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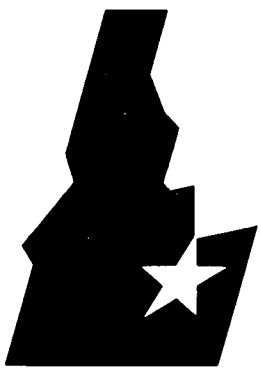
Weld Evaluation Project Formation of Weld/Component Data Base

Department of Energy Weld Evaluation Project TVA Watts Bar Nuclear Plant Unit 1

John M. Savage



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WELD EVALUATION PROJECT FORMATION OF WELD/COMPONENT DATA BASE

DEPARTMENT OF ENERGY WELD EVALUATION PROJECT TVA WATTS BAR NUCLEAR PLANT UNIT 1

John M. Savage

November 1987

U.S. Department of Energy
Idaho Operations Office

ABSTRACT

The Department of Energy/Weld Evaluation Project (DOE/WEP) was formed in December 1985 as the result of an interagency agreement between the DOE and the Tennessee Valley Authority (TVA). The project was assigned by the DOE to EG&G Idaho, Inc., for implementation. The DOE/WEP was tasked to perform a comprehensive, independent evaluation of the documented TVA welding program and the as-constructed weld quality with respect to the TVA-performed safety-related welds at the Watts Bar Nuclear Plant Unit 1 (WBNP-1). This is one of ten reports describing the plan, processes, implementation, and results of the DOE/WEP at the plant. This report describes the methodology relative to the formation of weld/component computer data bases used in the sampling of welded connections or components for examination.

ACKNOWLEDGMENTS

Acknowledgments are extended to the many participants in the data base preparation, maintenance, and sampling activities that are part of the DOE/WEP at the TVA WBNP-1. In particular, acknowledgment is made of the contribution by E. Mouser, S. M. Bradford, D. Ponke, R. Francis, D. Hammerquist, J. A. Holm, M. F. DeWitt, S. Deiro, and R. T. Chung.

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WELD EVALUATION PROJECT FORMATION OF WELD/COMPONENT DATA BASE

1. INTRODUCTION

The Department of Energy/Weld Evaluation Project (DOE/WEP) was formed in December 1985 as the result of an interagency agreement between the DOE and the Tennessee Valley Authority (TVA) to provide the TVA with an independent assessment of the quality of safety-related welding performed by the TVA during construction of the Watts Bar Nuclear Plant Unit 1 (WBNP-1). The DOE/WEP was conducted by EG&G Idaho, Inc., as contractor to the DOE.

The specific objectives of the DOE/WEP were the following:

1. Assess compliance of the TVA's documented weld program to the requirements in the WBNP Final Safety Analysis Report[1] and amendments through February 1, 1986.
2. Assess the applicable TVA employee concerns (ECs) and quality documents to determine if they identify quality problems with the TVA-performed, safety-related welds.
3. Evaluate the TVA's as-constructed plant weld status by conducting an examination of the plant welds, evaluating the results, and when deviations were determined to be unacceptable, analyzing and concurring with the TVA's corrective action proposals for these deviations.[a]
4. Provide the TVA with a statement of the compliance of the plant hardware with applicable construction welding codes on completion of corrective action.

This is one of the ten reports that describe the plan, processes, implementation, and results of the DOE/WEP at the WBNP-1. The assessment to meet Objective 1 was accomplished with the completion of the report, "Weld Program Review."[2] The other nine reports are listed as References 3 through 10. In addition to the Weld Program Review cited above, these reports delineate: the program organization and work scope, the formation of homogeneous groupings of welds, the data bases for weld reinspection results and status reports, the processes of component inspection and examination, the suitability for service evaluation engineering, the generic problem analysis of deviations found during the examinations, an aggregate assessment of weld reinspection results, and a final summary.

The DOE/WEP, EG&G Idaho, Inc., technical approach to meet part of Objective 3, was a statistical assessment of the TVA-performed safety-related welding at the TVA WBNP-1 using the criteria presented in the Nuclear Construction Issues Group (NCIG) document NCIG-02.[11] Meeting these criteria would demonstrate a 95% or greater confidence that at least 95% or more of the components meet the appropriate code inspection acceptance criteria. To accomplish the statistical evaluation, the DOE/WEP established computer data bases that included the applicable safety-related weld/component populations that represented the overall general plant classification (see Attachment 1). The methodology relative to the formation of these data bases is described in this report. These data bases were used for statistical sampling. Description of the formation of the groups used by the DOE/WEP is presented in the DOE/WEP report "WEP Formation of Homogeneous Groupings of Welds."[3]

The welds/components were installed by both the TVA Office of Construction and the TVA Office of Nuclear Operations. The TVA Office of Construction performed the fabrication and installation of safety-related items and the TVA Office of Nuclear Operations performed modifications and repairs to safety-related items already installed and turned over by the TVA Office of Construction. The TVA Office of Nuclear Operations also installed items that were

a. *Deviation* or *deviant weld* denotes a condition that does not meet the applicable code inspection acceptance criteria for the weldment specified by the engineer. These terms are used before an evaluation of the condition has been performed in accordance with other applicable code provisions to determine the acceptability of the condition.

turned over as open items (those not completed by the TVA Office of Construction).

This report presents the identification and composition of the TVA computer data bases in Section 2. The allocation of the DOE/WEP data bases is discussed in Section 3 and the validation of the DOE/WEP data base is presented in Section 4. The sampling methodology that the DOE/WEP used is discussed in Section 5. Attachments 2 and 10 discuss the classification, identification, and size of the general and special groups; Attachments 3 through 9 explain the file layout for the groups. Attachments 11, 12, and 13 present the sampling plans used.

2. IDENTIFICATION AND COMPOSITION OF THE TVA COMPUTER DATA BASES

During formation of the general groups, described in Reference 3, the TVA personnel aided in data base identifications and composition. Reviews of the existing TVA data bases were conducted to establish their sizes, contents, sorting capabilities, and the TVA computer mainframe space requirements. Once this familiarization was accomplished, the DOE/WEP requested that the appropriate sorts be performed. The sorts for each initial general group population were made so that each population would include the safety-related welds/components installed and designated as being completed for Unit 1 fuel load by the TVA Office of Construction.

In addition, the DOE/WEP personnel also reviewed those welds/components that were within the DOE/WEP scope of authorization that had been installed, modified, and/or repaired by the TVA Office of Nuclear Operations. These populations were established separately.

Each file was allocated and maintained on the TVA mainframe computer. These files were then considered "frozen" and access limited to the authorized DOE/WEP personnel. Descriptions of group identification and record size, along with the explanation of files for each group, are presented in Attachments 2 through 9 of this report.

3. ALLOCATION OF THE DOE/WEP DATA BASES

3.1 General Group Classification

The general group classification populations, which were reviewed and classified in accordance with the DOE/WEP Standard Practice (SP) WEP 3.1.2, are identified in Attachment 1. The populations were divided by pipe, structures fabricated in accordance with American Welding Society (AWS) criteria,[12] and Heating, Ventilating, and Air Conditioning (HVAC) systems. (Note that the HVAC population was not required for sampling; the DOE/WEP's resolution of the HVAC ducting was communicated to the TVA.[a]) Piping was further subdivided by applicable code (The American Society of Mechanical Engineers[13] and American National Standards Institute[14]), and then the ASME piping was again divided by pipe size (Groups A and B). The structural classifications, with exception of the pipe hanger group, were further subdivided by a time split of before and after February 13, 1981, owing to changes in the TVA specification requirements, inspection criteria, and inspection training requirements. The general populations, as allocated on the mainframe, were the entire population without any separation by time. General groups requiring the time-line separation were generated by DOE/WEP. This was accomplished by generating a random sample from the parent population. This sample was large enough so that the review of installation records would result in each "time-line" population containing a minimum of 200 elements or the entire population (if less than 200).

Five of the general groups required additional sorting and refinement for use by the DOE/WEP. These were Groups C, D, E, G, and H. These five general groups, as allocated and provided to the DOE/WEP by the TVA, did not permit a random sample by weld or component.

3.1.1 Group C. The ANSI[14] piping was set up by TVA with the unique identifier (item) being a piping segment. That is, an individual line item in the TVA's data base was a piping segment established by hydrostatic test boundaries. These segments represented an unknown quantity of welds. To adequately assess this population and give each weld an "equal chance of selection," the DOE/WEP decided to use a cluster sample technique (choose clusters at random and examine all elements in each selected cluster; in this case, choose segments and examine welds). Walkdowns performed by the DOE/WEP had indicated that on an average each segment represented six welds. The DOE/WEP generated a random sample of 200 pipe segments and used the first 10 segments to obtain a minimum of 64 welds. These segments were then field verified, welds counted, and weld maps generated. However, the first 10 segments yielded 94 welds. The DOE/WEP sampled at the segment level; therefore, all 94 welds, if accessible, would require inspection. Out of this original sample, 1 weld was outside the ANSI boundary, 16 welds were in a Non-Category I structure; therefore, they were non-safety-related (non-Q). Forty-three welds were on a piping system that had neither a primary nor secondary safety function and were, therefore, non-safety-related. In addition, two welds were brazed connections that were not in the DOE/WEP scope. This left 32 welds from the original sample. As a consequence of the issues surrounding the 43 welds on a non-safety system, and to acquire 32 additional samples to meet the minimum of 64, the DOE/WEP continued down the random sample of segments and only added segments from either primary or secondary safety systems. The DOE/WEP also decided to field verify and map a sufficient number of welds to build a weld data base and sample at the weld level instead of segments. This portion of the ANSI population contained 3251 welds from 96 piping segments. The DOE/WEP obtained 200 randomly selected samples from this portion of the population and used 32 accessible welds to complete the required minimum of 64.

The DOE/WEP also determined that a number of piping segments had not been included in the original TVA Office of Construction data base. These segments received a non-Q hydro by the TVA and were, therefore, eliminated from the original sort performed by the TVA. Per the TVA request, these segments were included in the population. Because of the limited size, two additional segments from these overlooked segments were selected for inspection. These two segments comprised 34 welds, but 5 were found to be inaccessible. As a result, these 29 (coupled with the 64)

a. Letter from F. C. Fogarty to R. E. Kosky, "Heating, Ventilation and Air Conditioning Ducting Weld Quality Evaluation," FCF-114-87, October 30, 1987.

brought the total number of welds in Group C to 93.

For items installed by the TVA Office of Nuclear Operations, the DOE/WEP reviewed and classified welds by population in accordance with WEP Standard Practice (SP) WEP 3.1.2 (contained in Appendix A). The DOE/WEP performed a similar comparison for this new portion and two additional welds were required. This now brought the Group C total to 95 welds.

In addition, during a United States Nuclear Regulatory Commission (USNRC) audit in July 1986, the USNRC identified 12 specific welds within the Group C boundary that they requested to be inspected. These 12 welds brought the Group C total to its present 107.

3.1.2 Groups D and E. Civil/structural components (D is post-February 13, 1981; and E is pre-February 13, 1981) were compiled and maintained by the TVA such that an individual line item could represent a part of or an entire design drawing. That is, the TVA would divide drawings by construction sequence and install items accordingly. In addition, where a line item indicated items by mark numbers (item numbers on a drawing) or item description, this one line item could then represent, for example, 1 or 300 items in the field, depending on the application. This data base, as allocated to the DOE/WEP on the mainframe, was, therefore, not adequate to obtain samples. The DOE/WEP took the data base and reviewed each line item (1706) against the applicable design drawing and expanded each accordingly (e.g., 1 embedded frame in the original data base may actually represent 300 installed items) and created a DOE/WEP data base (on EG&G PCs) of approximately 7500 items. This expanded data base was then used for obtaining the random samples.

3.1.3 Groups G and H. Instrumentation and control supports (G is post-February 13, 1981; and H is pre-February 13, 1981) were compiled and maintained by the TVA such that an individual line item on the computer was a designated subassembly. This population included 3107 subassemblies. Each subassembly was also subdivided by each connection to the panel. The individual supports on each instrument line were not uniquely represented in the data base as allocated on the mainframe. The DOE/WEP obtained a random sample of 450 subassemblies and then walked these subassemblies down to field verify each hanger as being welded and to uniquely identify each support on weld maps. This walkdown effort yielded a total of 2015 individual supports, which were input into EG&G PCs. The DOE/WEP then obtained the random sample of 64 supports from this population.

3.2 Special Groups

In addition to the overall assessment of the TVA safety-related welding by the formation and sampling of the general group populations, the DOE/WEP also populated and sampled groups designated as special. These groups are subsets of general populations and were formed as a result of the DOE/WEP review of employee concerns (addressing the TVA safety-related welding) and quality documents that indicated an apparent incompleted corrective actions or technically unjustified acceptance of non-conformances. The special groups mentioned here are those that required populating and sampling. The boundaries of these populations were specified in the assessment plans for each of these special groups. A listing of the special groups that did require populating is presented in Attachment 1.

Depending on the elements to be populated and the identified boundary, the DOE/WEP populated these groups in one or more of the following methods:

- If the applicable element was in a field on the TVA computer mainframe that could be directly sorted, then this was accomplished and a file created on the mainframe. Depending on the resulting size of the special population, this file either remained on the mainframe or the DOE/WEP obtained a listing and input this to the EG&G PCs for sampling ease and expeditious computer work. In either case, the samples were either obtained from the mainframe and then input to the EG&G PCs or obtained directly from the EG&G PCs.
- In some cases, the specific element needed for sorting was not available in the mainframe population. These groups required the DOE/WEP personnel to hand sort the applicable items. This involved either a review of inspection records, design drawings, field walkdowns, or a combination of these activities. The results of these

population efforts were input to the EG&G PCs, and the appropriate samples were obtained directly from these files.

- When expansion populations were identified as a result of generic problem analysis (GPA) activities,[8] the required populations and samples were developed according to the GPA conclusions.
- When the GPA results indicated additional samples were needed and the problem population could not be bounded, the random samples were obtained by continuing with the original sample and obtaining the required number.
- When the GPA results indicated additional samples were needed and the problem population could be bounded, the DOE/WEP sorted this population from the parent population either by computer or by hand. This population was input into the EG&G PC for required sampling.
- When expansions were identified as a result of suitability for service evaluation engineering (SSEE), the DOE/WEP sorted the problem population by computer or by hand and maintained this population on either the mainframe or the EG&G PC, depending on population size. These populations required 100% evaluation and no sampling was required.

4. VALIDATION OF THE DOE/WEP DATA BASES

To approve the general group populations for use by statistical sampling techniques, the DOE/WEP had to establish that the DOE/WEP data bases could be shown to include all applicable safety-related components/welds, with a 95%/95% confidence level. The DOE/WEP concluded that this verification could be based on sampling techniques as described in Standard Practice WEP 3.1.2 (contained in Appendix A of this report).

The DOE/WEP also concluded that the basic methodology presented in the Nuclear Construction Issues Group (NCIG) document NCIG-02[11] would be appropriate for this validation. Taking the more conservative approach, the DOE/WEP would sample the general group populations in a manner that adheres to the guidelines of a 95%/95% sampling methodology (see Attachment 11) for determining the acceptability of the populations. The conservatism would be that a sample size of 64 items would be used for all populations, regardless of the population size.

The actual validation process was performed in two separate activities. An initial validation was performed to conditionally approve the data bases before the DOE/WEP obtained any samples to be used in the weld assessment. This first validation was accomplished by arbitrarily selecting 64 welds/components from applicable design drawings for each general group. These welds/components were then verified as being installed in the field and also represented in the data base.

As a result of this initial activity, all of the general group populations were approved for sampling activities.

A second separate validation was performed as a means of final acceptance of the general group population data bases. This validation encompassed a different approach that would render a more thorough assessment of the data base completeness. In this case, an arbitrary sample of 64 welds/components for each general group was selected in the plant as installed. These welds/components were then verified as being represented on the applicable design drawings and also represented in the data base. This activity resulted in approval of all general group populations. It should be noted that the electrical support population was approved with a discrepancy that was noted on a welding task group discrepancy report. The discrepancy was associated with conduit supports that were entered in the TVA data base as having been installed by bolting when in reality they had been installed by welding. This was because of an input error by the TVA and these supports were then eliminated by the DOE/WEP during the sort routines. These conduit supports therefore were not sampled. This condition has been communicated to the TVA, and they have committed to take appropriate corrective action with respect to these supports in conjunction with their reverification effort for all electrical supports.[a]

In addition to validating the defined general group populations, this second validation effort was also used to verify that there were no additional populations of safety-related components that had not been populated. During this second validation and owing to the DOE/WEP's better understanding of the TVA documentation system and computer sorting mechanisms, the DOE/WEP concluded that three populations of safety-related components had not been included for sampling with the original general populations. It was further verified through correspondence with the TVA and field walkdowns that these populations were available and could be compiled for sampling purposes. It was determined that these populations would be handled as general populations, but they would be assigned special group designations. These groups were Special 252, 254, and 257 (see Attachment 1 for group definitions). In addition, it was also determined that ASME Code Section III Class MC welds (non-pipe) had been included in the piping Groups A and B. These MC welds were sorted out of the A and B populations and repopulated and sampled as Group 264. Sampling for the above-mentioned groups was performed as detailed in Section 5. This second validation verified that the DOE/WEP had populated and sampled all applicable safety-related components within the DOE/WEP scope for WBNP-1.

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a. Letter from C. D. Lundin to H. B. Bounds, TVA, "Watts Bar Nuclear Plant—Electrical Supports," T25 870211876, February 11, 1987.

5. SAMPLING METHODOLOGY

The DOE/WEP determined to use a statistical sampling program to assess the quality of the TVA safety-related welds at WBNP-1. The DOE/WEP based this program on the multiple sampling and group disposition plan basically described by NCIG-02,[11] "Sampling Plan for Visual Reinspection of Welds" and implemented in accordance with Standard Practice WEP 3.1.6 (contained in Appendix A).

Samples were drawn from the files directly from the mainframe computer system using the Statistical Analysis System (SAS).[15] The DOE/WEP selected a random seed number generated by a computer program that generated 500 random numbers from 1 to 10 million. Any resulting even numbers were discarded because the SAS routine required odd numbers.

Samples generated on EG&G PCs were randomly selected using Weldsamp.[16]

The random selection process provided an equal chance for selection of each item in the population. The number of items selected was 200 components or the total population, whichever was smaller. To provide a demonstration of 95% or greater confidence that at least 95% or more of the components meet the applicable code criteria, the appropriate sample size was used for assessment based on the population size (see Attachment 12). The number of items obtained (200 or the entire population) was sufficiently large to allow for replacement of inaccessible items.

To afford the post-turnover welds/components that are under the jurisdiction of the TVA Office of Nuclear Operations an equal chance of selection, a different method had to be used.

The welds/components by the TVA Office of Nuclear Operations are not in the same data bases as those installed by the Office of Construction and, therefore, were not available for sampling with the original general groups. Separate files were set up and population size comparisons were made. Based on the comparative sizes, a determination was made on the appropriate number of samples that would be obtained. These samples were drawn using EG&G PCs. These samples were selected in addition to the number of samples required by the general population size.

(Example: Group D population size = 2488; Group D—post-turnover population size = 109; calculation 109/2488 x 64 (original sample size) = 2.80 round up to 3. For this example, three additional samples would be obtained.)

The sampling methodology for expansion groups used one or more of the methods described above and sample sizes depended upon whether the expansion was bounded or not (see Section 3) and used the appropriate tables (see Attachments 11 and 12).

6. REFERENCES

1. *Tennessee Valley Authority Watts Bar Nuclear Plant Final Safety Analysis Report*, and Amendments through February 1, 1986, Tennessee Valley Authority, Chattanooga, TN.

2. W. H. Borter, *Weld Program Review*, DOE/ID-10152, December 1986.

3. S. M. Bradford, *WEP Formation of Homogeneous Groupings of Welds*, DOE/ID 10175-2, November 1987.

4. S. M. Bradford, *WEP Organization and Work Scope*, DOE/ID-10175-1, November 1987.

5. D. A. Armour, *WEP Component Inspection and Examination Process*, DOE/ID-10175-4, November 1987.

6. De Lon 'H' Gardner, *WEP Data Bases for Weld Reinspection Results and Status Reports*, DOE/ID-10175-3, November 1987.

7. R. K. Blandford, *WEP Suitability for Service Evaluation Engineering Process*, DOE/ID-10175-5, November 1987.

8. L. C. Brown, *WEP Generic Problem Analysis Process*, DOE/ID-10175-6, November 1987.

9. L. C. Brown and R. J. Wade, *WEP Aggregate Results of Weld Assessments,*, DOE/ID-10175-8, November 1987.

10. F. C. Fogarty, *Weld Evaluation Project Final Report*, DOE/ID-10175-9, November 1987.

11. Nuclear Construction Issues Group (NCIG), "Sampling Plan for Visual Reinspection of Welds," NCIG-02, Rev. 0, September 27, 1985.

12. American Welding Society Inc., *Structural Welding Code*, AWS D1.1-72, with Revision 2, 1974.

13. The American Society of Mechanical Engineers, "Rules for Construction of Nuclear Power Plant Components," *ASME Boiler and Pressure Vessel Code*, Section III-Division I, 1971 Edition with Summer 1973 Addenda (1974 Edition for Heat Treatment).

14. The American Society of Mechanical Engineers, "Power Piping," ANSI B31.1, June 15, 1973, with Summer 1973 Addenda.

15. Statistical Analysis System, SAS Institute, Cary, North Carolina 27511.

16. C. L. Atwood, *User's Guide to Weldsamp, An IBM PC Program*, EG&G-WEP-86-001, February 1986.

General and Special Group Classification

Original General Group Categories Formed for Overall Evaluation of As-Constructed Plant Welds

Piping			Time frame	Structural					HVAC duct
					Supports				
ASME small bore	ASME large bore	ANSI B31.1, B31.5		Civil	Pipe	I&C	Electrical	HVAC	
A	B	C	1986	D	F	G	I	K	M
≤ 2 in nominal pipe size	> 2 in nominal pipe size								
			Feb. 1981	———		———	———	———	
			1973	E		H	J	L	

Notes:

1. Time frame division indicates a change in the organization that inspected the welding, and other weld program changes implemented by the TVA in this time frame to upgrade construction welding. The changes could potentially have affected the homogeneity of weld quality.

2. A through M indicated DOE/WEP designation of the general groups.

Special Group Classifications[a]

202	Aux. Bldg. Electrical Supports @ Elev. 713
203	Additional Diesel Bldg. - Butt Welds Fire Protection System
207	Steam Generator Supports - Tang Plates
208	Instrument Panel Drain Threadolets - Systems 62, 63, 68
209	Temporary Minor Attachments - ASME (Thermocouple Attachments)
210	Backdating of Welder Certifications
212	RT Welds - Piping Penetrations Containment Wall
214	North and South Valve Room - Structural Welds
219	HVAC Duct Supports - Control Building
220	Butt Welds Made Without Required Purge
222	Platforms, Ladders, Stairs
224	Integral Attachments - Welding Pipe Support Lugs
225	Conduit Supports - Elevation 708 to 728 - Control Building
227	Stiffeners & Crossbracing - Surge Line Truss
228	Check Valves - Fire Protection System
229	Steam Generator Supports - Upper and Lower
230	Seismic Pipe Sleeve Hangers
249	RT Film Interpretation
250	Cable Tray Support Clip Welds - Expansion Group J and Special 202
251	Electrical Support Welds - Expansion Group J, Special 202, Special 225
252	Mechanical Equipment and Related Supports
253	RT Film Interpretation
254	Electrical Equipment and Supports
255	Support Bracing Elevation 741 - Expansion Group E
256	Mainframe Structural Floor Beams & Connections - Expansion Group E
257	Stainless Steel Liner Plant Welds
258	RT Film Interpretation
259	Instrument Supports - Group H Expansion (not sampled)
260	Main Structural Framework - Group D Expansion
261	Stiffener and Crossbracing - Surge Line Truss - Expansion Special 227
262	ASME Class 1 & 2 - GTAW Process - Expansion Group A
263	Safety Related/Safety Significant Civil Components - Expansion Group E
264	ASME Section III, Class MC
265	Instrument Supports - Expansion Group G
266	Electrical Equipment and Supports - Expansion Special 254

a. Limited to groups requiring populating and sampling.

Group Identification and Record Size

Weld Group Designation	File Name	Population Size
Group A	$KCA955.K.CX234234.Z73.EGGASB	41,209
Group B	$KCA955.K.CX234234.Z73.EGGALB	12,659
Group C	$KCA955.K.CX234234.UPIPEN.C	3,519
Group D and E	$KCA955.K.CX234234.ICIDS4	7,465
Group F	$KCA955.K.CX234234.WBHITS.PIPE4	35,035
Group G and H	$KCA955.K.CX234234.ICIDS.G	3,107
Group I and J	$KCA955.K.CX234234.Z99WBEC.TIER1	22,891
Group K and L	$KCA955.K.CX234234.WBHITS.HVAC4	2,772

Explanation of File Layout for Groups A and B ASME Small and Large Bore Piping

The data appearing on a printout of the ASME data base will be as follows:

1	2	3	4	5	6	7	8	9
1-067C-T256-43-0-0		06.00	0.280	GT8803	S-29-128	0450-021-1-1	X67-P5	B

10	11	12	13	14	15	
N	C	S	082782	042183	6SW	6CRR

1. Unique weld identification number identifies Unit (0,1,2) : System : Reference drawings (usually preceded by 47W) : Specific weld identification.

2. Indicates cut and/or repair revision.

3. Indicates pipe diameter (in.).

4. Indicates wall thickness (in.).

5. Indicates weld procedure (may be identified with N/A if repaired and no additional welding performed).

6. Indicates Weld Operation Sheet numbers.

7. Indicates weld sketch numbers.

8. Indicates N5 partial number (N5 is an ASME Code designation for completion of construction for piping installations).

9. Indicates level of NDE required (UT, PT, MT).

10. Indicates weld status (stage of completion).

11. Indicates TVA weld classification.

    TVA Class A = ASME Class 1
    TVA Class B = ASME Class 2
    TVA Classes C and D = ASME Class 3

12. Indicates weld joint design:

    B = Butt welds
    F = Fillet welds
    S = Socket welds
    C = Branch connection welds
    L = Lug welds

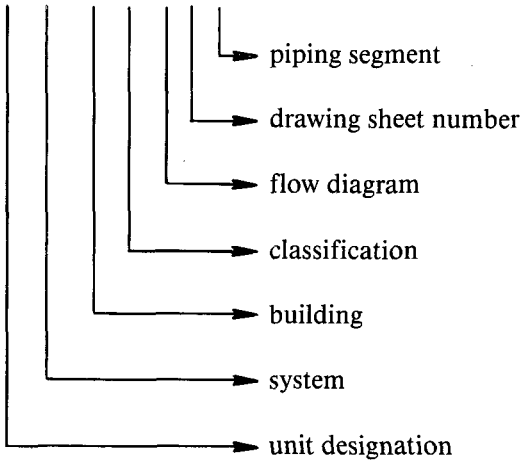
13. Indicates Welding Quality Control release date.

14. Indicates Weld Engineering release date.

15. Indicates welder(s) identification who performed welding on the applicable weld entry.

Explanation of File Layout for Group C ANSI Piping

Unique identifier: 1-040-AB-L-511-1-01



Tests: codes indicating what inspections have been performed.

Descriptions: brief narrative of the piping.

Class: piping class.

Transfer activity: codes indicating transfer status (turnover).[a]

---

a. "Transfer" denotes assignment of responsibility for hardware from the TVA Office of Construction to the TVA Office of Nuclear Operations.

Explanation of File Layout for Groups D and E Civil/Structural Components

The following explains the fields of the civil data base output:

Drawing — The alpha-numeric identifier of a design document, normally pictorial in nature.

SEQ — "SEQUENCE": This is a computer-generated numerical counter used to catalog multiple references to a drawing. This number makes a document unique. Normally, if more than one component is shown on a drawing, and each component is documented separately, each will have its own sequence number.

REV. — "REVISION": This is the revision of the drawing at the time of data entry.

UNIT — Generation unit the component is dedicated to:

Unit 1 = 1
Unit 2 = 2
Common = C.

SYS — "SYSTEM": As defined by the site system description.

LVL — Quality material level.

CONTRACT — Vendor/Supplier number, for DOE/WEP = N/A.

ROOM — Location of component:

DGB = Diesel generator building
ADGB = Additional diesel generator building
IPS = Intake pump structure
SVR = Steam valve room (south)
AB = Auxiliary building
PT = Pipe tunnels
RB = Reactor building
CB = Control building
ADEB = Additional equipment building
RHR = Residual heat removal
NVR = North valve room
XXX-aX = Elevation-column lines (auxiliary and control building)

2.04J 2.04G — Test identifier. These are the quality control procedure inspection reports.

J = Field installation and fabrication

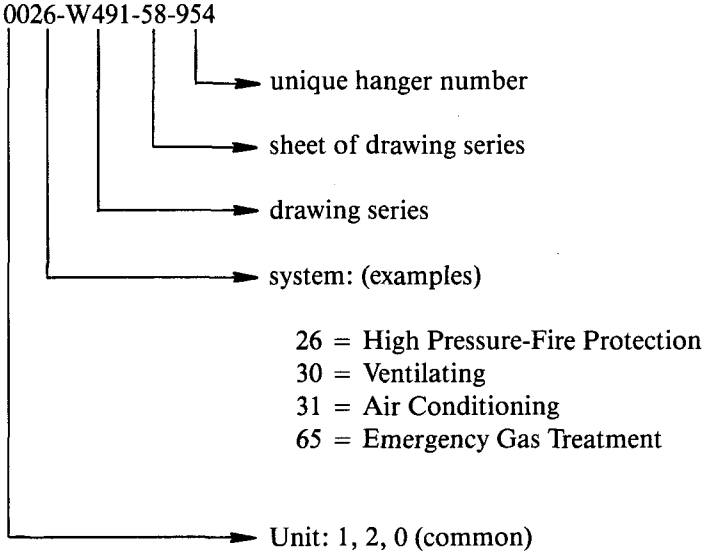
G = Fabrication.

C/or "RA*"	R	"REQUIRED": quality control inspection is required.
	A	Inspection results are acceptable first time (B - second time, C - third time, etc.).
	*	Records are in the TVA Quality Control and Records Unit.

Explanation of File Layout of Group F Pipe Hangers/Supports

This information is contained in the TVA document QCI 1.40 (Inspection and Test Documentation and Accountability), Revisions 0 through 7.

Unique identifier: 0026-W491-58-954



Transfer Designation[a]

X Not transferred

T Transferred

TZ Hanger records for WBNP Unit 2 transferred with Unit 1 (Unit 1 fuel load)

Z Hanger records for Unit 2 not transferred

Drawings

47A055-163 Typical hanger configuration for -163 hanger type.

Other typical configurations (for pipe and duct supports) include: 47A058, 47A059, 47A053, 47A052

Engineered support drawings show configuration, based on loads (given on drawings also) and show location of hanger. Drawings (for pipe and duct supports) include but are not limited to 47A920, 47A480, 47W930-1, and 47A915-3.

---

a. "Transfer" denotes assignment or responsibility for hardware from the TVA Office of Construction to the TVA Office of Nuclear Operations.

Status

All test and inspection activities are complete for the particular unique identifier, and documentation is in the TVA Quality Control and Records Unit (QC&RU).

* Current WBNP-QCP documentation requirements complete.

x Former documentation meets current WBNP-QCP requirements.

$ Former documentation does not meet current WBNP-QCP requirements; however documentation is acceptable and does satisfy, licensing requirements.

% No official documentation exists, and evaluation has satisfied the installation. The evaluation statement documents acceptance.

Test Library

HA = Bolted support (anchor plate)

HD = Welded support (no welds)

Test Sequence

01 Testing of expansion anchors set in hardened concrete
02 Inspection of bolted connections
03 Inspection of support orientation and alignment
04 Visual examination of weld joint
08 Final inspection of support configuration

Test Notation

A Test/inspection done once.

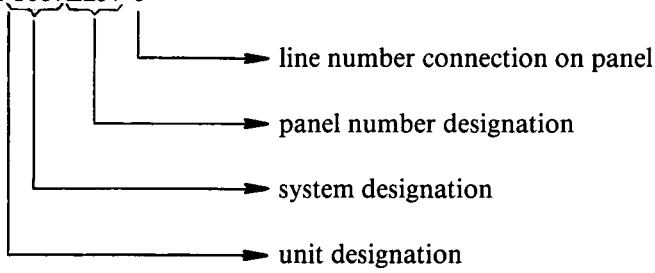
B Test/inspection done twice, and so on.

04* Test/inspection was conducted per QCP 4.23-4.

04$ Test/inspection was conducted per QCP 4.8.

Explanation of File Layout for Groups G and H Instrument Supports (subassemblies)

Unique identifier: 1087L257-6



Library tests: codes indicating what inspections had been performed.

Code: entry status for the TVA Quality Control and Records Unit.

Drawing: design drawing for the subassemblies.

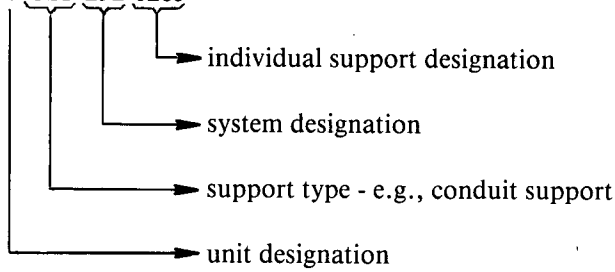
Work Package: number for identification of any applicable work package.

IOS: number of the Installation Operation Sheet that documents installation.

FCR or SVS or FOS: number of design change document (FCR or SVS) or number of the Fabrication Operation Sheet (FOS) that documents fabrication of the support.

Explanation of File Layout for Groups I and J Electrical Supports

Unique identifier: 0-CSP-292-0285



Description: indicates the location of the support.

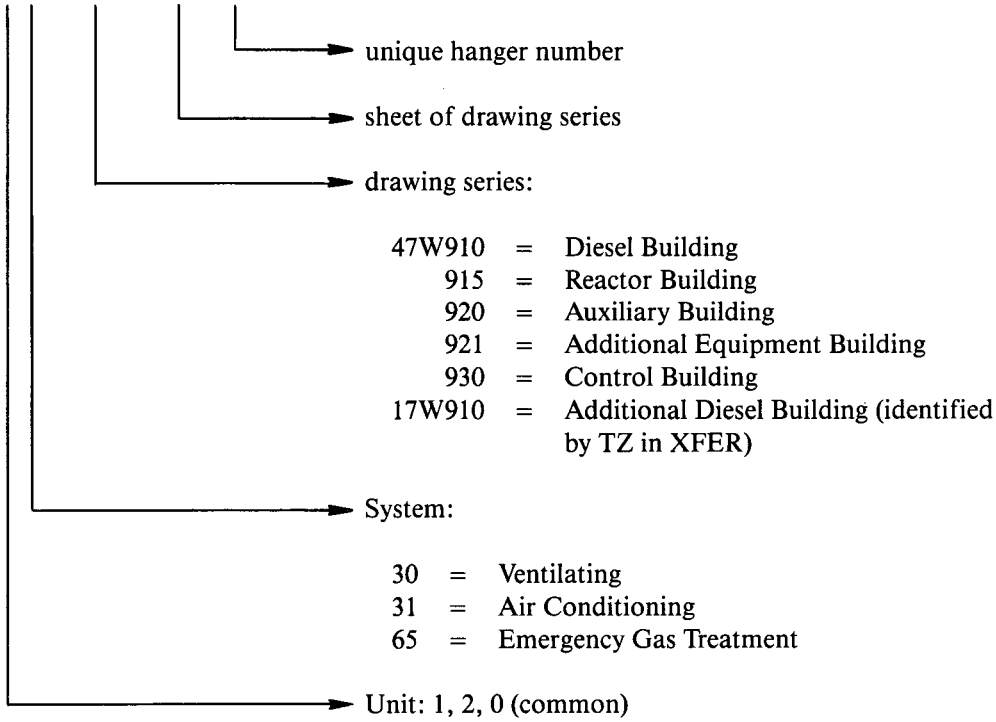
Miscellaneous data: typical drawing number.

Test sequence: codes indicating what inspections had been performed.

Explanation of File Layout for Groups K and L HVAC Hangers

This information is contained in the TVA document QCI 1.40 (inspection and Test Documentation and Accountability), Revision 0 through 7.

Unique identifier: 0030-DW910-01H-1300



Transfer Designation[a]

X Not transferred

T Transferred

TZ Hanger records for WBNP Unit 2 transferred with Unit 1 (Unit 1 fuel load)

Z Hanger records for Unit 2 not transferred

---

a. "Transfer" denotes assignment of responsibility for hardware from the TVA Office of Construction to the TVA Office of Nuclear Operations.

Drawings

47A055-163 Typical hanger configuration for -163 hanger

Other Typicals (for pipe and duct supports) include: 47A058, 47A059, 47A053, 47A052

Engineered support drawings show configuration, based on loads (given on drawings also), and show location of hanger. Drawings (for pipe and duct supports) include but are not limited to 47A920, 47A480, 47W930-1, 47A915-3.

Status

All test and inspection activities are complete for the particular unique identifier, and documentation is in the TVA Quality Control and Records Unit (QC&RU).

* Current WBNP-QCP documentation requirements complete.

x Former documentation meets current WBNP-QCP requirements.

$ Former documentation does not meet current WBNP-QCP requirements; however, documentation is acceptable and does satisfy licensing requirements.

% No official documentation exists and evaluation has satisfied the installation. Evaluation statement documents acceptance.

Test Library

HA = Bolted support (anchor plate)

HD = Welded support (no welds)

Test Sequence

01 Testing of expansion anchors set in hardened concrete
02 Inspection of bolted connections
03 Inspection of support orientation and alignment
04 Visual examination of weld joint
08 Final inspection of support configuration

Test Notation

A Test/inspection done once.

B Test/inspection done twice, and so on.

04* Test/inspection was conducted per QCP 4.23-4.

04$ Test/inspection was conducted per QCP 4.8.

General and Special Groups

Group Designation	Pre-turnover Population Size	Post-turnover Population Size	Sample Size[a]	Actual
A	41,209	94	64	66
B	12,659	28	64	74
C	3,519	1,184	107	107
D	2,488	109	67	67
E	4,977	N/A	64	64
F	35,035	103	64	65
G	13,691	117	66	66
H	221	N/A	57	57
I	7,630	15	64	64
J	15,261	N/A	64	64
K	2,134	2	64	64
L	638	N/A	64	64
202	1,504	N/A	63	64
203	12	N/A	12	12
207	41	N/A	31	31
208	220	N/A	56	56
209	72	N/A	42	42
210	172	N/A	60	60
212	156	N/A	52	52
214	997	N/A	91	91
219	621	N/A	61	61
220	24	N/A	5	5
222	297	N/A	50	50
224	2,499	N/A	64	64
225	736	N/A	62	62
227	51	N/A	34	35
228	10	N/A	10	10
229	1,000	N/A	70	70
230	550	N/A	92	92
249[b]	1,696	N/A	1,696[e]	1,696
250[b]	d	N/A	78	78
251[b]	d	N/A	30	30
252	197	N/A	54	54
253[b]	104	N/A	104[e]	104
254	5,929	N/A	64	64
255[b]	168	N/A	168[f]	—[c]
256[b]	182	N/A	182[f]	—[c]
257	4,984	N/A	64	64
258[b]	1,278	N/A	1,278[e]	1,278
260[b]	—[d]	N/A	30	30
261[b]	10	N/A	10	10

Group Designation	Pre-turnover Population Size	Post-turnover Population Size	Sample Size[a]	Actual
262[b]	17,679	N/A	86	86
263[b]	—[d]	N/A	30	31
264[b]	308	N/A	58	58
265[b]	—[d]	N/A	30	30
266[b]	—[d]	N/A	30	30

a. Minimum Sample Size: includes additions to populations (post-turnover and added scope)

b. Expansion

c. The TVA to perform corrective action

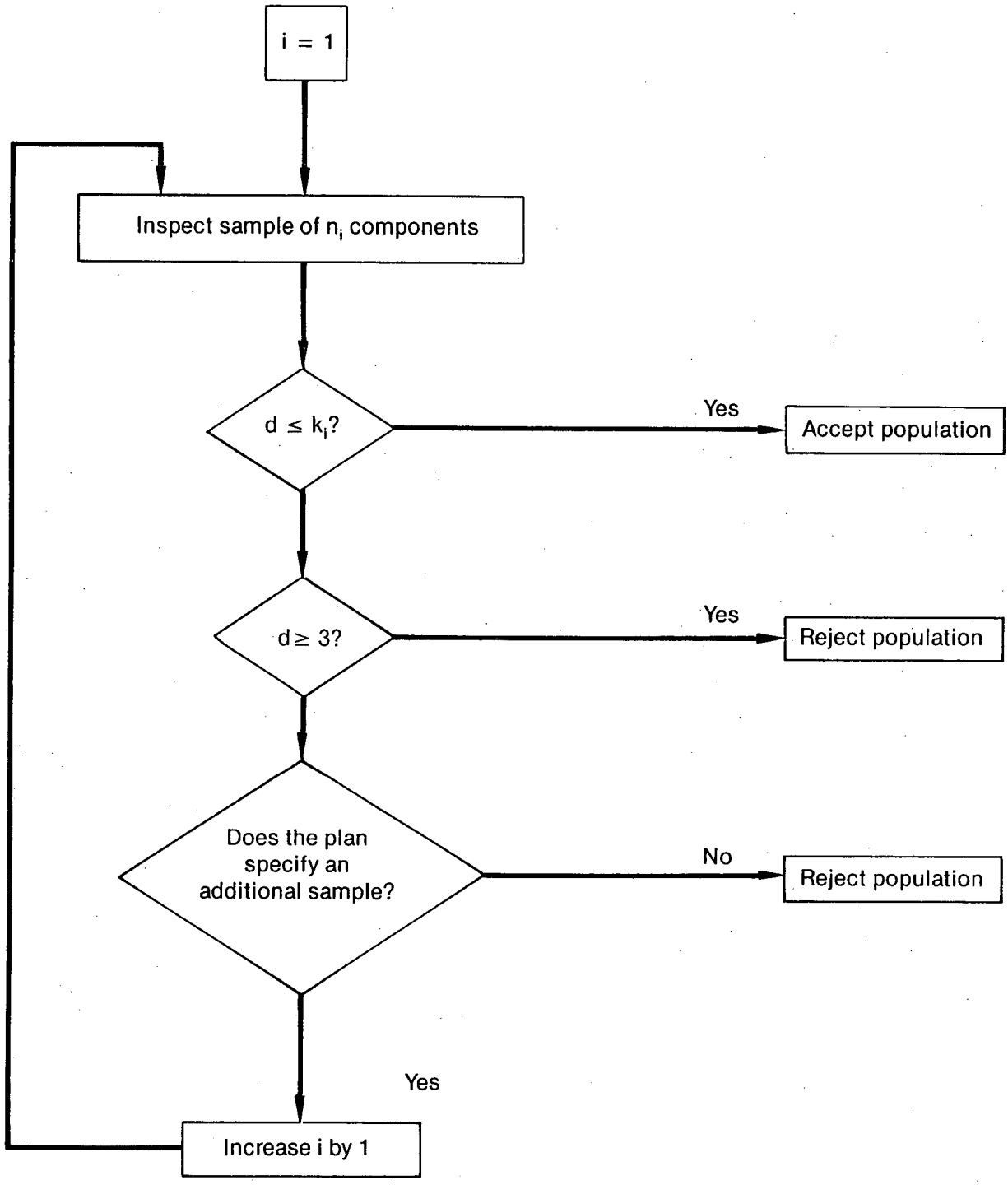
d. Population not bounded-continued with original population's random sample

e. 100% Radiography Film Review

f. 100% Expansion Due to Unsuitable-for-Service

Note: In some cases, the actual sample size exceeds the minimum sample size. This is because of added scope, post-turnover samples, and extra samples inspected in anticipation of additional inaccessible or indeterminate items.

Sampling Plan for a Population



d = the cumulative total number of components verified that are unacceptable.
$k_1 = 0; k_2 = 1; k_3 = 2.$

NOTE: $n_1 = 64, n_2 = 51, n_3 = 51$

7-2585

Multiple-Stage Plan Sample Sizes for 95% Confidence of 95% Reliability

Population Size	Sample Sizes[a] n_1	n_2	n_3	Population Size	Sample Sizes[a] n_1	n_2	n_3
1-19	all	—	—	67	41	15	6
20-25	19	all	—	68	41	16	6
26	20	all	—	69	41	17	6
27	21	all	—	70	42	17	6
28	22	all	—	71	42	18	6
29-30	23	all	—	72	42	19	6
31	24	all	—	73	42	19	8
32	25	all	—	74	42	20	8
33-34	26	all	—	75	42	21	8
35	27	all	—	76	42	21	10
36	28	all	—	77	43	21	10
37	29	all	—	78	43	22	10
38-39	30	all	—	79-88	44	22	10
40	30	5	all	89	44	22	11
41	31	5	all	90	44	23	11
42	31	6	all	91	44	23	13
43	31	7	all	92	44	24	14
44	31	8	all	93	44	25	15
45	31	9	all	94	45	25	15
46	32	9	all	95	45	25	16
47	32	10	all	96	46	25	16
48	33	10	all	97	46	26	16
49	33	11	all	98	47	26	16
50	34	11	all	99-111	47	26	17
51	34	12	all	112	47	27	18
52	35	12	all	113	47	28	18
53	35	13	all	114	47	29	19
54	36	13	all	115	48	29	19
55	37	13	all	116	48	29	20
56	37	14	all	117-118	49	29	20
57	38	14	all	119-133	50	29	20
58	38	15	all	134	50	30	21
59-64	39	15	5	135	50	31	21
65	40	15	5	136	50	31	24
66	40	15	6	137-138	51	31	24
139	51	32	25	338	58	43	37
140-155	52	32	25	339-378	59	43	37
156	52	32	26	379-397	59	43	38
157	52	33	27	398	59	43	40
158	52	34	28	399-417	59	43	42

Population Size	Sample Sizes[a] n_1	n_2	n_3	Population Size	Sample Sizes[a] n_1	n_2	n_3
159-175	53	34	28	418-477	60	43	42
176	53	34	29	478-497	60	44	42
177	53	35	30	498	60	44	43
178-195	54	35	30	499-518	60	45	43
196	54	35	33	519-618	61	45	43
197	54	36	33	619-638	61	45	44
198-216	55	36	33	639-678	61	46	44
217	55	37	33	679-698	61	46	46
218	55	38	33	699-898	62	46	46
219-237	56	38	33	899-958	62	47	46
238	56	38	34	959-998	62	47	47
239-255	56	39	34	999-1078	62	48	47
256	56	39	35	1079-1638	63	48	47
257-276	57	39	35	1639-1698	63	48	48
277	57	40	35	1699-1778	63	48	49
278	57	40	36	1779-2078	63	49	49
279-296	57	41	36	2079-2178	63	49	50
297-318	58	41	36	2179-6938	64	49	50
319-336	58	42	36	6939-16398	64	50	50
337	58	42	37	16399-25038	64	50	51
				25039-infinity	64	51	51

a. The sample sizes of NCIG-02 have been changed from (64,50,50) to (64,51,51). This corrects a small round-off inaccuracy in NCIG-02, and provides at least 95% confidence of at least 95% reliability. The sample size for populations of indeterminate size shall be the more conservative of those available (i.e., $n_1 = 64$; $n_2 = 51$, $n_3 = 51$).

Single-Stage Plan Sample Sizes for 95% Confidence of 95% Reliability
(For GPA Expansions Only)

Population Size	Sample Size
1-19	all
20-24	19
25-26	20
27	21
28	22
29-30	23
31	24
32	25
33-34	26
35	27
36	28
37	29
38-48	30
49-50	31
51	32
52-53	33
54	34
55-56	35
57-58	36
59-71	37
72-73	38
74-75	39
76-77	40
78-92	41
93-95	42
96-97	43
98-114	44
115-117	45
118-135	46
136-138	47
139-157	48
158-177	49
178-197	50
198-218	51
219-258	52

Population Size	Sample Size
259-317	53
318-397	54
398-517	55
518-738	56
739-1258	57
1259-4398	58
4399-infinity	59

APPENDIX A
APPLICABLE DOE WELD EVALUATION PROJECT STANDARD PRACTICES

INDEX OF APPLICABLE DOE/WEP STANDARD PRACTICES

SP WEP 3.1.2, "Preparing, Verifying, Populating, and Maintaining the Component Data Base" A-3

SP WEP 3.1.6, "Identifying Random Samples From Homogeneous Groups" A-10

EG&G Idaho, Inc.	Title: PREPARING, VERIFYING, POPULATING, AND MAINTAINING THE COMPONENT DATA BASE	No.: WEP 3.1.2 Rev 7
		Page 1 of 7
		Date: 05/19/87
STANDARD PRACTICE	Approved:	REVISIONS: Vertical line, right margin
DOE Weld Evaluation Project		
Reviewed By:		See DRR 673

1. PURPOSE AND SCOPE

To assign responsibility and define preparation, verification, population, and direct maintenance of the Component Data Base.

2. RESPONSIBILITY AND PRACTICE

2.1 Preparation

Technical Program (TP) Component Selection Group (CS) shall be responsible to verify the adequacy of the Tennessee Valley Authority (TVA) computer data base for safety-related components. Project Administration and Control (PAC) Data Base personnel are responsible for preparing and maintaining a Weld Evaluation Project (WEP) data base for those components. Welded, safety-related components will be divided by TP CS into groups as discussed in Standard Practice (SP) WEP 3.1.3.

2.1.1 Perform a walkdown to provide an arbitrary sample (Definition 3.1) of 64 components related to each major group classification (Definition 3.2) to be validated.

TVA weld maps, drawings, or component identification tags shall be reviewed as necessary to determine proper weld/component identification.

2.1.2 A weld/component data base shall be generated for each applicable safety-related weld/component group to be validated. A listing of the data base shall be compared with the aribitrary sample to ensure data base completeness. Record the results of the verification on Form WEP 308, Attachment 1.

2.1.3 Discrepancies identified on Form WEP 308 shall be documented in accordance with SP WEP 3.2.2. Refer to Figure 1 for sample expansion.

2.1.4 Obtain the TP Manager approval signature for verified lists on Form WEP 308, Attachment 1.

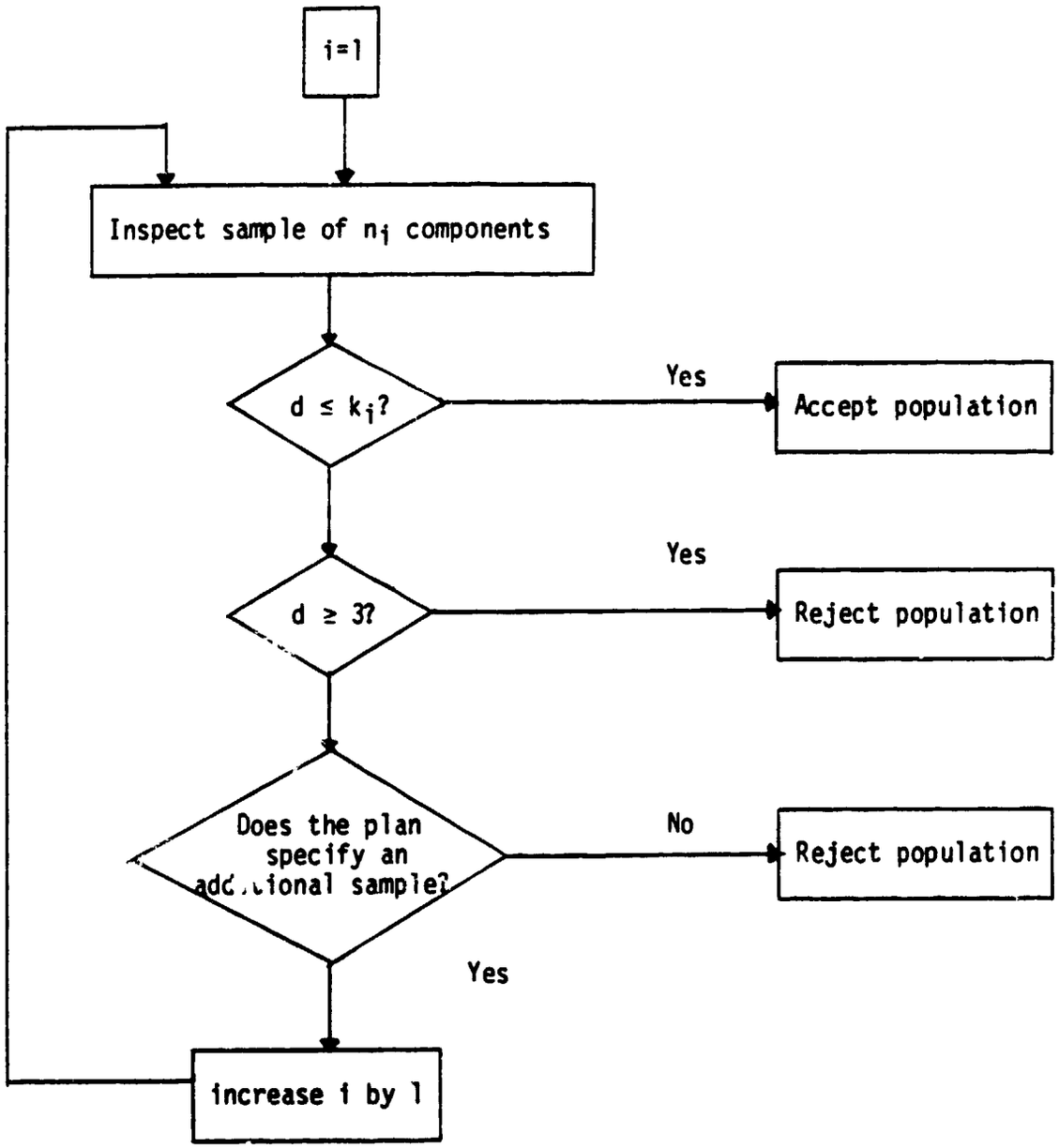


Figure 1. Sampling plan to be used for a population.

In Figure 1, d is the cumulative total number of components verified that are unacceptable. The values of k_1, k_2, and k_3 are 0, 1, and 2, respectively.

NOTE: $n_1 = 64$, $n_2 = 51$, $n_3 = 51$,.

3.2 Major classifications--Groups of weld(s)/component related by similar characteristics such as ASME piping welds, AWS civil structural, etc.

3.3 Component data base--Master data and homogeneous group files maintained on the TVA/WEP computer system.

3.4 Population--A group of weld(s)/component that is bounded within a major classification or by a particular concern.

3.5 Back-up data--Data both downloaded to the internal hard disk and duplicated onto floppy disk.

4. REFERENCES

4.1 Standard Practice WEP 3.1.3, "Establishing Homogeneous Groups and Boundaries."

4.2 L. C. Brown ltr to Population Definition Group/Distribution, LCB-06-86, Procedure for Reporting Potential Discrepancies Uncovered During the Population Verification Process.

4.3 L. C. Brown ltr to Population Definition Group/Distribution, LCB-07-86, Clarification of Major Configuration Definition for Data Base Verification.

4.4 Standard Practice WEP 3.2.2, "Reporting Deviations to TVA."

4.5 Standard Practice WEP 3.1.6, "Identifying Random Samples from Homogeneous Groups."

ATTACHMENT 2 (continued)

Form WEP 314
Rev. 03/87

HOMOGENEOUS GROUP POPULATION APPROVAL

Data base conditionally approved pending resolution of DRs[a]

_____ _____
Technical Program Manager Date

Data base approved

_____ _____
Technical Program Manager Date

a. Conditional Approval--approval to conduct random sorts per SP WEP 3.1.6, and approval to use the data base for other WEP activities; however, the validity of such activities is contingent upon final approval of the data base.

EG&G Idaho, Inc.	Title: IDENTIFYING RANDOM SAMPLES FROM HOMOGENEOUS GROUPS	No.: WEP 3.1.6 Rev 5
		Page 1 of 5
		Date: 10/24/86
STANDARD PRACTICE DOE Weld Evaluation Project	Approved:	REVISIONS: Vertical line, right margin
Reviewed By:		See DRR 523

1. PURPOSE AND SCOPE

To define the process for identifying random samples from homogeneous groups of Tennessee Valley Authority (TVA)-welded, safety-related components. These groups are portions of the total population of TVA-welded, safety-related components at the TVA Watts Bar Nuclear Plant Unit 1.

2. RESPONSIBILITY AND PRACTICE

2.1 Using a random number generator on a computer, Technical Program (TP) Component Selection (CS) shall generate a list of randomly selected components from each homogeneous group population.

2.1.1 Each generated list shall contain 200 random components or the total population, whichever is smaller, to provide a contingency for removal from the list of inaccessible components. CS will generate an extended list to provide the needed samples. Appendix A shall be used to meet the sample size for 95%/95% for a multiple stage sampling plan and Appendix B shall be used to meet the sample size for a single stage sampling plan.

2.1.2 The seed number used to generate each random sample shall be recorded in a log that will be maintained in Configuration Management (CM) as a Weld Evaluation Project (WEP) quality record to ensure reproducibility and/or extendability of random sample selection. This log will be designated as having limited access and a list of authorized WEP personnel shall be available in CM.

2.1.3 The list of random components/welds will be annotated with the total number required to examine the group. Reference 4.1 defines the sample sizes for a multiple stage sampling plan utilizing the 95%/95% acceptance criteria listed in Appendix A. Sample sizes are listed in Appendix B for a single sample plan if required by the sampling methods as outlined in Standard Practice (SP) WEP 3.3.2.

2.1.4 After the initial random sample has been acquired, some homogeneous groups require manual sorting, reentry of data, and a second random sort to generate a sample of components per Paragraph 2.1.1, this procedure is outlined in Reference 4.3.

2.2 In accordance with SP WEP 3.1.7, accessibility of the components on the list will be verified and any inaccessible components in the sample will be replaced by the next sample on the list.

2.3 Upon completion of the accessibility assessment, Inspection/Examination (I/E) will submit a copy of the final list of random samples to Project Administration and Control (PAC).

3. DEFINITIONS

3.1 Population--A group of components or welds that is determined by the Employee Concern/Quality Indicator/Assessment (EC/QIA) Manager to be assessed by random sampling methodology.

3.2 Sample--A portion of the population that is selected for examination. If some of the components in the sample are inaccessible, others must be added.

3.3 Inaccessible--A weld or component shall be considered inaccessible as defined by the requirements of Reference 4.4.

3.4 Seed Number--The WEP-selected arbitrary number to initialize the process of random number generation by a computer. The seed numbers are generated by a computer program that generates 500 random numbers from one million to ten million. Any resulting even numbers are discarded, since the TVA SAS program (Reference 4.5) requires odd numbers only for seed numbers.

4. REFERENCES

4.1 "Sampling Plan for Visual Reinspection of Welds," NCIG-02, September 27, 1985, Revision 0.

4.2 Standard Practice WEP 3.3.2, "Root Cause and Generic Problem Evaluation."

4.3 L. C. Brown ltr to C. A. Atwood, LCB-08-86, Special Procedure for Obtaining Random Samples From Populations without Unique Component Identification.

4.4 Standard Practice WEP 3.1.7, "Weld Accessibility Assessment."

4.5 Statistical Analysis System, SAS Institute, Cary, North Carolina, 27511.

APPENDIX A

MULTIPLE STAGE PLAN SAMPLE SIZES FOR 95% CONFIDENCE OF 95% RELIABILITY

Population Size	Sample Sizes n_1	n_2	n_3	Population Size	Sample Sizes n_1	n_2	n_3
1-19	all	--	--	67	41	15	6
20-25	19	all	--	68	41	16	6
26	20	all	--	69	41	17	6
27	21	all	--	70	42	17	6
28	22	all	--	71	42	18	6
29-30	23	all	--	72	42	19	6
31	24	all	--	73	42	19	8
32	25	all	--	74	42	20	8
33-34	26	all	--	75	42	21	8
35	27	all	--	76	42	21	10
36	28	all	--	77	43	21	10
37	29	all	--	78	43	22	10
38-39	30	all	--	79-88	44	22	10
40	30	5	all	89	44	22	11
41	31	5	all	90	44	23	11
42	31	6	all	91	44	23	13
43	31	7	all	92	44	24	14
44	31	8	all	93	44	25	15
45	31	9	all	94	45	25	15
46	32	9	all	95	45	25	16
47	32	10	all	96	46	25	16
48	33	10	all	97	46	26	16
49	33	11	all	98	47	26	16
50	34	11	all	99-111	47	26	17
51	34	12	all	112	47	27	18
52	35	12	all	113	47	28	18
53	35	13	all	114	48	29	19
54	36	13	all	115	48	29	19
55	37	13	all	116	48	29	20
56	37	14	all	117-118	49	29	20
57	38	14	all	119-133	50	29	20
58	38	15	all	134	50	30	21
59-64	39	15	5	135	50	31	21
65	40	15	5	136	50	31	24
66	40	15	6	137-138	51	31	24

APPENDIX A (continued)

Population Size	Sample Sizes n_1	n_2	n_3	Population Size	Sample Sizes n_1	n_2	n_3
139	51	32	25	338	58	43	37
140-155	52	32	25	339-378	59	43	37
156	52	32	26	379-397	59	43	38
157	52	33	27	398	59	43	40
158	52	34	28	399-417	59	43	42
159-175	53	34	28	418-477	60	43	42
176	53	34	29	478-497	60	44	42
177	53	35	30	498	60	44	43
178-195	54	35	30	499-518	60	45	43
196	54	35	33	519-618	61	45	43
197	54	36	33	619-638	61	45	44
198-216	55	36	33	639-678	61	46	44
217	55	37	33	679-698	61	46	46
218	55	38	33	699-898	62	46	46
219-237	56	38	33	899-958	62	47	46
238	56	38	34	959-998	62	47	47
239-255	56	39	34	999-1078	62	48	47
256	56	39	35	1079-1638	63	48	47
257-276	57	39	35	1639-1698	63	48	48
277	57	40	35	1699-1778	63	48	49
278	57	40	36	1779-2078	63	49	49
279-296	57	41	36	2079-2178	63	49	50
297-318	58	41	36	2179-6938	64	49	50
319-336	58	42	36	6939-16398	64	50	50
337	58	42	37	16399-25038	64	50	51
				25039-infinity	64	51	51

NOTES:

a. The sample sizes of Reference 4.1 have been changed from (64,50,50) to (64,51,51). This corrects a small round-off inaccuracy in Reference 4.1, and provides at least 95% confidence of at least 95% reliability.

b. The sample size for populations of indeterminate size shall be the more conservative of those available in Table 1 (i.e., $n_1 = 64$, $n_2 = 51$, $n_3 = 51$).

APPENDIX B

SINGLE STAGE PLAN SAMPLE SIZES FOR 95% CONFIDENCE OF 95% RELIABILITY

Population Size	Sample Size
1-19	all
20-24	19
25-26	20
27	21
28	22
29-30	23
31	24
32	25
33-34	26
35	27
36	28
37	29
38-48	30
49-50	31
51	32
52-53	33
54	34
55-56	35
57-58	36
59-71	37
72-73	38
74-75	39
76-77	40
78-92	41
93-95	42
96-97	43
98-114	44
115-117	45
118-135	46
136-138	47
139-157	48
158-177	49
178-197	50
198-218	51
219-258	52
259-317	53
318-397	54
398-517	55
518-738	56
739-1258	57
1259-4398	58
4399-infinity	59