WATTS BAR NUCLEAR PLANT

EVALUATION OF ICE CONDENSER BASKET SCREWS

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EXECUTIVE SUMMARY

This report provides results of inspections and testing of Watts Bar ice condenser basket screws performed during the Unit 1 Cycle 2 outage to address continuing concerns involving the potential reduction in ice condenser basket joint load carrying capacity (relative to design basis requirements) due to cracked or missing screws. Additionally, this effort validates previous evaluations which concluded that the adequacy of the screws was sufficient for the structural functionality of the ice condenser baskets (WBPER950246).

Inspection was performed of 23,468 lower and intermediate screw locations which may be subjected to accident loads and 23,012 upper screw locations that are not subjected to accident loads but are subjected to maintenance servicing and surveillance testing loads. Of the 46,480 locations inspected (from a total of 186,624), screws were missing at 17 locations and the screw heads were missing at 9 additional locations. Conservatively characterizing screws as "missing" at these 26 (i.e., 17 + 9) observed locations, the missing rate for the entire ice condenser is 0.056% (i.e., approximately 1 in every 1785 screws). Statistical analysis shows that it is highly unlikely that more than 2 screws are missing from any accident loaded 12-screw joint in the ice condenser.

Twenty-five specimens with 2 pairs of screws per specimen were load tested at the operating temperature of the Watts Bar ice condensers. Twenty specimens were fabricated from randomly selected "in-service" screws removed from the Watts Bar ice condenser baskets, and five specimens were fabricated from randomly selected warehouse screws. These tests demonstrated shear load capacities for both the "in-service" and warehouse screws well in excess of the bounding accident loads calculated by Westinghouse, and comparable to the single-screw test results for the D. C. Cook Plant.

Considering the worst-case configuration for 2 missing screws from any load-bearing 12-screw joint and the Watts Bar bounding accident load, both the "in-service" and warehouse screw shear capacities provide substantial margin against failure.

The Watts Bar missing screw data and screw capacity tests have been compared to the Westinghouse full basket joint tests with 4 screws missing from a 12-screw joint. Based upon this comparison, the Westinghouse tests, which demonstrated acceptability, bound the Watts Bar conditions; i.e., both the missing screw and applicable load conditions.

The load tests and inspections conducted during the Unit 1 Cycle 2 outage, as well as comparison to the earlier Westinghouse full-basket tests and the D. C. Cook individual screw shear tests, provide a substantial basis to conclude that the load capacities of ice condenser basket screws installed in Watts Bar Nuclear Plant ice condenser baskets are more than adequate to accommodate the postulated loads and to compensate for the small number of missing screws.

In light of these results, no further corrective actions (other than on-going maintenance activities) are required to resolve the concerns which prompted this evaluation.

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PURPOSE

The purpose of this report is to provide an assessment of results obtained from inspection and testing of Watts Bar ice condenser basket screws performed during the Unit 1 Cycle 2 outage. As described within Reference 1, this inspection and test program was developed to address continuing concerns involving the structural integrity of ice basket joints. These concerns involve the potential for missing screws and screw cracking. The net effect of these issues is a potential reduction in basket joint load carrying capacity. Thus, the objective of the current evaluation is to verify that previous evaluations, which showed that Watts Bar joint capacity met design requirements, were valid.

Terminology Note: As shown by Figure 1, each of the 48 foot long basket columns in the Watts Bar ice condenser is comprised of four basket sections with joints at 12 foot intervals. These intermediate joints must transmit column loads during accidents conditions. In addition, there is an upper ring joint to provide a load path for servicing (e.g., lifting for ice weighing operations) and a lower ring joint to restrain axial loads during accident conditions. Each upper or lower basket connection contains 12 screws, while each intermediate basket-to-basket connection contains 24 screws. A 24-screw connection contains 12 screws (6 pairs at 60° intervals) which attach the upper basket to the connector ring, and 12 screws which attach the lower basket to the connector ring. In the context of this report, the term "12-screw joint" applies to both the 12-screw top and bottom ring joints, as well as to any of the 6 pairs of screws above or below a ring connector.

BACKGROUND

Prior to initial plant operation, a small quantity of screw heads and whole screws was found in the ice condenser melt tank, which led to concerns regarding the integrity of ice condenser basket joints. These concerns were documented in Problem Evaluation Report (PER) number WBPER950246. TVA concluded that although some screws may have been broken or damaged during installation, the number of screws or screw pieces detected was very small compared to the total number of installed screws and did not significantly reduce the capacity of the ice basket joints. Tightening during installation is probably the most severe service to which an ice basket screw is exposed. This condition combines both shear stress due to torsion required for thread forming and tensile stress due to torque reaction. Thus, screw failures during installation are more likely than during a subsequent design load condition (i.e., accident loads).

Evaluations performed for WBPER950246 focused on screw metallurgical conditions, which might have contributed to fracture during installation. Examinations of both new screws and screws removed from service indicated the presence of shallow cracks in some specimens. These cracks were attributed to the screw manufacturing process associated with hardening of the screw surface. Although most of the specimen cracks were considered non-injurious (i.e., failure under accident loads is not likely due to crack orientation and character), some transverse thread root cracking was detected. WBPER950246 was closed based on the following factors: (a) Westinghouse analysis showed that with ten screws out of twelve screws in place design requirements would be met; (b) the probability of having more than two screws missing from a mechanical connection was remote; (c) the amount of screws and screw pieces compared to the total number installed was small; and (d) screw failures during installation was more likely than during a design load condition.

More recently, concerns have been raised at non-TVA plants with regard to ice condenser joint integrity and/or missing screws. To support resolution of these issues, Westinghouse performed generic tests of complete ice condenser baskets for the condition of either 2 or 4 screws missing from a joint. American Electric Power (AEP) performed load tests of specimens (each containing one screw in single shear) assembled both from screws removed from service in the D. C. Cook plant and warehouse screws.

The Reference 1 evaluation plan, involving plant inspections and laboratory load tests, was developed to definitively validate resolution of these issues for Watts Bar. This report documents the results of those inspections and load tests.

INSPECTIONS

Although a single missing screw in a typical 12 screw basket-to-coupling joint is a minor effect, the possibility of multiple screws missing from a single joint would be more significant. To address this issue for Watts Bar, the Reference 1 evaluation plan included inspection of a large number of screw locations to determine the missing screw rate that can be applied to the total population of screws in the Unit 1 ice condenser. This inspection scope primarily involved the upper and lower rings but also included a number of basket joints at the first joint below the upper ring (i.e., the 36 foot elevation as indicated by Figure 1). In all, 46,480 individual screw locations were examined out of a total of 186,624 potential locations in the ice condenser ($\approx 25\%$). This number included 23,468 lower and intermediate screw locations which may be subjected to the accident loads and 23,012 upper screw locations that are not subjected to accident loads but are subjected to maintenance servicing and surveilance testing loads. At the conclusion of this examination, 26 screws were categorized as missing, including those where the entire screw was determined to be missing (17) and those where the screw head was missing (9). Inspection results are summarized below with more detailed results given in Tables 1 and 2 which follow the text of this report.

	Upper Joints	Lower & Interm. Jts.	Total
Locations Inspected	23,012	23,468	46,480
Total Screws Missing	17	9	26
Joints Inspected (some partially)	1,944	1,958	3,902
Joints with 1 Screw Missing	11	9	20
Joints with 2 Screws Missing	1	0	1
Joints with 3 Screws Missing	0	0	0
Joints with 4 Screws Missing	1	0	1

Note that Table 1 also includes a heading for broken screws. This condition involves damage to the protruding screw tip during ice maintenance activities and is confined to the upper ring joints. Since the upper ring joint screws are only loaded in shear during ice weighing operations (maximum applied load limited to 3,000 pounds), the number of screws required to withstand this load could be as few as 4 of the 12 normally installed. Furthermore, in many cases the screw fracture end protrudes through the ring, with little or no loss in capacity. In some cases the fracture end is flush or slightly inside the ring which may reduce ultimate capacity; however, such screws still provide a significant capacity as shear connections. Therefore, this type of damage has not prevented the upper ring joint from performing its function during ice weighing operations. On this basis, this condition is being handled as a maintenance issue for corrective actions.

The inspection results indicated that the condition of screws in the upper ring was not representative of screws in accident loaded joints. The conditions found in the upper ring joints have been attributed to ice maintenance activities which do not affect other joints. As such, the likelihood of missing screws or missing screw heads in the upper ring is greater than in lower or intermediate joints; however, the upper ring joint screws are not subjected to accident loads. The lower and intermediate ring inspection for missing screws and missing screw heads involved approximately the same number of screw locations as the upper ring (i.e., 23,468 vs. 23,012) and in no case was more than one screw categorized as missing from any single 12 screw joint. Thus, it is conservative to apply the missing screw rate for the total number of locations inspected to the population of screws in accident loaded joints as a random process. In addition, 174 visually accessible screw tips in lower ring joints were examined, and none of these were found to be broken.

To estimate the maximum number of 12 screw accident loaded joints that might have one or more missing screws, the overall missing rate of 0.056% (i.e., $26 \times 100 / 46{,}480$) is considered to be randomly distributed through the total population of screw locations in accident loaded joints. Using this assumption, Attachment A provides the results of calculations for the expected number of joints with 0, 1, 2 and more missing screws as well as the probability that all accident loaded joints will have fewer than 1, 2, 3 or 4 missing screws. Examination of these results shows that there is a 99.95% probability that no accident loaded joint will have more than 2 missing screws. Stated another way, there is a probability of only 0.05% that an accident loaded joint will have more than 2 missing screws.

Verification that the statistical analysis is conservative for accident loaded joints can be demonstrated by comparing predictions with inspection results. For the approximately 1958 accident loaded joints inspected, the statistical model predicts finding 13 joints with 1 screw missing (9 were found) and 0.04 or zero joints with 2 or more screws missing (none were found).

SCREW LOAD TESTS

In addition to the in-plant inspections, the Reference 1 evaluation plan provided for shear tests of splice joint specimens, shown by Figure 2. As can be seen, each specimen involved a pair of screws on either side of the splice such that each pair was subjected to the test load. It should be noted that with this configuration, maximum load capacity of the splice is dependent on the weaker of the two pairs. Five specimens contained screws randomly selected from the Watts Bar warehouse. Twenty specimens contained screws randomly selected and removed from service in the Watts Bar ice condenser baskets. The specimens were tested to failure at temperatures corresponding to the operating temperatures of the ice condenser.

The test results are described in Reference 3. Figure 3 shows the maximum loads achieved for each of the 25 tests. The average of the maximum loads for the 5 specimens with screws removed from the warehouse was [ ], with a range of [ ]. The 20 in-service screw test specimens reflected a maximum load range from [ ], with the exception of a single outlier at [ ]. The average maximum load for the 20 in-service specimens was [ ]. If the [ ] were excluded, the average of the remaining 19 in-service specimens would be [ ]. In this case there is little difference in average capacity between typical in-service screws and new screws taken from the Watts Bar warehouse.

It should also be noted that the Watts Bar results are comparable to the single-screw shear test results performed for AEP, as documented in Reference 4. The averages for various lots of screws removed from service at D. C. Cook Plant ranged from [ ]. Normalizing the Watts Bar test data to a single screw results in an average capacity of [ ]. The minimum per-screw capacity of [ ] from the Watts Bar tests is comparable to the minimum capacity of [ ] for the Cook in-service screws. The maximum per-screw capacity of [ ] from the Watts Bar tests is comparable to the maximum capacity of [ ] for the Cook in-service screws.

SCREW LOAD ANALYSIS

As shown previously, there is a very low probability that more than 2 screws are missing from any 12-screw accident loaded joint in the Watts Bar ice condenser baskets. Attachment B establishes the relationship between the shear load transmitted to the most highly loaded screw with 2 screws missing from a 12-screw joint as compared to the case with no missing screws. The maximum shear load with 2 missing screws is seen to increase by a [ ]. As indicated by Reference 2, for Watts Bar the maximum accident load of [ ] occurs in the intermediate joint at the 24 foot elevation (see Figure 1). Applying the [ ] to the [ ] maximum accident load, the bounding required test specimen capacity for a condition of 2 missing screws from a 12-screw joint is:

$$P_{req} = [\ \ ]$$

All tested Watts Bar specimens exceeded this load. It is also important to note that due to the considerable ductility inherent in the twelve screw joint, there is a tendency toward a more uniform distribution of load between all the screw pairs in a joint (both above and below the splice ring) prior to failure. The capacity of a joint would thus be more a function of the <u>average</u> load capacity of the screws in that joint rather than the minimum capacity of any single screw. The [ ] average capacity of the in-service test specimens is more than twice the [ ] required load. This provides further assurance that the actual margin of safety is considerably higher than would be predicted by the capacity of the minimum strength screw in any joint.

In addition to the [ ] for the case of 2 missing screws, Attachment B also establishes the relationship between the shear load transmitted to the most highly loaded screw with 4 screws missing from a 12-screw joint as compared to the case with no missing screws. For 4 missing screws (two adjacent pairs) this [ ] is seen to be [ ]. Applying these factors, the capacity of a 12-screw joint can be calculated using the average screw capacity from the Watts Bar specimen tests. The following table shows that margin continues to exist for cases involving both 2 and 4 missing screws:

	Joint Load (pounds)	
	2 Missing Screws	4 Missing Screws
WBN JOINT CAPACITY BASED ON AVERAGE LOAD FROM SCREW TEST	[ ]	[ ]
WBN DESIGN	[ ]	[ ]
MARGIN	[ ]	[ ]

COMPARISON TO WESTINGHOUSE TESTS

Full scale joint load tests were performed on a generic basis by Westinghouse as documented by Reference 2. These tests were performed with either 2 or 4 basket screws missing from a 12 screw basket-to-coupling joint. Considering that each basket-to-coupling joint involves 6 pairs of screws evenly distributed around the joint perimeter (i.e., 60° arc separation), conservatism was assured as the locations without screws involved either a single pair (i.e., 2 screws missing) or two adjacent screw pairs (i.e., 4 screws missing). Missing pairs imposes a worst case condition because, in addition to increasing the uniform load on each remaining screw by the ratio of 12 divided by the number remaining, it also results in the greatest reduction in screw pattern "section modulus" and maximizes the neutral axis shift of the resulting screw pattern relative to the basket centerline (See Attachment B). The Westinghouse tests demonstrated that a basket joint provides a capacity of <u>at least</u> [ ] with a single pair missing and <u>at least</u> [ ] with two adjacent pairs missing when tested with 10-32 Pozidrive Truss Head TEKS/2 as specified for Watts Bar. The capacity of a joint with these screws is actually greater than [ ] with 2 missing screws and greater than [ ] with 4 missing screws since the tests were performed to specified loads and did not result in failure.

As an additional point of conservatism, it should be noted that the specified loads used in the Westinghouse test exceed the maximum joint accident load of [ ] for Watts Bar. The margin of the Westinghouse tests versus the worst case Watts Bar situation is reflected below:

	Joint Load (pounds)	
	2 Missing Screws	4 Missing Screws
<u>W</u> TEST	[ ]	[ ]
WBN DESIGN	[ ]	[ ]
MARGIN	[ ]	[ ]

Based on this evaluation, the results of the Westinghouse tests are consistent with Watts Bar testing and both tests demonstrate acceptability for the missing screw rate observed in the Watts Bar Unit 1 ice condenser, as well as for the more severe condition of 4 missing screws.

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CONCLUSIONS

The following conclusions are drawn based on the preceding evaluations:

- The load capacities of ice condenser basket screws installed in Watts Bar Nuclear Plant ice condenser baskets are more than adequate to accommodate the postulated loads and to compensate for the small number of missing screws.
- The rate of missing screws in the Watts Bar ice condenser baskets is extremely low at 0.056%. Thus, it is highly unlikely that more than two screws are missing from any load bearing joint in the ice condenser.
- Tests of screws removed from service in the Watts Bar ice condenser baskets demonstrated shear load capacities well in excess of the bounding service loads calculated by Westinghouse.
- The Watts Bar test results were very comparable to the single-screw test results for the D. C. Cook Plant.
- Applying the [ ] for 2 missing screws to the bounding service load, the shear capacities of the screws still provide substantial margin against failure.
- Results from the Westinghouse full basket joint tests with 4 screws not installed in a 12-screw joint are consistent with the Watts Bar tests and 12-screw joint analysis.
- Based on tested sample, the screws in the Watts Bar warehouse are comparable to the in-service screws and also have ample capacity for use as replacement screws in the ice condenser baskets.
- In light of these results, no further corrective actions (other than on-going maintenance activities) are required to resolve the concerns which were the subject of this evaluation.

REFERENCES

1. "Watts Bar Nuclear Plant - Ice Condenser Basket Screws - U1C2 Evaluation Plan," March 12, 1999, [ ].
2. Internal Westinghouse memorandum dated September 21, 1998, subject "Ice Condenser Ice Basket Sheet Metal Screw Test Reports", W No. EDRE-EMT-759, [ ]. Contains the following attached documents:
    - "Report on Ice Basket Couple Assembly Testing," WNSD P/O MB44590, dated September 14, 1998.
    - "Ice Condenser Ice Basket Sheet Metal Screw Design Demonstration Tests Summary Report," EDRE-EMT-753, dated September 20, 1998.

3. TVA Central Laboratories & Field Testing Services Technical Report No. 99-0801, "Watts Bar Nuclear Plant - Shear Test Evaluation on U1C2 Ice Condenser Basket Screws," dated March 24, 1999, [ ].

4. "Shear Testing and Metallurgical Evaluation of Screws From Unit 1 Ice Baskets," by Dr. Fred K. Roehrig, P.E., Gelles Laboratories, Columbus, Ohio, submitted to AEP Cook Nuclear Plant, dated September, 1998. [ ].

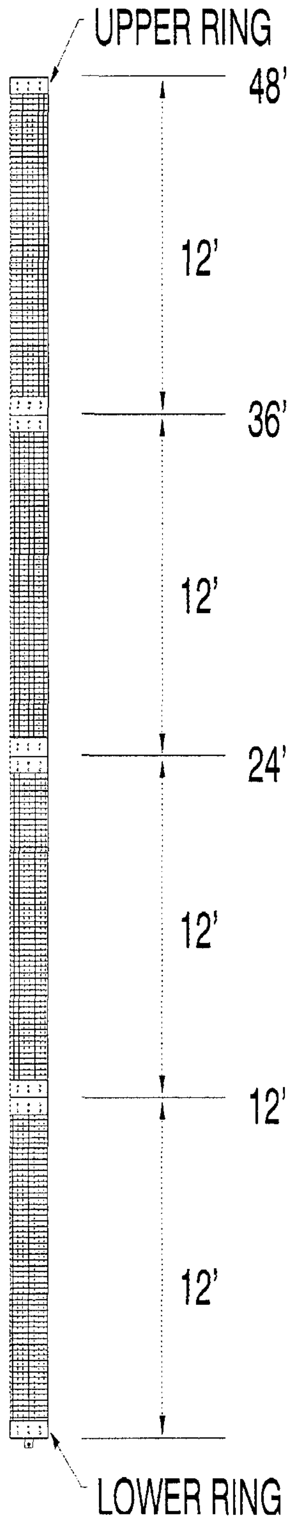

FIGURE 1 - ICE BASKET COLUMN - ELEVATION VIEW

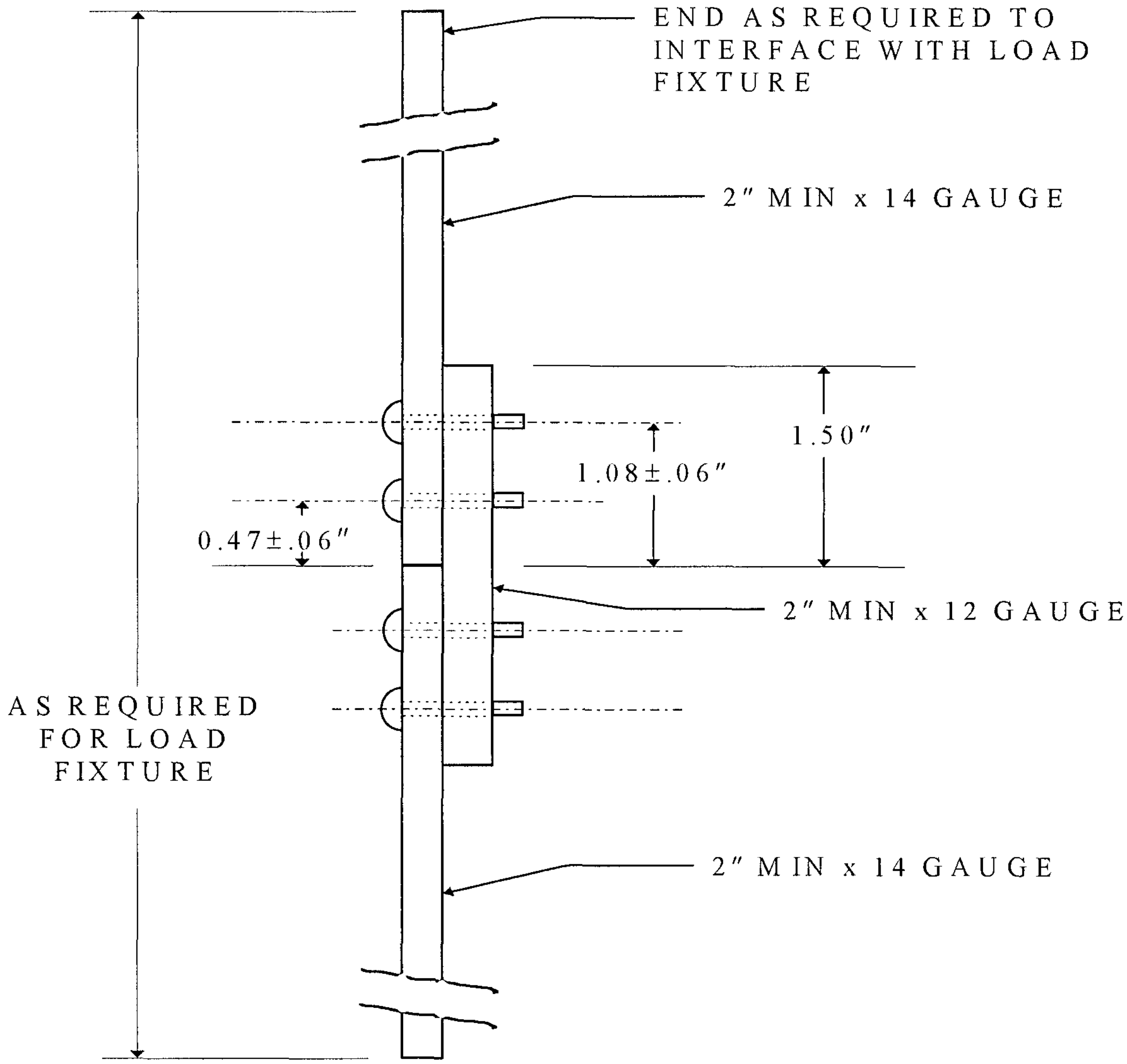

FIGURE 2 - TEST SPECIMEN SIDE VIEW

Figure 3

TABLE 1 - SCREW INSPECTION RESULTS; UPPER AND LOWER RINGS

UPPER ICE BAY	# INSPECTED	# MISSING	# HEAD MISSING	# BROKEN
1	972	1	0	26
2	972	0	1	3
3	972	0	0	9
4	972	0	0	5
5	960	0	0	6
6	964	0	0	1
7	952	0	0	5
8	921	0	0	2
9	964	1	0	0
10	971	0	0	6
11	920	1	0	3
12	919	3	0	33
13	913	1	0	6
14	962	0	0	3
15	969	1	0	25
16	953	0	0	17
17	972	0	0	58
18	976	0	0	21
19	968	4	0	38
20	975	0	0	34
21	949	1	0	34
22	972	0	0	13
23	972	0	0	26
24	972	0	0	8
UPPER BAY SUM	23012	13	1	382

TABLE 1 (Continued)

LOWER ICE BAY	# INSPECTED	# MISSING	#HEAD MISSING	# BROKEN
1	972	0	0	N.A.
2	972	1	0	N.A.
3	972	0	0	N.A.
4	972	0	0	N.A.
5	972	0	0	N.A.
6	972	0	0	N.A.
7	972	0	0	N.A.
8	972	0	0	N.A.
9	972	0	0	N.A.
10	972	0	0	N.A.
11	972	0	0	N.A.
12	972	0	0	N.A.
13	972	1	1	N.A.
14	972	0	0	N.A.
15	972	1	0	N.A.
16	972	0	0	N.A.
17	972	0	0	N.A.
18	972	0	0	N.A.
19	972	0	2	N.A.
20	972	0	0	N.A.
21	972	0	0	N.A.
22	972	0	1	N.A.
23	972	1	0	N.A.
24	972	0	3	N.A.
LOWER BAY SUM	23328	4	7	N.A.
UPPER BAY SUM	23012	13	1	382
U/L BAY TOTAL	46340	17	8	N.A.

Note: Broken screws are screws broken on the interior portion of the basket as a result of maintenance activities. These screws are located in the upper ring which carry load only for weighing of baskets. In the lower bay only a limited number of screw locations could be examined to determine if broken. Visual examination was performed on 174 screws (106 Bay 1, 56 Bay 2, 10 Bay 4 and 2 Bay 13) with no evidence of breakage.

TABLE 2 - SCREW INSPECTION RESULTS FOR CONNECTIONS LOCATED AT THE FIRST BASKET JOINT BELOW THE TOP RING

BAY	Basket No.	Number of screws reviewed	Number of screws found missing	Number of screws with heads missing	Remarks
1	C6	24	0	0	Baseline basket. Basket raised 10'.
4	F1	6	0	0	Basket raised 3". Camera used for visual evaluation. Basket could not be turned to view all screws.
7	B4	24	0	1	Basket raised 10'-1". Camera used to evaluate whether screw missing or head missing.
9	C2	24	0	0	Basket raised 4'-0". Camera used for visual evaluation.
16	D2	14	0	0	Basket frozen, could not lift or turn. Camera used for visual evaluation.
17	C8	24	0	0	Basket raised 53". Camera used for visual evaluation.
20	G4	24	0	0	Basket raised 10-3".
TOTAL		140	0	1	

The screws in the first coupling ring below the top ring is located 12'-0" below the top ring. Basket C6 of Bay 1, basket B4 of Bay 7, and basket G4 of Bay 20 were accessible for visually review. For basket B4 of Bay 7, the camera was used to determine that the head was missing from the screw rather than the screw missing completely. The other baskets were reviewed by camera.

Mathematical Approach

The Binomial Probability Function from Chapter 19.9 of *Advanced Engineering Mathematics, 3rd Edition* by E. Kreysig can be used to determine the probability of a given number of missing items in a given sample from a total population with a known missing rate as follows:

The number of different combinations of z different things, y at a time without repetitions is given by:

$$f(z,y) \equiv \frac{z!}{y! \cdot (z-y)!}$$ Chapter 19.6, Equation (4a)

The bionomial probability function for sampling without replacement is given by:

$$PF(M,x,N,n) \equiv f(n,x) \cdot \left(\frac{M}{N}\right)^x \cdot \left(1 - \frac{M}{N}\right)^{n-x}$$ Chapter 19.9 Equation (7)

Verify Function Using Example 1. from Kreysig

$N := 10$	Total Population
$M := 3$	Number of Defectives in Total Population
$n := 2$	Sample Size
$x := 2$	Number of Defectives in Sample
$PF(M,x,N,n) = 0.09$	Probability of Occurrence, Checks with Text

Application to Ice Basket Screws

The Binomial Probability Function can be used to determine the probability of a given number of missing screws in a 12 screw ice basket joint if the percentage of missing screws in the total population is known. The number of screws in a joint (12) is the sample size relative to the total population of screws in loaded joints. Per Kreysig, the Binomial Function is adequate for infinite (i.e., very large) populations even if sampling without replacement is performed.

$N_{SAMP} := 46480$		Number of Screw Locations Inspected in WBN U1
$N_M := 26$		Number of Missing Screws in WBN U1
$DEF\% := \frac{N_M}{N_{SAMP}}$	$DEF\% = 0.056 \cdot \%$	Percent Missing Screws in Total Population
$n := 12$		Number of Screws in Loaded Joint (i.e., sample)
$N_J := 1944 \cdot 7$	$N_J = 13608$	Total Number of Loaded Joints (1944 baskets, 7 loaded joints per basket (upper ring not loaded)
$N := N_J \cdot n$	$N = 163296$	Total Number of Screws in Loaded Joints

$M := N \cdot DEF\%$ $\quad M = 91$ — Number of Missing Screws in All Loaded Joints

$i := 0 .. 12$ — Counter Indice (i.e., Missing Screws)

$P_i := PF(M, i, N, n)$ — Array of Probabilities for i Missing Screws

$N_{AJ_i} := P_i \cdot N_J$ — Array of Number of Joints Affected by i Missing Screws

$PP_i := \sum_{j=0}^{i} P_j$ — Array of Probabilities that a Single Joint Will Have i or Fewer Missing Screws

$PT_i := (PP_i)^{N_J}$ — Array of Probabilities That All Joints Will Have i or Fewer Missing Screws

Number of Missing Screws vs Probability of Occurrence in a Single Joint

P =

	0
0	0.9933
1	0.0067
2	$2.0537 \cdot 10^{-5}$
3	$3.8314 \cdot 10^{-8}$
4	$4.8249 \cdot 10^{-11}$
5	$4.3208 \cdot 10^{-14}$

Number of Missing Screws vs Number of Joints Expected to Have That Number of Missing Screws

N_{AJ} =

	0
0	13516.93593
1	90.78409
2	0.27946
3	0.00052
4	$6.56575 \cdot 10^{-7}$
5	$5.87969 \cdot 10^{-10}$

Number of Missing Screws vs Probability That a Joint Will That Number or Fewer Missing Screws

PP = ·%

	0
0	99.3308
1	99.9979
2	100.000
3	100.000
4	100.000
5	100.0000

Number of Missing Screws vs Probability That All Joints Will Have That Number or Fewer Missing Screws

PT = ·%

	0
0	0.0000
1	75.5794
2	99.9478
3	99.9999
4	100.000
5	100.0000

Conclusion:

There is a 99.95% Probability That All 13608 Load Bearing Joints in the WBN Unit 1 Ice Condenser Have 2 or Fewer Missing Screws.

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ATTACHMENT B - EFFECT OF 2 OR 4 MISSING SCREWS

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ENCLOSURE 2

PROP

DRP-013

NRC FORM 190
(9-1998)
NRCMD 3.12

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