	1340		1291	Scale
2-13-6-4	6	1192	1162	1236		1162	Scale
2-13-6-5	6	1193	1177	1207		1177	Scale

2-13-6-6	6	1194	1259	1293		1259	Scale
2-13-6-7	6	1195	1256	1253		1256	Scale
2-13-6-8	6	1196	1281	1317		1281	Scale
2-13-6-9	6	1197	1326	1353		1326	Scale
2-14-6-1	6	1198	1181	1163		1181	Scale
2-14-6-2	6	1199	1138	1236		1138	Scale
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2-14-6-4	6	1201	1178	1253		1178	Scale
2-14-6-5	6	1202	1274			1274	Scale
2-14-6-6	6	1203	1280			1280	Scale
2-14-6-7	6	1204	Frozen	1194		1194	ICEMAN™
2-14-6-8	6	1205	1190	1218		1190	Scale
2-14-6-9	6	1206	Frozen	1191		1191	ICEMAN™
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2-15-6-4	6	1210	1318	1331		1318	Scale
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2-15-6-7	6	1213	1206	1303		1206	Scale
2-15-6-8	6	1214	1295	1309		1295	Scale
2-15-6-9	6	1215	1188	1211		1188	Scale
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2-16-6-4	6	1219	1161	1238		1161	Scale
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2-16-6-8	6	1223	1348	1372		1348	Scale
2-16-6-9	6	1224	1341	1258		1341	Scale
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2-21-6-5	6	1265	1161			1161	Scale
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2-21-6-8	6	1268	1081	1148		1081	Scale
2-21-6-9	6	1269	1106	1130		1106	Scale
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2-23-6-5	6	1283	1316	1314		1316	Scale
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2-01-7-5	7	1301	1311	1308		1311	Scale
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2-01-7-7	7	1303	1104	1076		1104	Scale
2-01-7-8	7	1304	1162	1248		1162	Scale
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2-02-7-4	7	1309	978	1002		978	Scale
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2-02-7-7	7	1312	993	1048		993	Scale
2-02-7-8	7	1313	866	964		866	Scale
2-02-7-9	7	1314	1129	1134		1129	Scale
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2-03-7-2	7	1316	Frozen		956	956	Visual
2-03-7-3	7	1317	1391	1378		1391	Scale
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2-03-7-5	7	1319	1238	1234		1238	Scale
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2-04-7-3	7	1326	1278	1300		1278	Scale
2-04-7-4	7	1327	Frozen		1201	1201	Visual
2-04-7-5	7	1328	1270	1102		1270	Scale
2-04-7-6	7	1329	Frozen	1200		1200	ICEMAN™
2-04-7-7	7	1330	Frozen		1080	1080	Visual
2-04-7-8	7	1331	1159	1167		1159	Scale
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2-05-7-2	7	1334	1183	1200		1183	Scale
2-05-7-3	7	1335	1233			1233	Scale
2-05-7-4	7	1336	Frozen		1344	1344	Visual
2-05-7-5	7	1337	Frozen		1261	1261	Visual
2-05-7-6	7	1338	1322	1421		1322	Scale
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2-05-7-9	7	1341	Frozen		1301	1301	Visual
2-06-7-1	7	1342	Frozen		1277	1277	Visual
2-06-7-2	7	1343	Frozen		1038	1038	Visual
2-06-7-3	7	1344	Frozen		1052	1052	Visual
2-06-7-4	7	1345	Frozen		1196	1196	Visual
2-06-7-5	7	1346	Frozen		1258	1258	Visual
2-06-7-6	7	1347	Frozen		1393	1393	Visual
2-06-7-7	7	1348	Frozen		1256	1256	Visual
2-06-7-8	7	1349	Frozen		1387	1387	Visual

2-06-7-9	7	1350	Frozen		1011	1011	Visual
2-07-7-1	7	1351	Frozen		1053	1053	Visual
2-07-7-2	7	1352	1159	1144		1159	Scale
2-07-7-3	7	1353	1127	1158		1127	Scale
2-07-7-4	7	1354	1187	1185		1187	Scale
2-07-7-5	7	1355	1175			1175	Scale
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2-07-7-7	7	1357	1196	1231		1196	Scale
2-07-7-8	7	1358	1104	1126		1104	Scale
2-07-7-9	7	1359	1121			1121	Scale
2-08-7-1	7	1360	1174	1238		1174	Scale
2-08-7-2	7	1361	1230			1230	Scale
2-08-7-3	7	1362	1224			1224	Scale
2-08-7-4	7	1363	1128			1128	Scale
2-08-7-5	7	1364	Frozen		1267	1267	Visual
2-08-7-6	7	1365	1184	1194		1184	Scale
2-08-7-7	7	1366	Frozen	1236		1236	ICEMAN™
2-08-7-8	7	1367	Frozen		1445	1445	Visual
2-08-7-9	7	1368	Frozen		1278	1278	Visual
2-09-7-1	7	1369	Frozen		1254	1254	Visual
2-09-7-2	7	1370	Frozen		1143	1143	Visual
2-09-7-3	7	1371	1193	1534		1193	Scale
2-09-7-4	7	1372	1238	1210		1238	Scale
2-09-7-5	7	1373	Frozen		1234	1234	Visual
2-09-7-6	7	1374	1241	1267		1241	Scale
2-09-7-7	7	1375	1151	1194		1151	Scale
2-09-7-8	7	1376	1180	1201		1180	Scale
2-09-7-9	7	1377	1241	1280		1241	Scale
2-10-7-1	7	1378	Frozen		1267	1267	Visual
2-10-7-2	7	1379	1047	1010		1047	Scale
2-10-7-3	7	1380	1268	1308		1268	Scale
2-10-7-4	7	1381	1176	1194		1176	Scale
2-10-7-5	7	1382	Frozen		1247	1247	Visual
2-10-7-6	7	1383	1349	1346		1349	Scale
2-10-7-7	7	1384	Frozen	1411		1411	ICEMAN™
2-10-7-8	7	1385	Frozen	1440		1440	ICEMAN™
2-10-7-9	7	1386	Frozen		1300	1300	Visual
2-11-7-1	7	1387	Frozen		1355	1355	Visual
2-11-7-2	7	1388	1359	1304		1359	Scale
2-11-7-3	7	1389	1285	1338		1285	Scale
2-11-7-4	7	1390	1411	1395		1411	Scale
2-11-7-5	7	1391	Frozen		1133	1133	Visual
2-11-7-6	7	1392	1192	1225		1192	Scale
2-11-7-7	7	1393	1209	1225		1209	Scale
2-11-7-8	7	1394	1330	1333		1330	Scale
2-11-7-9	7	1395	1135			1135	Scale
2-12-7-1	7	1396	Frozen		1378	1378	Visual
2-12-7-2	7	1397	Frozen		1267	1267	Visual
2-12-7-3	7	1398	Frozen		1345	1345	Visual
2-12-7-4	7	1399	Frozen		1356	1356	Visual
2-12-7-5	7	1400	Frozen	1376		1376	ICEMAN™
2-12-7-6	7	1401	1119	1214		1119	Scale

2-12-7-7	7	1402	1310	1403		1310	Scale
2-12-7-8	7	1403	1116	1165		1116	Scale
2-12-7-9	7	1404	Frozen		1145	1145	Visual
2-13-7-1	7	1405	Frozen		1276	1276	Visual
2-13-7-2	7	1406	Frozen		1231	1231	Visual
2-13-7-3	7	1407	1253	1291		1253	Scale
2-13-7-4	7	1408	1229	1242		1229	Scale
2-13-7-5	7	1409	Frozen		1356	1356	Visual
2-13-7-6	7	1410	Frozen		1388	1388	Visual
2-13-7-7	7	1411	Frozen		1230	1230	Visual
2-13-7-8	7	1412	Frozen		1079	1079	Visual
2-13-7-9	7	1413	Frozen		1256	1256	Visual
2-14-7-1	7	1414	1178	1237		1178	Scale
2-14-7-2	7	1415	1138	1205		1138	Scale
2-14-7-3	7	1416	Frozen		1046	1046	Visual
2-14-7-4	7	1417	Frozen		1136	1136	Visual
2-14-7-5	7	1418	Frozen		1262	1262	Visual
2-14-7-6	7	1419	Frozen	1323		1323	ICEMAN™
2-14-7-7	7	1420	Frozen	1156		1156	ICEMAN™
2-14-7-8	7	1421	Frozen	1739		1739	ICEMAN™
2-14-7-9	7	1422	Frozen		1473	1473	Visual
2-15-7-1	7	1423	1227	1222		1227	Scale
2-15-7-2	7	1424	Frozen		1104	1104	Visual
2-15-7-3	7	1425	Frozen		1069	1069	Visual
2-15-7-4	7	1426	Frozen		1009	1009	Visual
2-15-7-5	7	1427	Frozen		1378	1378	Visual
2-15-7-6	7	1428	Frozen		1405	1405	Visual
2-15-7-7	7	1429	1168	1181		1168	Scale
2-15-7-8	7	1430	1146	1211		1146	Scale
2-15-7-9	7	1431	1158	1199		1158	Scale
2-16-7-1	7	1432	1182	1229		1182	Scale
2-16-7-2	7	1433	1182	1320		1182	Scale
2-16-7-3	7	1434	1068	1115		1068	Scale
2-16-7-4	7	1435	1204	1230		1204	Scale
2-16-7-5	7	1436	Frozen		1172	1172	Visual
2-16-7-6	7	1437	Frozen		1054	1054	Visual
2-16-7-7	7	1438	Frozen	1191		1191	ICEMAN™
2-16-7-8	7	1439	1153	1308		1153	Scale
2-16-7-9	7	1440	Frozen		1132	1132	Visual
2-17-7-1	7	1441	Frozen		1167	1167	Visual
2-17-7-2	7	1442	Frozen	1255		1255	ICEMAN™
2-17-7-3	7	1443	1356	1371		1356	Scale
2-17-7-4	7	1444	1323	1312		1323	Scale
2-17-7-5	7	1445	Frozen		1321	1321	Visual
2-17-7-6	7	1446	1151			1151	Scale
2-17-7-7	7	1447	1222	1253		1222	Scale
2-17-7-8	7	1448	1303	1274		1303	Scale
2-17-7-9	7	1449	1040	1072		1040	Scale
2-18-7-1	7	1450	Frozen		1256	1256	Visual
2-18-7-2	7	1451	1180	1172		1180	Scale
2-18-7-3	7	1452	1331	1236		1331	Scale
2-18-7-4	7	1453	1011	1054		1011	Scale

2-18-7-5	7	1454	1129			1129	Scale
2-18-7-6	7	1455	1096	1158		1096	Scale
2-18-7-7	7	1456	1335	1363		1335	Scale
2-18-7-8	7	1457	1198	1246		1198	Scale
2-18-7-9	7	1458	Frozen		1359	1359	Visual
2-19-7-1	7	1459	932			932	Scale
2-19-7-2	7	1460	1115	1165		1115	Scale
2-19-7-3	7	1461	1180	1211		1180	Scale
2-19-7-4	7	1462	1202	1219		1202	Scale
2-19-7-5	7	1463	1163	1213		1163	Scale
2-19-7-6	7	1464	1118	1123		1118	Scale
2-19-7-7	7	1465	Frozen		1134	1134	Visual
2-19-7-8	7	1466	Frozen		1209	1209	Visual
2-19-7-9	7	1467	Frozen		1128	1128	Visual
2-20-7-1	7	1468	1117	1152		1117	Scale
2-20-7-2	7	1469	1175	1177		1175	Scale
2-20-7-3	7	1470	1265	1331		1265	Scale
2-20-7-4	7	1471	954	990		954	Scale
2-20-7-5	7	1472	1132			1132	Scale
2-20-7-6	7	1473	1259	1228		1259	Scale
2-20-7-7	7	1474	914	1073		914	Scale
2-20-7-8	7	1475	1143	1194		1143	Scale
2-20-7-9	7	1476	1028			1028	Scale
2-21-7-1	7	1477	1070			1070	Scale
2-21-7-2	7	1478	1133	1081		1133	Scale
2-21-7-3	7	1479	1165	1230		1165	Scale
2-21-7-4	7	1480	1148	1224		1148	Scale
2-21-7-5	7	1481	1141			1141	Scale
2-21-7-6	7	1482	1218	1311		1218	Scale
2-21-7-7	7	1483	1228	1259		1228	Scale
2-21-7-8	7	1484	1093	1141		1093	Scale
2-21-7-9	7	1485	1007	1046	1070	1007	Scale
2-22-7-1	7	1486	1140	1155		1140	Scale
2-22-7-2	7	1487	1216			1216	Scale
2-22-7-3	7	1488	1412	1304		1412	Scale
2-22-7-4	7	1489	1243	1247		1243	Scale
2-22-7-5	7	1490	Frozen		1383	1383	Visual
2-22-7-6	7	1491	1325			1325	Scale
2-22-7-7	7	1492	1345	1367		1345	Scale
2-22-7-8	7	1493	Frozen		1034	1034	Visual
2-22-7-9	7	1494	1055			1055	Scale
2-23-7-1	7	1495	1100	1166		1100	Scale
2-23-7-2	7	1496	1145	1182		1145	Scale
2-23-7-3	7	1497	1294	1399		1294	Scale
2-23-7-4	7	1498	1284	1274		1284	Scale
2-23-7-5	7	1499	1200	1219		1200	Scale
2-23-7-6	7	1500	1270	1260		1270	Scale
2-23-7-7	7	1501	1212	1215		1212	Scale
2-23-7-8	7	1502	1295	1306		1295	Scale
2-23-7-9	7	1503	1185	1062		1185	Scale
2-24-7-1	7	1504	972	1002		972	Scale
2-24-7-2	7	1505	1096	1148		1096	Scale

2-24-7-3	7	1506	1130	1119		1130	Scale
2-24-7-4	7	1507	1189	1223		1189	Scale
2-24-7-5	7	1508	Frozen		1289	1289	Visual
2-24-7-6	7	1509	1249	1312		1249	Scale
2-24-7-7	7	1510	1292	1314		1292	Scale
2-24-7-8	7	1511	1192	1216		1192	Scale
2-24-7-9	7	1512	Frozen		1147	1147	Visual
2-01-8-1	8	1513	Frozen		1131	1131	Visual
2-01-8-2	8	1514	Frozen		1429	1429	Visual
2-01-8-3	8	1515	Frozen		1322	1322	Visual
2-01-8-4	8	1516	Frozen		1429	1429	Visual
2-01-8-5	8	1517	Frozen		1333	1333	Visual
2-01-8-6	8	1518	Frozen		1536	1536	Visual
2-01-8-7	8	1519	1090	1124	1141	1090	Scale
2-01-8-8	8	1520	770	764	1120	770	Scale
2-01-8-9	8	1521	853	843	1098	853	Scale
2-02-8-1	8	1522	995		1261	995	Scale
2-02-8-2	8	1523	858		810	858	Scale
2-02-8-3	8	1524	1067	1096	1216	1067	Scale
2-02-8-4	8	1525	866		1034	866	Scale
2-02-8-5	8	1526	1058		1039	1058	Scale
2-02-8-6	8	1527	946		1205	946	Scale
2-02-8-7	8	1528	838		1082	838	Scale
2-02-8-8	8	1529	1165		1536	1165	Scale
2-02-8-9	8	1530	1026		1141	1026	Scale
2-03-8-1	8	1531	Frozen		1045	1045	Visual
2-03-8-2	8	1532	Frozen		1072	1072	Visual
2-03-8-3	8	1533	Frozen		1429	1429	Visual
2-03-8-4	8	1534	Frozen		1034	1034	Visual
2-03-8-5	8	1535	Frozen		901	901	Visual
2-03-8-6	8	1536	Frozen		904	904	Visual
2-03-8-7	8	1537	1148	1077	1205	1148	Scale
2-03-8-8	8	1538	1314	1284	1360	1314	Scale
2-03-8-9	8	1539	1100		1370	1100	Scale
2-04-8-1	8	1540	Frozen		1429	1429	Visual
2-04-8-2	8	1541	1381		1386	1381	Scale
2-04-8-3	8	1542	Frozen		1109	1109	Visual
2-04-8-4	8	1543	Frozen		1312	1312	Visual
2-04-8-5	8	1544	Frozen		1008	1008	Visual
2-04-8-6	8	1545	Frozen		1205	1205	Visual
2-04-8-7	8	1546	Frozen		1098	1098	Visual
2-04-8-8	8	1547	Frozen		1322	1322	Visual
2-04-8-9	8	1548	Frozen		984	984	Visual
2-05-8-1	8	1549	Frozen		999	999	Visual
2-05-8-2	8	1550	Frozen		1157	1157	Visual
2-05-8-3	8	1551	Frozen		1083	1083	Visual
2-05-8-4	8	1552	Frozen		1038	1038	Visual
2-05-8-5	8	1553	Frozen		1215	1215	Visual
2-05-8-6	8	1554	Frozen		928	928	Visual
2-05-8-7	8	1555	Frozen		928	928	Visual
2-05-8-8	8	1556	Frozen		923	923	Visual
2-05-8-9	8	1557	Frozen		1109	1109	Visual

2-06-8-1	8	1558	Frozen		1170	1170	Visual
2-06-8-2	8	1559	Frozen		1072	1072	Visual
2-06-8-3	8	1560	Frozen		1180	1180	Visual
2-06-8-4	8	1561	Frozen		1207	1207	Visual
2-06-8-5	8	1562	Frozen		1287	1287	Visual
2-06-8-6	8	1563	Frozen		1188	1188	Visual
2-06-8-7	8	1564	Frozen		1287	1287	Visual
2-06-8-8	8	1565	1382		1264	1382	Scale
2-06-8-9	8	1566	Frozen		989	989	Visual
2-07-8-1	8	1567	Frozen		956	956	Visual
2-07-8-2	8	1568	Frozen		1000	1000	Visual
2-07-8-3	8	1569	1321	1344	1418	1321	Scale
2-07-8-4	8	1570	Frozen		821	821	Visual
2-07-8-5	8	1571	Frozen		1358	1358	Visual
2-07-8-6	8	1572	Frozen		1386	1386	Visual
2-07-8-7	8	1573	1219	1286	1372	1219	Scale
2-07-8-8	8	1574	1254	1349	1384	1254	Scale
2-07-8-9	8	1575	1035		1075	1035	Scale
2-08-8-1	8	1576	Frozen		1281	1281	Visual
2-08-8-2	8	1577	Frozen		1434	1434	Visual
2-08-8-3	8	1578	Frozen		1483	1483	Visual
2-08-8-4	8	1579	Frozen		1081	1081	Visual
2-08-8-5	8	1580	Frozen		1254	1254	Visual
2-08-8-6	8	1581	Frozen		1289	1289	Visual
2-08-8-7	8	1582	Frozen		1173	1173	Visual
2-08-8-8	8	1583	Frozen		1536	1536	Visual
2-08-8-9	8	1584	Frozen		1115	1115	Visual
2-09-8-1	8	1585	Frozen		1330	1330	Visual
2-09-8-2	8	1586	Frozen		1250	1250	Visual
2-09-8-3	8	1587	Frozen		1192	1192	Visual
2-09-8-4	8	1588	1219		1116	1219	Scale
2-09-8-5	8	1589	Frozen		1416	1416	Visual
2-09-8-6	8	1590	Frozen		1383	1383	Visual
2-09-8-7	8	1591	Frozen		1156	1156	Visual
2-09-8-8	8	1592	Frozen		1098	1098	Visual
2-09-8-9	8	1593	Frozen		1123	1123	Visual
2-10-8-1	8	1594	1240	1359	1409	1240	Scale
2-10-8-2	8	1595	1115	1237	1251	1115	Scale
2-10-8-3	8	1596	1115	1268	1274	1115	Scale
2-10-8-4	8	1597	1092	1131	1288	1092	Scale
2-10-8-5	8	1598	Frozen		1216	1216	Visual
2-10-8-6	8	1599	1143	1249	1293	1143	Scale
2-10-8-7	8	1600	Frozen		1317	1317	Visual
2-10-8-8	8	1601	Frozen		1377	1377	Visual
2-10-8-9	8	1602	Frozen		1284	1284	Visual
2-11-8-1	8	1603	Frozen		1381	1381	Visual
2-11-8-2	8	1604	Frozen		1497	1497	Visual
2-11-8-3	8	1605	Frozen		1327	1327	Visual
2-11-8-4	8	1606	Frozen		1376	1376	Visual
2-11-8-5	8	1607	Frozen		1376	1376	Visual
2-11-8-6	8	1608	Frozen		1367	1367	Visual
2-11-8-7	8	1609	Frozen		1345	1345	Visual

2-11-8-8	8	1610	Frozen		1320	1320	Visual
2-11-8-9	8	1611	1086	1171	1216	1086	Scale
2-12-8-1	8	1612	Frozen		1323	1323	Visual
2-12-8-2	8	1613	Frozen		1416	1416	Visual
2-12-8-3	8	1614	Frozen		1418	1418	Visual
2-12-8-4	8	1615	Frozen		1340	1340	Visual
2-12-8-5	8	1616	Frozen		1394	1394	Visual
2-12-8-6	8	1617	Frozen		1447	1447	Visual
2-12-8-7	8	1618	1106	1186	1109	1106	Scale
2-12-8-8	8	1619	Frozen		1315	1315	Visual
2-12-8-9	8	1620	Frozen		1349	1349	Visual
2-13-8-1	8	1621	Frozen		1309	1309	Visual
2-13-8-2	8	1622	Frozen		1193	1193	Visual
2-13-8-3	8	1623	Frozen		1232	1232	Visual
2-13-8-4	8	1624	1159	1271	1189	1159	Scale
2-13-8-5	8	1625	Frozen		1362	1362	Visual
2-13-8-6	8	1626	Frozen		1367	1367	Visual
2-13-8-7	8	1627	Frozen		1357	1357	Visual
2-13-8-8	8	1628	Frozen		1465	1465	Visual
2-13-8-9	8	1629	Frozen		1422	1422	Visual
2-14-8-1	8	1630	Frozen		1202	1202	Visual
2-14-8-2	8	1631	1350	1329	1309	1350	Scale
2-14-8-3	8	1632	Frozen		1199	1199	Visual
2-14-8-4	8	1633	Frozen		1161	1161	Visual
2-14-8-5	8	1634	Frozen		1181	1181	Visual
2-14-8-6	8	1635	Frozen		1411	1411	Visual
2-14-8-7	8	1636	1330	1478	1388	1330	Scale
2-14-8-8	8	1637	Frozen		1153	1153	Visual
2-14-8-9	8	1638	Frozen		1296	1296	Visual
2-15-8-1	8	1639	Frozen		1159	1159	Visual
2-15-8-2	8	1640	Frozen		1477	1477	Visual
2-15-8-3	8	1641	Frozen		1158	1158	Visual
2-15-8-4	8	1642	Frozen		1117	1117	Visual
2-15-8-5	8	1643	Frozen		1102	1102	Visual
2-15-8-6	8	1644	Frozen		1127	1127	Visual
2-15-8-7	8	1645	Frozen		1260	1260	Visual
2-15-8-8	8	1646	1156	1257	1242	1156	Scale
2-15-8-9	8	1647	Frozen		1167	1167	Visual
2-16-8-1	8	1648	Frozen		1191	1191	Visual
2-16-8-2	8	1649	Frozen		1376	1376	Visual
2-16-8-3	8	1650	1202	1176	1189	1202	Scale
2-16-8-4	8	1651	Frozen		1143	1143	Visual
2-16-8-5	8	1652	Frozen		1253	1253	Visual
2-16-8-6	8	1653	Frozen		1367	1367	Visual
2-16-8-7	8	1654	Frozen		1132	1132	Visual
2-16-8-8	8	1655	Frozen		1181	1181	Visual
2-16-8-9	8	1656	Frozen		989	989	Visual
2-17-8-1	8	1657	Frozen		1322	1322	Visual
2-17-8-2	8	1658	Frozen		1408	1408	Visual
2-17-8-3	8	1659	Frozen		1107	1107	Visual
2-17-8-4	8	1660	Frozen		1378	1378	Visual
2-17-8-5	8	1661	Frozen		803	803	Visual

2-17-8-6	8	1662	Frozen		1363	1363	Visual
2-17-8-7	8	1663	1086	1108	1196	1086	Scale
2-17-8-8	8	1664	Frozen		1406	1406	Visual
2-17-8-9	8	1665	1202		1411	1202	Scale
2-18-8-1	8	1666	1076		1221	1076	Scale
2-18-8-2	8	1667	Frozen		1397	1397	Visual
2-18-8-3	8	1668	1140		1208	1140	Scale
2-18-8-4	8	1669	1286	1314	1359	1286	Scale
2-18-8-5	8	1670	Frozen		1058	1058	Visual
2-18-8-6	8	1671	Frozen		1274	1274	Visual
2-18-8-7	8	1672	Frozen		1261	1261	Visual
2-18-8-8	8	1673	Frozen		1044	1044	Visual
2-18-8-9	8	1674	Frozen		1010	1010	Visual
2-19-8-1	8	1675	1130	1259	1370	1130	Scale
2-19-8-2	8	1676	Frozen		1319	1319	Visual
2-19-8-3	8	1677	Frozen		1223	1223	Visual
2-19-8-4	8	1678	Frozen		1131	1131	Visual
2-19-8-5	8	1679	Frozen		1184	1184	Visual
2-19-8-6	8	1680	Frozen		1487	1487	Visual
2-19-8-7	8	1681	Frozen		1004	1004	Visual
2-19-8-8	8	1682	Frozen		994	994	Visual
2-19-8-9	8	1683	Frozen		1221	1221	Visual
2-20-8-1	8	1684	Frozen		1192	1192	Visual
2-20-8-2	8	1685	Frozen	1231	1210	1231	ICEMAN™
2-20-8-3	8	1686	1275	1311	1377	1275	Scale
2-20-8-4	8	1687	1186	1194	1219	1186	Scale
2-20-8-5	8	1688	1071	1177	1073	1071	Scale
2-20-8-6	8	1689	1323	1010	1438	1323	Scale
2-20-8-7	8	1690	1126	1164	1274	1126	Scale
2-20-8-8	8	1691	772	817	817	772	Scale
2-20-8-9	8	1692	972	971	1447	972	Scale
2-21-8-1	8	1693	Frozen		862	862	Visual
2-21-8-2	8	1694	1062	1189	1369	1062	Scale
2-21-8-3	8	1695	1181	1294	1288	1181	Scale
2-21-8-4	8	1696	Frozen		992	992	Visual
2-21-8-5	8	1697	Frozen		1154	1154	Visual
2-21-8-6	8	1698	Frozen		1093	1093	Visual
2-21-8-7	8	1699	Frozen		1207	1207	Visual
2-21-8-8	8	1700	Frozen		1409	1409	Visual
2-21-8-9	8	1701	Frozen		1137	1137	Visual
2-22-8-1	8	1702	Frozen		1448	1448	Visual
2-22-8-2	8	1703	1200	1216	1068	1200	Scale
2-22-8-3	8	1704	1465	1524	1296	1465	Scale
2-22-8-4	8	1705	Frozen		1269	1269	Visual
2-22-8-5	8	1706	Frozen		1483	1483	Visual
2-22-8-6	8	1707	Frozen		1225	1225	Visual
2-22-8-7	8	1708	Frozen	1244	1075	1244	ICEMAN™
2-22-8-8	8	1709	1449	1391	1487	1449	Scale
2-22-8-9	8	1710	Frozen		1216	1216	Visual
2-23-8-1	8	1711	Frozen		1487	1487	Visual
2-23-8-2	8	1712	Frozen		1085	1085	Visual
2-23-8-3	8	1713	Frozen		1225	1225	Visual

2-23-8-4	8	1714	Frozen		1166	1166	Visual
2-23-8-5	8	1715	1495	42	1417	1495	Scale
2-23-8-6	8	1716	1236	1253	1324	1236	Scale
2-23-8-7	8	1717	1284	1273	1317	1284	Scale
2-23-8-8	8	1718	Frozen		1178	1178	Visual
2-23-8-9	8	1719	Frozen		1016	1016	Visual
2-24-8-1	8	1720	894	1267	1116	894	Scale
2-24-8-2	8	1721	1112		1238	1112	Scale
2-24-8-3	8	1722	1116	1169	1254	1116	Scale
2-24-8-4	8	1723	Frozen		1089	1089	Visual
2-24-8-5	8	1724	Frozen		1292	1292	Visual
2-24-8-6	8	1725	Frozen		1135	1135	Visual
2-24-8-7	8	1726	Frozen		1231	1231	Visual
2-24-8-8	8	1727	Frozen		1406	1406	Visual
2-24-8-9	8	1728	Frozen		1250	1250	Visual
2-01-9-1	9	1729	Frozen		1056	1056	Visual
2-01-9-2	9	1730	Frozen		1536	1536	Visual
2-01-9-3	9	1731	Frozen		1536	1536	Visual
2-01-9-4	9	1732	Frozen		1536	1536	Visual
2-01-9-5	9	1733	Frozen		1322	1322	Visual
2-01-9-6	9	1734	Frozen		704	704	Visual
2-01-9-7	9	1735	Frozen		986	986	Visual
2-01-9-8	9	1736	856		1174	856	Scale
2-01-9-9	9	1737	828	1114	688	828	Scale
2-02-9-1	9	1738	Frozen		1037	1037	Visual
2-02-9-2	9	1739	Frozen		1376	1376	Visual
2-02-9-3	9	1740	Frozen		1104	1104	Visual
2-02-9-4	9	1741	Frozen		1333	1333	Visual
2-02-9-5	9	1742	Frozen		840	840	Visual
2-02-9-6	9	1743	Frozen		938	938	Visual
2-02-9-7	9	1744	Frozen		880	880	Visual
2-02-9-8	9	1745	Frozen		1451	1451	Visual
2-02-9-9	9	1746	Frozen		1072	1072	Visual
2-03-9-1	9	1747	Frozen		1139	1139	Visual
2-03-9-2	9	1748	Frozen		1078	1078	Visual
2-03-9-3	9	1749	Frozen		1232	1232	Visual
2-03-9-4	9	1750	Frozen		1370	1370	Visual
2-03-9-5	9	1751	Frozen		1345	1345	Visual
2-03-9-6	9	1752	Frozen		1464	1464	Visual
2-03-9-7	9	1753	Frozen		1376	1376	Visual
2-03-9-8	9	1754	Frozen		1178	1178	Visual
2-03-9-9	9	1755	Frozen		1298	1298	Visual
2-04-9-1	9	1756	Frozen		1370	1370	Visual
2-04-9-2	9	1757	1230		1333	1230	Scale
2-04-9-3	9	1758	Frozen		1226	1226	Visual
2-04-9-4	9	1759	Frozen		1195	1195	Visual
2-04-9-5	9	1760	Frozen		1110	1110	Visual
2-04-9-6	9	1761	Frozen		1216	1216	Visual
2-04-9-7	9	1762	Frozen		1024	1024	Visual
2-04-9-8	9	1763	Frozen		1141	1141	Visual
2-04-9-9	9	1764	Frozen		1154	1154	Visual
2-05-9-1	9	1765	Frozen		1500	1500	Visual

2-05-9-2	9	1766	Frozen		1307	1307	Visual
2-05-9-3	9	1767	Frozen		1367	1367	Visual
2-05-9-4	9	1768	Frozen		1191	1191	Visual
2-05-9-5	9	1769	Frozen		1335	1335	Visual
2-05-9-6	9	1770	Frozen		976	976	Visual
2-05-9-7	9	1771	1166		1358	1166	Scale
2-05-9-8	9	1772	Frozen		1019	1019	Visual
2-05-9-9	9	1773	Frozen		1298	1298	Visual
2-06-9-1	9	1774	Frozen		1131	1131	Visual
2-06-9-2	9	1775	Frozen		1500	1500	Visual
2-06-9-3	9	1776	Frozen		1260	1260	Visual
2-06-9-4	9	1777	Frozen		1507	1507	Visual
2-06-9-5	9	1778	Frozen		1358	1358	Visual
2-06-9-6	9	1779	Frozen		1416	1416	Visual
2-06-9-7	9	1780	Frozen		1504	1504	Visual
2-06-9-8	9	1781	Frozen		1163	1163	Visual
2-06-9-9	9	1782	Frozen		1188	1188	Visual
2-07-9-1	9	1783	Frozen		1234	1234	Visual
2-07-9-2	9	1784	Frozen		1497	1497	Visual
2-07-9-3	9	1785	Frozen		1289	1289	Visual
2-07-9-4	9	1786	Frozen		923	923	Visual
2-07-9-5	9	1787	Frozen		1500	1500	Visual
2-07-9-6	9	1788	Frozen		1341	1341	Visual
2-07-9-7	9	1789	Frozen		1161	1161	Visual
2-07-9-8	9	1790	Frozen		1428	1428	Visual
2-07-9-9	9	1791	Frozen		1114	1114	Visual
2-08-9-1	9	1792	Frozen		1448	1448	Visual
2-08-9-2	9	1793	Frozen		937	937	Visual
2-08-9-3	9	1794	1498		1465	1498	Scale
2-08-9-4	9	1795	Frozen		1329	1329	Visual
2-08-9-5	9	1796	Frozen		1378	1378	Visual
2-08-9-6	9	1797	Frozen		1399	1399	Visual
2-08-9-7	9	1798	Frozen		1536	1536	Visual
2-08-9-8	9	1799	Frozen		1448	1448	Visual
2-08-9-9	9	1800	Frozen		1536	1536	Visual
2-09-9-1	9	1801	Frozen		1447	1447	Visual
2-09-9-2	9	1802	Frozen		1121	1121	Visual
2-09-9-3	9	1803	1286	1360	1287	1286	Scale
2-09-9-4	9	1804	Frozen		1362	1362	Visual
2-09-9-5	9	1805	Frozen		1504	1504	Visual
2-09-9-6	9	1806	Frozen		1259	1259	Visual
2-09-9-7	9	1807	Frozen		1442	1442	Visual
2-09-9-8	9	1808	Frozen		1536	1536	Visual
2-09-9-9	9	1809	Frozen		1333	1333	Visual
2-10-9-1	9	1810	Frozen		1438	1438	Visual
2-10-9-2	9	1811	1079	1354	1269	1079	Scale
2-10-9-3	9	1812	935		1255	935	Scale
2-10-9-4	9	1813	Frozen		1045	1045	Visual
2-10-9-5	9	1814	Frozen		1283	1283	Visual
2-10-9-6	9	1815	Frozen		1435	1435	Visual
2-10-9-7	9	1816	Frozen		1363	1363	Visual
2-10-9-8	9	1817	Frozen		1394	1394	Visual

2-10-9-9	9	1818	Frozen		1358	1358	Visual
2-11-9-1	9	1819	Frozen		1435	1435	Visual
2-11-9-2	9	1820	Frozen		1452	1452	Visual
2-11-9-3	9	1821	Frozen		1426	1426	Visual
2-11-9-4	9	1822	Frozen		1404	1404	Visual
2-11-9-5	9	1823	Frozen		1429	1429	Visual
2-11-9-6	9	1824	Frozen		1435	1435	Visual
2-11-9-7	9	1825	Frozen		1477	1477	Visual
2-11-9-8	9	1826	Frozen		1411	1411	Visual
2-11-9-9	9	1827	Frozen		1394	1394	Visual
2-12-9-1	9	1828	Frozen		1345	1345	Visual
2-12-9-2	9	1829	Frozen		1483	1483	Visual
2-12-9-3	9	1830	Frozen		1411	1411	Visual
2-12-9-4	9	1831	Frozen		1458	1458	Visual
2-12-9-5	9	1832	Frozen		1370	1370	Visual
2-12-9-6	9	1833	Frozen		1233	1233	Visual
2-12-9-7	9	1834	Frozen		1447	1447	Visual
2-12-9-8	9	1835	Frozen		1339	1339	Visual
2-12-9-9	9	1836	Frozen		1536	1536	Visual
2-13-9-1	9	1837	Frozen		1305	1305	Visual
2-13-9-2	9	1838	Frozen		1388	1388	Visual
2-13-9-3	9	1839	Frozen		1320	1320	Visual
2-13-9-4	9	1840	Frozen		1248	1248	Visual
2-13-9-5	9	1841	Frozen		1406	1406	Visual
2-13-9-6	9	1842	1229		1213	1229	Scale
2-13-9-7	9	1843	Frozen		1244	1244	Visual
2-13-9-8	9	1844	Frozen		1447	1447	Visual
2-13-9-9	9	1845	Frozen		1394	1394	Visual
2-14-9-1	9	1846	Frozen		1291	1291	Visual
2-14-9-2	9	1847	Frozen		1536	1536	Visual
2-14-9-3	9	1848	1334		1402	1334	Scale
2-14-9-4	9	1849	Frozen		1500	1500	Visual
2-14-9-5	9	1850	Frozen		1500	1500	Visual
2-14-9-6	9	1851	Frozen		1443	1443	Visual
2-14-9-7	9	1852	Frozen		1424	1424	Visual
2-14-9-8	9	1853	Frozen		1497	1497	Visual
2-14-9-9	9	1854	Frozen		1447	1447	Visual
2-15-9-1	9	1855	Frozen		1411	1411	Visual
2-15-9-2	9	1856	Frozen		1467	1467	Visual
2-15-9-3	9	1857	Frozen		1463	1463	Visual
2-15-9-4	9	1858	Frozen		1291	1291	Visual
2-15-9-5	9	1859	Frozen		1239	1239	Visual
2-15-9-6	9	1860	Frozen		1398	1398	Visual
2-15-9-7	9	1861	1219	1245	1298	1219	Scale
2-15-9-8	9	1862	1330		1435	1330	Scale
2-15-9-9	9	1863	Frozen		1362	1362	Visual
2-16-9-1	9	1864	Frozen		1003	1003	Visual
2-16-9-2	9	1865	Frozen		1041	1041	Visual
2-16-9-3	9	1866	1095		1072	1095	Scale
2-16-9-4	9	1867	Frozen		1417	1417	Visual
2-16-9-5	9	1868	Frozen		1392	1392	Visual
2-16-9-6	9	1869	Frozen		1497	1497	Visual

2-16-9-7	9	1870	Frozen		1276	1276	Visual
2-16-9-8	9	1871	Frozen		1387	1387	Visual
2-16-9-9	9	1872	Frozen		1394	1394	Visual
2-17-9-1	9	1873	Frozen		1239	1239	Visual
2-17-9-2	9	1874	Frozen		1455	1455	Visual
2-17-9-3	9	1875	Frozen		1414	1414	Visual
2-17-9-4	9	1876	Frozen		1086	1086	Visual
2-17-9-5	9	1877	Frozen		1339	1339	Visual
2-17-9-6	9	1878	Frozen		1304	1304	Visual
2-17-9-7	9	1879	Frozen		1497	1497	Visual
2-17-9-8	9	1880	Frozen		1117	1117	Visual
2-17-9-9	9	1881	Frozen		1035	1035	Visual
2-18-9-1	9	1882	Frozen		1058	1058	Visual
2-18-9-2	9	1883	Frozen	1161	1319	1161	ICEMAN™
2-18-9-3	9	1884	1100		1345	1100	Scale
2-18-9-4	9	1885	Frozen		1053	1053	Visual
2-18-9-5	9	1886	Frozen		1434	1434	Visual
2-18-9-6	9	1887	Frozen		1260	1260	Visual
2-18-9-7	9	1888	Frozen		1388	1388	Visual
2-18-9-8	9	1889	Frozen		1368	1368	Visual
2-18-9-9	9	1890	Frozen		1483	1483	Visual
2-19-9-1	9	1891	Frozen		1429	1429	Visual
2-19-9-2	9	1892	Frozen		1356	1356	Visual
2-19-9-3	9	1893	Frozen		1294	1294	Visual
2-19-9-4	9	1894	Frozen		1120	1120	Visual
2-19-9-5	9	1895	Frozen		1507	1507	Visual
2-19-9-6	9	1896	Frozen		1075	1075	Visual
2-19-9-7	9	1897	Frozen		1098	1098	Visual
2-19-9-8	9	1898	Frozen		1116	1116	Visual
2-19-9-9	9	1899	Frozen		1497	1497	Visual
2-20-9-1	9	1900	Frozen	1301	1497	1301	ICEMAN™
2-20-9-2	9	1901	Frozen		1399	1399	Visual
2-20-9-3	9	1902	1175		1340	1175	Scale
2-20-9-4	9	1903	1080		1536	1080	Scale
2-20-9-5	9	1904	Frozen		1102	1102	Visual
2-20-9-6	9	1905	902	934	1279	902	Scale
2-20-9-7	9	1906	1040	1214	1047	1040	Scale
2-20-9-8	9	1907	Frozen		1365	1365	Visual
2-20-9-9	9	1908	Frozen		1204	1204	Visual
2-21-9-1	9	1909	Frozen		1243	1243	Visual
2-21-9-2	9	1910	Frozen		1429	1429	Visual
2-21-9-3	9	1911	791		1088	791	Scale
2-21-9-4	9	1912	Frozen		1129	1129	Visual
2-21-9-5	9	1913	Frozen		1424	1424	Visual
2-21-9-6	9	1914	Frozen		1448	1448	Visual
2-21-9-7	9	1915	1230	1361	1448	1230	Scale
2-21-9-8	9	1916	Frozen		1401	1401	Visual
2-21-9-9	9	1917	Frozen		1013	1013	Visual
2-22-9-1	9	1918	Frozen		1203	1203	Visual
2-22-9-2	9	1919	Frozen		1380	1380	Visual
2-22-9-3	9	1920	1242		1536	1242	Scale
2-22-9-4	9	1921	Frozen		1309	1309	Visual

2-22-9-5	9	1922	Frozen		1451	1451	Visual
2-22-9-6	9	1923	Frozen		1314	1314	Visual
2-22-9-7	9	1924	Frozen		1195	1195	Visual
2-22-9-8	9	1925	Frozen		1340	1340	Visual
2-22-9-9	9	1926	Frozen		1307	1307	Visual
2-23-9-1	9	1927	Frozen		1256	1256	Visual
2-23-9-2	9	1928	Frozen		1361	1361	Visual
2-23-9-3	9	1929	Frozen		1299	1299	Visual
2-23-9-4	9	1930	Frozen		1390	1390	Visual
2-23-9-5	9	1931	Frozen		1358	1358	Visual
2-23-9-6	9	1932	Frozen		1297	1297	Visual
2-23-9-7	9	1933	Frozen		1183	1183	Visual
2-23-9-8	9	1934	Frozen		1159	1159	Visual
2-23-9-9	9	1935	Frozen		1318	1318	Visual
2-24-9-1	9	1936	694	727	1035	694	Scale
2-24-9-2	9	1937	1240		1307	1240	Scale
2-24-9-3	9	1938	1018	1026	1065	1018	Scale
2-24-9-4	9	1939	Frozen		1349	1349	Visual
2-24-9-5	9	1940	Frozen		1390	1390	Visual
2-24-9-6	9	1941	Frozen		1287	1287	Visual
2-24-9-7	9	1942	Frozen		1458	1458	Visual
2-24-9-8	9	1943	Frozen		1177	1177	Visual
2-24-9-9	9	1944	Frozen		1363	1363	Visual
		Mean (lb)	1274.1	1310.3	1266.6	1278.4	
		Standard Deviation (lb)	146.0	145.2	157.5	154.1	
		Number of Data Points	1230	1175	737	1944	
		Total (lb)				2,485,268	

Table A-2. Ice Mass Sample Group

(from parent population in Table A-1)

Basket Number	Row	Column	Bay	Radial Zone	Sample Group	Mass (lb)	Method
124	1	7	14	C	1	1350	Visual
158	1	5	18	C	2	1325	Visual
127	1	1	15	C	3	1532	Scale
26	1	8	03	C	4	1050	Visual
92	1	2	11	C	5	1322	Visual
178	1	7	20	C	6	1538	ICEMAN™
86	1	5	10	C	7	1678	ICEMAN™
163	1	1	19	C	8	1101	Visual
105	1	6	12	C	9	1356	Scale
171	1	9	19	C	10	1278	Visual
195	1	6	22	C	11	1500	Visual
73	1	1	09	C	12	1365	Visual
29	1	2	04	C	13	1884	Scale
14	1	5	02	C	14	1145	Visual
22	1	4	03	C	15	1300	Visual
149	1	5	17	C	16	1400	Visual
265	2	4	06	C	1	1500	Visual
334	2	1	14	C	2	1468	ICEMAN™
337	2	4	14	C	3	1433	ICEMAN™
425	2	2	24	C	4	1198	Scale
386	2	8	19	C	5	1412	Visual
264	2	3	06	C	6	1643	ICEMAN™
221	2	5	01	C	7	1374	Scale
322	2	7	12	C	8	1485	Scale
364	2	4	17	C	9	1283	Visual
226	2	1	02	C	10	1100	Visual
391	2	4	20	C	11	1383	Scale
379	2	1	19	C	12	1199	Visual
310	2	4	11	C	13	1356	Visual
292	2	4	09	C	14	1245	Visual
332	2	8	13	C	15	1436	Scale
287	2	8	08	C	16	1347	Scale
478	3	1	06	C	1	1516	ICEMAN™
492	3	6	07	C	2	1478	Scale
628	3	7	22	C	3	1413	Scale
487	3	1	07	C	4	1450	Scale
463	3	4	04	C	5	1426	Scale
456	3	6	03	C	6	1506	Scale
605	3	2	20	C	7	1421	Scale
450	3	9	02	C	8	1329	Scale
638	3	8	23	C	9	1458	Scale
542	3	2	13	C	10	1334	Scale
620	3	8	21	C	11	1367	Scale
501	3	6	08	C	12	1392	Scale
625	3	4	22	C	13	1503	Scale
464	3	5	04	C	14	1415	Scale

519	3	6	10	C	15	1438	Scale
534	3	3	12	C	16	1425	Scale
811	4	1	19	B	1	1411	Scale
777	4	3	15	B	2	1218	Scale
823	4	4	20	B	3	1243	Scale
756	4	9	12	B	4	1298	Scale
842	4	5	22	B	5	1345	Scale
688	4	4	05	B	6	1264	Scale
725	4	5	09	B	7	1255	Scale
651	4	3	01	B	8	1306	Scale
702	4	9	06	B	9	1291	Scale
746	4	8	11	B	10	1397	Scale
714	4	3	08	B	11	1207	Scale
788	4	5	16	B	12	1247	Scale
805	4	4	18	B	13	1211	Scale
650	4	2	01	B	14	1320	Scale
778	4	4	15	B	15	1202	Scale
706	4	4	07	B	16	1344	Scale
883	5	1	03	B	1	1366	Scale
867	5	3	01	B	2	1248	Scale
935	5	8	08	B	3	1195	Scale
994	5	4	15	B	4	1265	Scale
936	5	9	08	B	5	1326	Scale
975	5	3	13	B	6	1329	Scale
990	5	9	14	B	7	1233	Visual
934	5	7	08	B	8	1170	Scale
917	5	8	06	B	9	1233	Scale
1022	5	5	18	B	10	1244	Scale
952	5	7	10	B	11	1305	Scale
887	5	5	03	B	12	1314	Scale
987	5	6	14	B	13	1246	Scale
898	5	7	04	B	14	1190	Scale
939	5	3	09	B	15	1185	Scale
1059	5	6	22	B	16	1207	Scale
1183	6	4	12	B	1	1258	Scale
1244	6	2	19	B	2	1230	Scale
1146	6	3	08	B	3	1159	Scale
1181	6	2	12	B	4	1225	Scale
1267	6	7	21	B	5	1110	Scale
1258	6	7	20	B	6	1192	Scale
1136	6	2	07	B	7	1183	Scale
1167	6	6	10	B	8	1363	Scale
1132	6	7	06	B	9	1338	Scale
1173	6	3	11	B	10	1212	Scale
1121	6	5	05	B	11	1218	Scale
1267	6	7	21	B	12	1110	Scale
1256	6	5	20	B	13	1149	Scale
1175	6	5	11	B	14	1288	Scale
1163	6	2	10	B	15	1198	Scale

1273	6	4	22	B	16	1342	Scale
1490	7	5	22	A	1	1383	Visual
1510	7	7	24	A	2	1292	Scale
1342	7	1	06	A	3	1277	Visual
1487	7	2	22	A	4	1216	Scale
1397	7	2	12	A	5	1267	Visual
1378	7	1	10	A	6	1267	Visual
1498	7	4	23	A	,7	1284	Scale
1436	7	5	16	A	8	1172	Visual
1368	7	9	08	A	9	1278	Visual
1301	7	5	01	A	10	1311	Scale
1371	7	3	09	A	11	1193	Scale
1506	7	3	24	A	12	1130	Scale
1323	7	9	03	A	13	1130	Scale
1466	7	8	19	A	14	1209	Visual
1421	7	8	14	A	15	1739	ICEMAN™
1367	7	8	08	A	16	1445	Visual
1604	8	2	11	A	1	1497	Visual
1625	8	5	13	A	2	1362	Visual
1709	8	8	22	A	3	1449	Scale
1664	8	8	17	A	4	1406	Visual
1536	8	6	03	A	5	904	Visual
1571	8	5	07	A	6	1358	Visual
1528	8	7	02	A	7	838	Scale
1660	8	4	17	A	8	1378	Visual
1520	8	8	01	A	9	770	Scale
1636	8	7	14	A	10	1330	Scale
1650	8	3	16	A	11	1202	Scale
1514	8	2	01	A	12	1429	Visual
1634	8	5	14	A	13	1181	Visual
1519	8	7	01	A	14	1090	Scale
1606	8	4	11	A	15	1376	Visual
1594	8	1	10	A	16	1240	Scale
1803	9	3	09	A	1	1286	Scale
1909	9	1	21	A	2	1243	Visual
1767	9	3	05	A	3	1367	Visual
1743	9	6	02	A	4	938	Visual
1802	9	2	09	A	5	1121	Visual
1731	9	3	01	A	6	1536	Visual
1934	9	8	23	A	7	1159	Visual
1886	9	5	18	A	8	1434	Visual
1939	9	4	24	A	9	1349	Visual
1932	9	6	23	A	10	1297	Visual
1846	9	1	14	A	11	1291	Visual
1757	9	2	04	A	12	1230	Scale
1875	9	3	17	A	13	1414	Visual
1905	9	6	20	A	14	902	Scale
1799	9	8	08	A	15	1448	Visual
1775	9	2	06	A	16	1500	Visual

Table A-3. Example Calculations

(for Table A-2 sample group)

No Stratified Sampling									
Sample Size	Sample Group(s)	Mean, X (lb)	Standard Deviation, s (lb)	No. of Data Points from Scale	No. of Data Points from ICEMAN™	No. of Data Points from VISUAL	Total Error of the mean (lb)	95% Conf. Mean (lb)	Total Ice Bed Mass is at least (lb)
36	1-4	1321	133	21	3	12	61.4	1259	2,447,985
72	1-8	1314	156	40	6	26	46.5	1267	2,463,030
90	1-10	1305	154	52	6	32	41.0	1264	2,456,726
108	1-12	1301	147	65	6	37	36.2	1265	2,458,818
144	1-16	1305	155	88	7	49	31.8	1273	2,475,670

Stratified Sampling: Three Sequential Rows in each Radial Zone										
Sample size	Sample Group(s)	Radial Zone	Mean, X (lb)	Standard Deviation, s (lb)	No. of Data Points from Scale	No. of Data Points from ICEMAN™	No. of Data Points from VISUAL	Total Error of the mean (lb)	95% Conf. Mean (lb)	Total Ice Bed Mass is at least (lb)
36 Total										2,372,078
12	1-4	C	1393	143.4	5	3	4	117.0	1276	
12	1-4	B	1260	70.2	12	0	0	37.1	1223	
12	1-4	A	1310	144.0	4	0	8	147.3	1162	
72 total										2,410,530
24	1-8	C	1415	147.2	11	6	7	76.8	1338	
24	1-8	B	1258	73.8	23	0	1	33.8	1224	
24	1-8	A	1268	178.0	6	0	18	110.0	1158	
90 total										2,409,810
30	1-10	C	1392	147.3	14	6	10	70.6	1321	
30	1-10	B	1264	72.9	29	0	1	28.5	1235	
30	1-10	A	1259	184.5	9	0	21	96.4	1162	
108 total										2,417,634
36	1-12	C	1388	139.3	17	6	13	64.2	1324	
36	1-12	B	1259	73.0	35	0	1	25.1	1233	
36	1-12	A	1257	172.6	13	0	23	83.0	1174	
144 total										2,439,746
48	1-16	C	1269	185.4	24	6	18	63.0	1206	
48	1-16	B	1254	71.2	47	0	1	20.3	1234	
48	1-16	A	1393	148.3	17	1	30	67.6	1325	

Original WOG Standard Technical Specification - *Ice Bed*

FOR INFORMATION ONLY

3.6 CONTAINMENT SYSTEMS

3.6.15 Ice Bed (Ice Condenser)

LCO 3.6.15 The ice bed shall be OPERABLE.

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Ice bed inoperable.	A.1 Restore ice bed to OPERABLE status.	48 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3. AND B.2 Be in MODE 5.	6 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.6.15.1 Verify maximum ice bed temperature is ≤ [27]°F.	12 hours
	(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.15.2	Verify total weight of stored ice is ≥ [2,721,600] lb by: a. Weighing a representative sample of ≥ 144 ice baskets and verifying each basket contains ≥ [1400] lb of ice; and b. Calculating total weight of stored ice, at a 95% confidence level, using all ice basket weights determined in SR 3.6.15.2.a.	9 months
SR 3.6.15.3	Verify azimuthal distribution of ice at a 95% confidence level by subdividing weights, as determined by SR 3.6.15.2.a, into the following groups: a. Group 1 — bays 1 through 8; b. Group 2 — bays 9 through 16; and c. Group 3 — bays 17 through 24. The average ice weight of the sample baskets in each group from radial rows 1, 2, 4, 6, 8, and 9 shall be ≥ [1400] lb.	9 months
SR 3.6.15.4	Verify, by visual inspection, accumulation of ice or frost-on Structural members comprising flow channels through the ice condenser is ≤ [0.38] inch thick.	9 months
		(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.15.5	Verify by chemical analyses of at least nine representative samples of stored ice: a. boron concentration is ≥ [1800] ppm; and b. pH is ≥ [9.0] and ≤ [9.5].	[18] months
SR 3.6.15.6	Visually inspect, for detrimental structural wear, cracks, corrosion, or other damage, two ice baskets from each azimuthal group of bays. See SR 3.6.15.3.	40 months

B 3.6 CONTAINMENT SYSTEMS

B 3.6.15 Ice Bed (Ice Condenser)

BASES

BACKGROUND

The ice bed consists of over 2,721,600 lb of ice stored in baskets within the ice condenser. Its primary purpose is to provide a large heat sink in the event of a release of energy from a Design Basis Accident (DBA) in containment. The ice would absorb energy and limit containment peak pressure and temperature during the accident transient. Limiting the pressure and temperature reduces the release of fission product radioactivity from containment to the environment in the event of a DBA.

The ice condenser is an annular compartment enclosing approximately 300° of the perimeter of the upper containment compartment, but penetrating the operating deck so that a portion extends into the lower containment compartment. The lower portion has a series of hinged doors exposed to the atmosphere of the lower containment compartment, which, for normal unit operation, are designed to remain closed. At the top of the ice condenser is another set of doors exposed to the atmosphere of the upper compartment, which also remain closed during normal unit operation. Intermediate deck doors, located below the top deck doors, form the floor of a plenum at the upper part of the ice condenser. These doors also remain closed during normal unit operation. The upper plenum area is used to facilitate surveillance and maintenance of the ice bed.

The ice baskets held in the ice bed within the ice condenser are arranged to promote heat transfer from steam to ice. This arrangement enhances the ice condenser's primary function of condensing steam and absorbing heat energy released to the containment during a DBA.

In the event of a DBA, the ice condenser inlet doors (located below the operating deck) open due to the pressure rise in the lower compartment. This allows air and steam to flow from the lower compartment into the ice condenser. The resulting pressure increase within the ice condenser causes the intermediate deck doors and the top deck doors to open, which allows the air to flow out of the ice condenser into the upper compartment. Steam condensation within the ice condenser limits the pressure and temperature buildup in containment. A divider barrier separates the upper and lower compartments and ensures that the steam is directed into the ice condenser.

The ice, together with the containment spray, is adequate to absorb the initial blowdown of steam and water from a DBA and the additional heat loads that would enter containment during several hours following the initial blowdown. The additional heat loads would come from the residual heat in the reactor core, the hot piping and components, and the secondary system, including the steam generators. During the post blowdown period, the Air Return System (ARS) returns upper compartment air through the divider barrier to the lower compartment. This serves to equalize pressures in containment and to continue circulating heated air and steam from the lower compartment through the ice condenser where the heat is removed by the remaining ice.

As ice melts, the water passes through the ice condenser floor drains into the lower compartment. Thus, a second function of the ice bed is to be a large source of borated water (via the containment sump) for long term Emergency Core Cooling System (ECCS) and Containment Spray System heat removal functions in the recirculation mode.

A third function of the ice bed and melted ice is to remove fission product iodine that may be released from the core during a DBA. Iodine removal occurs during the ice melt phase of the accident and continues as the melted ice is sprayed into the containment atmosphere by the Containment Spray System. The ice is adjusted to an alkaline pH that facilitates removal of radioactive iodine from the containment atmosphere. The alkaline pH also minimizes the occurrence of the chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation.

It is important for the ice to be uniformly distributed around the 24 ice condenser bays and for open flow paths to exist around ice baskets. This is especially important during the initial blowdown so that the steam and water mixture entering the lower compartment do not pass through only part of the ice condenser, depleting the ice there while bypassing the ice in other bays.

Two phenomena that can degrade the ice bed during the long service period are:

a. Loss of ice by melting or sublimation; and

b. Obstruction of flow passages through the ice bed due to buildup of frost or ice. Both of these degrading phenomena are reduced by minimizing air leakage into and out of the ice condenser.

The ice bed limits the temperature and pressure that could be expected following a DBA, thus limiting leakage of fission product radioactivity from containment to the environment.

APPLICABLE SAFETY ANALYSES

The limiting DBAs considered relative to containment temperature and pressure are the loss of coolant accident (LOCA) and the steam line break (SLB). The LOCA and SLB are analyzed using computer codes designed to predict the resultant containment pressure and temperature transients. DBAs are not assumed to occur simultaneously or consecutively.

Although the ice condenser is a passive system that requires no electrical power to perform its function, the Containment Spray System and the ARS also function to assist the ice bed in limiting pressures and temperatures. Therefore, the postulated DBAs are analyzed in regards to containment Engineered Safety Feature (ESF) systems, assuming the loss of one ESF bus, which is the worst case single active failure and results in one train each of the Containment Spray System and ARS being inoperable.

The limiting DBA analyses (Ref. 1) show that the maximum peak containment pressure results from the LOCA analysis and is calculated to be less than the containment design pressure. For certain aspects of the transient accident analyses, maximizing the calculated containment pressure is not conservative. In particular, the cooling effectiveness of the ECCS during the core reflood phase of a LOCA analysis increases with increasing containment backpressure. For these calculations, the containment backpressure is calculated in a manner designed to conservatively minimize, rather than maximize, the calculated transient containment pressures, in accordance with 10 CFR 50, Appendix K (Ref. 2). The maximum peak containment atmosphere temperature results from the SLB analysis and is discussed in the Bases for LCO 3.6.5, "Containment Air Temperature."

In addition to calculating the overall peak containment pressures, the DBA analyses include calculation of the transient differential pressures that occur across subcompartment walls during the initial blowdown phase of the accident transient. The internal containment walls and structures are designed to withstand these local transient pressure differentials for the limiting DBAs.

The ice bed satisfies Criterion 3 of the NRC Policy Statement.

LCO

The ice bed LCO requires the existence of the required quantity of stored ice, appropriate distribution of the ice and the ice bed, open flow paths through the ice bed, and appropriate chemical content and pH of the stored ice. The stored ice functions to absorb heat during a DBA, thereby limiting containment air temperature and pressure. The chemical content and pH of the ice provide core SDM (boron content) and remove radioactive iodine from the containment atmosphere when the melted ice is recirculated through the ECCS and the Containment Spray System, respectively.

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause an increase in containment pressure and temperature requiring the operation of the ice bed. Therefore, the LCO is applicable in MODES 1, 2, 3, and 4.

In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES. Therefore, the ice bed is not required to be OPERABLE in these MODES.

ACTIONS

A.1

If the ice bed is inoperable, it must be restored to OPERABLE status within 48 hours. The Completion Time was developed based on operating experience, which confirms that due to the very large mass of stored ice, the parameters comprising OPERABILITY do not change appreciably in this time period. Because of this fact, the Surveillance Frequencies are long (months), except for the ice bed temperature, which is checked every 12 hours. If a degraded condition is identified, even for temperature, with such a large mass of ice it is not possible for the degraded condition to significantly degrade further in a 48 hour period. Therefore, 48 hours is a reasonable amount of time to correct a degraded condition before initiating a shutdown.

B.1 and B.2

If the ice bed cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.6.15.1

Verifying that the maximum temperature of the ice bed is ≤ [27]°F ensures that the ice is kept well below the melting point. The 12 hour Frequency was based on operating experience, which confirmed that, due to the large mass of stored ice, it is not possible for the ice bed temperature to degrade significantly within a 12 hour period and was also based on assessing the proximity of the LCO limit to the melting temperature.

Furthermore, the 12 hour Frequency is considered adequate in view of indications in the control room, including the alarm, to alert the operator to an abnormal ice bed temperature condition. This SR may be satisfied by use of the Ice Bed Temperature Monitoring System.

SURVEILLANCE REQUIREMENTS

SR 3.6.15.2

The weighing program is designed to obtain a representative sample of the ice baskets. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall consist of one basket from radial rows 1, 2, 4, 6, 8, and 9. If no basket from a designated row can be obtained for weighing, a basket from the same row of an adjacent bay shall be weighed.

The rows chosen include the rows nearest the inside and outside walls of the ice condenser (rows 1 and 2, and 8 and 9, respectively), where heat transfer into the ice condenser is most likely to influence melting or sublimation. Verifying the total weight of ice ensures that there is adequate ice to absorb the required amount of energy to mitigate the DBAs.

If a basket is found to contain < [1400] lb of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The average weight of ice in these 21 baskets (the discrepant basket and the 20 additional baskets) shall be ≥ [1400] lb at a 95% confidence level.

Weighing 20 additional baskets from the same bay in the event a Surveillance reveals that a single basket contains < [1400] lb ensures that no local zone exists that is grossly deficient in ice. Such a zone could experience early melt out during a DBA transient, creating a path for steam to pass through the ice bed without being condensed. The Frequency of 9 months was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. Operating experience has verified that, with the 9 month Frequency, the weight requirements are maintained with no significant degradation between surveillances.

SURVEILLANCE REQUIREMENTS

SR 3.6.15.3

This SR ensures that the azimuthal distribution of ice is reasonably uniform, by verifying that the average ice weight in each of three azimuthal groups of ice condenser bays is within the limit. The Frequency of 9 months was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. Operating experience has verified that, with the 9 month Frequency, the weight requirements are maintained with no significant degradation between surveillances.

SR 3.6.15.4

This SR ensures that the flow channels through the ice condenser have not accumulated an excessive amount of ice or frost blockage. The visual inspection must be made for two or more flow channels per ice condenser bay and must include the following specific locations along the flow channel:

a. Past the lower inlet plenum support structures and turning vanes;

b. Between ice baskets;

c. Past lattice frames;

d. Through the intermediate floor grating; and

e. Through the top deck floor grating.

The allowable [0.38] inch thick buildup of frost or ice is based on the analysis of containment response to a DBA with partial blockage of the ice condenser flow passages. If a flow channel in a given bay is found to have an accumulation of frost or ice > [0.38] inch thick, a representative sample of 20 additional flow channels from the same bay must be visually inspected.

If these additional flow channels are all found to be acceptable, the discrepant flow channel may be considered single, unique, and acceptable deficiency. More than one discrepant flow channel in a bay is not acceptable, however. These requirements are based on the sensitivity of the partial blockage analysis to additional blockage. The Frequency of 9 months was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses.

SR 3.6.15.5

Verifying the chemical composition of the stored ice ensures that the stored ice has a boron concentration of at least [1800] ppm as sodium tetraborate and a high pH, ≥ [9.0] and ≤ [9.5], in order to meet the requirement for borated water when the melted ice is used in the ECCS recirculation mode of operation. Sodium tetraborate has been proven effective in maintaining the boron content for long storage periods, and it also enhances the ability of the solution to remove and retain fission product iodine. The high pH is required to enhance the effectiveness of the ice and the melted ice in removing iodine from the containment atmosphere. This pH range also minimizes the occurrence of chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation. The Frequency of [18] months was developed considering these facts

a. Long ice storage tests have determined that the chemical composition of the stored ice is extremely stable.

b. Operating experience has demonstrated that meeting the boron concentration and pH requirements has never been a problem; and

c. Someone would have to enter the containment to take the sample, and if the unit is at power, that person would receive a radiation dose.

SR 3.6.15.6

This SR ensures that a representative sampling of ice baskets, which are relatively thin walled, perforated cylinders, have not been degraded by wear, cracks, corrosion, or other damage. Each ice basket must be raised at least 12 feet for this inspection. The Frequency of 40 months for a visual inspection of the structural soundness of the ice baskets is based on engineering judgment and considers such factors as the thickness of the basket walls relative to corrosion rates expected in their service environment and the results of the long term ice storage testing.

REFERENCES

1. FSAR, Section [6.2].

2. 10 CFR 50, Appendix K.

Topical Report ICUG-001

List of Changes to the July 2001 Version (rev. 0) to Produce the May 2003 Version (rev. 2)

The following changes have been incorporated into the republication of topical report ICUG-001 that is dated May 2003 (revision 2). The July 2001 version (revision 0), which was the original publication, is the official previous version. Revision 1 to topical report ICUG-001 was not formally issued; all changes in that revision have been incorporated in Revision 2.

1. Cover page updated to specify "Revision 2" and "May 2003".

2. Page ii, **Table of Contents**: Added several headings in Chapters 1 and 2 to reflect changes made per reference 27.

3. Page iii, **List of Figures and Tables**: Revised term "sample population" to "sample group" (three places) per reference 19.

4. Page iii, **List of Figures and Tables**: Revised titles of several tables and figures to reflect changes made per reference 27.

5. Page v, **Nomenclature**: Revised term "sample populations" to "sample groups" (three places). Revised definition of "Sampling without replacement" to reflect similar clarification, per reference 19.

6. Page O-1, **Active Ice Mass Management**: Added following sentence at beginning of second paragraph: "Existing AIMM practices manage each ice basket in the ice bed above the required mean mass supporting the safety analysis." Change per reference 22.

7. Page O-2, **Industry Challenges**: Revised term "sample population" to "sample group" per reference 19.

8. Page O-3, **Industry Challenges**: Revised last two paragraphs to read: "A further disparity in the historical methodology required *each* statistically sampled basket to contain the specified amount of ice, while the Bases allowed for individual baskets to be "light" (i.e., less than the technical specification required minimum mass) if baskets in the local area were sufficiently full. This contradiction also led to differing industry interpretations, even though the original intent was, as described by the technical specification bases, to prevent localized gross degradation of the ice bed. The technical specification methodology presented here treats this contradiction by recognizing that the two primary concerns of the ice mass design basis—and therefore the two required surveillances—are the presence of sufficient total ice mass in the bed distributed appropriately to accommodate the overall DBA response, and a sufficient minimum mass in any individual basket maintained to prevent localized areas of degradation that might challenge the DBA containment pressure response.

   "The requirement for the overall DBA response is met by determining total ice mass in the bed based on a sampled group. In this manner, the word "each" is eliminated from the operability requirement, and individual baskets can sublimate during an operating cycle to whatever level their relative position in the ice bed dictates. Conversely, the minimum individual basket mass requirement stipulates a minimum mass of ice for *each* of the statistically sampled baskets so that a minimum amount of ice in the basket is verified to be present. The use of *each* in this instance is appropriate, since the containment analysis is primarily concerned with localized degradation (i.e., a cluster of baskets with degraded mass) and the sampled group is a valid representation of the entire Radial Zone under surveillance. As noted previously, AIMM practice will manage each basket above the required safety analysis mean, such that no individual basket would be expected to sublimate below this mean value. If a basket sublimates below the safety analysis mean value this instance is identified within the plant's corrective action program, including evaluating AIMM practices to identify the cause and to correct any deficiencies. If a basket sublimates below the minimum individual basket mass requirement, then this condition is TS prohibited, necessitating reporting per the requirements of 10CFR50.73 in addition to corrective action program determination of cause and appropriate corrective actions. Certain individual baskets in the corners of the ice bed would typically pose the greatest challenge to maintaining their stored ice mass above the safety analysis mean, due to the relatively high sublimation rates in these areas. However, AIMM practice would generally identify these baskets for servicing every outage, thereby enabling the ice mass in these baskets to be maintained above the safety analysis mean, which would prevent any challenge to the surveillance requirements." Changes per references 22 and 27. Also revised term "sample population" to "sample group" (two places) per reference 19.

9. Page O-3, **Summary of Significant Aspects**: Clarified that industry commitments to manage the ice mass in each basket above the required technical specification mean, a statistically random sample in each Radial Zone, and a defined minimum individual ice mass per basket combine to become the basis for verification of appropriate ice distribution in lieu of a limited azimuthal row-group surveillance, and deleted reference to minimum blowdown ice mass per reference 22.

10. Page O-4, **Figure O-1**: Revised term in flow diagram "Blowdown Limit" to "Minimum Individual Basket Limit" per reference 22.

11. Page O-5, **Table O-1**: Revised fourth bullet to: "A surveillance for minimum total ice mass in the bed assures the initial conditions of the DBA analyses". Deleted fifth bullet. Revised sixth bullet to: "A surveillance for minimum ice mass in each individual basket prevents localized degradation to avoid any challenge to the DBA containment pressure response". Revised eighth bullet to: "Proper azimuthal distribution of ice in the ice bed is no longer assessed by a separate surveillance requirement; it is implemented through established industry-wide maintenance practices that manage each ice basket above the required safety analysis mean and confirmed through as-found random sampling techniques". Revised ninth bullet to: "All ice baskets in the parent population are subject to random statistical sampling, as opposed to only two-thirds of the population subject to representative sampling." Changes per references 22 and 27.

12. Pages I-1, I-2, **Design Basis**: Revised second paragraph to clarify the description of the original short-term containment pressurization analysis (TMD). Revised third paragraph to clarify the description of the long-term containment pressurization analyses (LOTIC/GOTHIC), and the link to localized degraded regions of ice mass in the bed. Changes per reference 27.

13. Page I-2, **Design Basis**: Revised parenthetical item 2 at end of paragraph to: "enough ice mass is sufficiently distributed such that localized regions of mass degradation do not exist in the ice bed", per reference 27.

14. Page I-2, **Design Basis**: Revised fourth paragraph to clarify the use of mass determination uncertainty. Changes per reference 27.

15. Page I-2, **Original Ice Mass Technical Specification Requirements**: revised "sample population" to "sample group" (two places), per reference 19.

16. Page I-3, **Original Ice Mass Technical Specification Requirements**: Revised paragraph under Figure 1-1 to read: "In addition, these masses were used as the verification that a degraded localized region did not exist in the ice bed that would challenge the DBA pressure response. If a basket in the 144-basket statistical sample was found to weigh less than the required individual limit (described as "light"), the sample was to be increased in the localized region (i.e., the affected Bay) by 20 baskets. The averaged mass of the 20 additional baskets and the "light" basket was then required to meet the surveillance limit". Deleted reference to the long-term phase of the DBA in the last sentence on the page. Changes per references 22 and 27.

17. Page I-4, **Historical Data**: Clarifications for consistency with other sections. Changes per reference 27.

18. Page I-4, **Historical Data Analysis**: Revised term "sample population" to "sample group", per reference 19. Minor editorial revisions.

19. Page I-5, **Historical Data Analysis**: Revised last paragraph to clarify AIMM basis, per reference 27.

20. Page I-5, **AIMM Methodology**: Added new section, per reference 27.

21. Page I-6, **Determination of Basket Mass in AIMM Practice**: Added new section, per reference 27.

22. Page I-6, **The Radial Zone Concept**: Revised title of section for clarification, per reference 27.

23. Page I-7, **The Radial Zone Concept**: Clarification revisions for AIMM description, per reference 27.

24. Page I-8, **Regions of Localized Degraded Mass**: Added new section, per reference 27.

25. Page I-9, **Conclusions**: Editorial revisions made to clarify design basis requirements basis description. Changes per reference 27.

26. Page I-10, **Conclusions**: Revised first paragraph on page to read, "The minimum individual basket mass surveillance requirement is based on the minimum amount of ice needed in each basket to avoid localized regions of degradation in the ice bed that might challenge the DBA pressure response. This limit is derived from sensitivity runs performed using the three-dimensional GOTHIC analytical code. Concurrent assurance that localized regions of gross degradation do not exist in the ice bed is given via Active Ice Mass Management (AIMM) methodology, which is based on current industry maintenance practice and asserts that the ice mass in each basket in the ice bed will be managed above the required safety analysis mean, and serviced prior to reaching this limit. Therefore, the methodology for the requirement of minimum individual basket mass has two elements: 1) active maintenance practice (AIMM)

that manages each basket to the required safety analysis mean, and 2) a defined surveillance minimum limit of 600 lb per basket." Changes made per reference 27.

27. Page II-1, **Purpose/Scope**: Revisions made to description of Section purpose to clarify additional detail regarding alternate mass determination and uncertainty standards. Changes per reference 27.

28. Page II-1, **Preferred Ice Mass Determination Method**: Revisions made to clarify calibration of load cells. Minor editorial changes. Changes per reference 27.

29. Pages II-1, II-2&II-3, **Alternate Ice Mass Determination Methods**: Revisions made to add detail regarding the use of alternate mass determination methods. Added description of software projection methodology and visual estimation methodology. Added description of need for industry standard for uncertainty and documentation. Changes per reference 27.

30. Pages II-3, **Standards: Ice Basket Mass Determination Uncertainty**: Added new section per reference 27.

31. Page II-13, **Conclusions**: Revised entire section to reflect the additional detail added to the chapter regarding the development of alternate ice basket mass determination uncertainty and summarize the hierarchy of mass determination techniques, per reference 27.

32. Page III-1, **Purpose/Scope**: Editorial changes for consistency, per reference 27.

33. Page III-2, **Ice Mass Statistical Strategy**: Revised the term "sample population" to "sample group" (four places). Corrected mislabeled variable in equation for s and in definition of X_i. Change per reference 19. Added clarification to description of Equation 3.1, per reference 27.

34. Page III-3, **Ice Mass Statistical Strategy**: Revised term "sample population" to "sample group", per reference 19. Added clarification to description of Equation 3.2, per reference 27.

35. Page III-3, **Sample Size**: Deleted the parenthetical statement "(the probability density function of which is a symmetric bell-shaped curve)", per reference 19.

36. Page III-4, **Sample Size**: Revised term "sample population" to "sample group" (five places), per reference 19. Editorial changes per reference 27.

37. Page III-5, **Sample Size**: Revised term "sample population" to "sample group" (two places), per reference 19.

38. Page III-7, **Alternate Mass Determination Methods**: Revised wording for clarity and consistency. Changes per reference 27.

39. Page III-7, **Table 3-1**: Revised Note 2 under the table to: "The error values shown may not be equal to the one-sigma random error defined in Equation 3.2. Plant-specific procedures will determine the appropriate value to use in Equation 3.2 and will normally represent two standard deviations for any alternate mass determination method". Changes per reference 19.

40. Page III-9, **Alternate Basket Selection Strategy**: Revised term "sample population" to "sample group", per reference 19.

41. Page III-10, **Applications of Sampling Plan**: Revised term "sample population" to "sample group" (four places), per reference 19.

42. Page III-11, **Table 3-3**: Revised term "sample population" to "sample group", per reference 19.

43. Pages III-12 through III-15, **Table 3-4**: Revised term "sample population" to "sample group" (four places, in title), per reference 19.

44. Page R-2, **References**: Added the following sequentially numbered references:

    19. ICUG Response to NRC Request for Additional Information, R.S Lytton letter to NRC dated June 12, 2002 (w/enclosure).

    20. ICUG Response to NRC Request for Additional Information, R.S Lytton letter to NRC dated October 10, 2002 (w/enclosure).

    21. ICUG Response to NRC Request for Additional Information, R.S Lytton letter to NRC dated October 22, 2002 (w/enclosures).

    22. ICUG Response to NRC Request for Additional Information, R.S. Lytton letter to NRC dated November 26, 2002 (w/enclosures).

    23. Everhart, Jerry, *Determining Mass Measurement Uncertainty*, January 1997.

    24. Abernathy, R.B., et al, and Thompson, Jr., J.W., *Measurement Uncertainty Handbook*, January 1980.

    25. McClave, James T., and Dietrich, Frank H., *A First Course in Statistics*, third edition, copyright 1989.

    26. Eisenhart, C., *Expression of Uncertainties of Final Results, Precision Measurement and Calibration,* NBS Handbook 91, Vol. I, February 1969.

    27. USNRC Draft Safety Evaluation for Ice Condenser Utility Group Topical Report No. ICUG-001, Revision 0: *Application of the Active Ice Mass Management Concept to the Ice Condenser Ice Mass Technical Specification*, dated May 6, 2003 (w/enclosure).

45. Page A-1, **Appendix A**: revised "sample population" to "sample group", per reference 19.

46. Page A-43, **Appendix A**: revised "sample population" to "sample group", per reference 19.

47. Page A-47, **Appendix A**: revised "sample population" to "sample group", per reference 19.

48. Added this list of changes to the back.

49. Added a list of attached ICUG-NRC correspondence to the back.

50. Attached ICUG-NRC correspondence (references 19-22, and 27) to the back.