STATISTICAL SAMPLING PROGRAM TO TEST CONCRETE EXPANSION BOLTS FULFILLING REQUIREMENTS OF NRC I.E. BULLETIN NO. 79-02 DATED MARCH 8, 1979

FOR

ARKANSAS NUCLEAR ONE - UNIT 1

JOB 11406-276

Issued Jointly by

Civil/Structural

and Plant Design of

Bechtel Power Corporation

in San Francisco

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(BASED ON 95% CONFIDENCE LEVEL AND 2% DEFECTS)

STATISTICAL SAMPLING PROGRAM TO TEST CONCRETE EXPANSION ANCHORS

1.0 INTRODUCTION

The United States Nuclear Regulatory Commission (NRC) requires the verification of the quality of concrete expansion anchors used in the supports of Seismic Category I piping systems of each nuclear power plants (Reference 1). The quality is defined as the ability to meet the design requirement. The quality can be verified either from the existing QC (Quality Control) document or by conducting a testing program. This report discusses a sampling and testing program to determine statistically the quality of installed concrete expansion anchors in operating nuclear power plants.

2.0 APPROACH

A suitable method of testing will be selected to determine the quality of installation. Experience shows that the required capacity with the prescribed safety factor is attained when the expansion anchors are properly installed. The acceptance criterion is established in Reference 2.

If the total number (N) of anchors in a plant is small (say, less than 500), the quality of anchors can be established by a screening process

in which each and every anchor would be tested.

If the total number of anchors (N) is very large, testing only a few anchors selected at random according to a sequential sampling program, as described below, would be adequate and cost effective. The sample size (n), which is the number of anchors selected at random for test, depends on the desired quality (p) and confidence level (c). The confidence level (c) is the probability that the ratio of defective anchors to the total (N) is less than or equal to p.

For example, if it is planned to demonstrate that there is less than 5% defective anchors at a confidence level of 95%, the corresponding sampling program is as shown in Table 1. Accordingly, 58 randomly selected anchors are tested first. If there is no defective anchor encountered, then no more testing is required and the anchors are of acceptable quality. However, if a defective anchor is encountered, 34 additional randomly selected anchors are tested. Thus, the total number of anchors tested becomes 92. Again, if the total number of defective anchors remains one, no more testing is required and the anchors are acceptable. On the other hand, if the total number of defective anchors have increased the testing continues as shown in Table 1 till the anchors are acceptable. The anchors will be considered unacceptable and the testing of all anchors will follow if more than 17 defective anchors were encountered while testing 505 anchors selected at random.

3.0 PROCEDURE

Various items involved in the approach explained above are the following:

3.1 Numbering

All the concrete expansion anchors in the supports of Seismic Category I piping systems can be identified, for convenience, by numbering them sequentially. The numbering can be performed by any convenient manner proceeding from one building to another. A summary table similar to Table 2 could be developed. From this numbering system any particular anchor can be identified. For example, if it is required to test 1048th anchor, it can be seen from Table 2 that 1048th anchor is the third anchor in the 40th baseplate located in the fourth floor of auxiliary building. Within a baseplate all the anchors can be numbered systematically, for example, going clockwise starting from top right corner.

3.2 Sampling

The selection of anchors at random for the test (sampling) can be performed either using random numbers or by any other means. Random numbers can be obtained either from a standard table or by using a computer program. For example, 58 random numbers for a plant with 5000 anchors are shown in Table 3. These numbers were obtained using a FORTRAN subroutine, GGUB, in the UNIVAC computer system.

4.0 DISCUSSION

4.1 Theory

The sequential sampling by attributes is very common and easy to implement. The statistical theory involved is given briefly here. The distribution function f(p) for the probability of encountering m defective anchors in a sample of n anchors selected at random from a total of N anchors is hypergeometric as follows:

$$f(p) = K_1 \frac{\binom{Np}{m}\binom{N-Np}{n-m}}{\binom{N}{n}}$$

where: p = ratio of defective anchors to the total (quality of anchors as defined in Section 2)

K_1 = normalizing constant

( ) = refers to combinations. For example, $\binom{N}{n}$ is the number of combinations of N anchors taken n at a time given by: $\frac{N!}{(N-n)!n!}$

If the sample size (n) is much smaller than the total number of anchors (N), the hypergeometric distribution can be approximated by the following binomial distribution,

$$f(p) = K_2 \binom{n}{m} p^{m} (1-p)^{n-m} \quad ; \quad \text{if } n \leq \frac{N}{10}$$

where: K_2 = normalizing constant = (n+1)

The required confidence level (c) can be obtained from the following relationship:

$$c = \int_0^p f(p)\, dp$$

$$\text{(i.e.)} \quad c = K_2 \binom{n}{m} \int_0^p p^{m} (1-p)^{n-m}\, dp$$

From the last expression, sample sizes (n) can be calculated for various number of defectives (m) encountered to demonstrate less than p defective at a confidence level of c. For example, the sample sizes are calculated and shown in Table 1 for p = 0.05 c = 0.95 and m = 0, 1, 2, ..., 17.

4.2 Acceptance Probability

It is important to study the acceptance probability while assessing the quality of anchors based on a sampling program. The curve in Figure 1 shows the probability of anchors with known amount of defectives passing the sampling program designed to establish less than 5% defectives at 95% confidence level.

The curve shows that if a lot of anchors has 5% defectives, it has only one in twenty chance of being accepted (acceptance probability of 0.05) by the sampling program. The acceptance probability increases as the actual quality of anchors increases. A lot with only 1% defective anchors has an acceptance probability of 0.98. Increasing the sample size will increase the acceptance probability. However, a sampling program cannot change the quality of anchors.

4.3 Efficiency

The sampling program is efficient in accepting anchors of very good quality as discussed above. But it is not so efficient in rejecting anchors of inferior quality. The sampling program can be modified to alleviate this by adding a rejection criterion. For illustration, a rejection criterion is developed and shown in Table 1 for the example. Accordingly, if 7 or more defectives are encountered in the first sample of 58 anchors, the anchors will be rejected and the testing of all anchors will follow. Similarly, if 12 or more defectives are encountered in a sample of 92 anchors, the anchors will be rejected and the testing of all anchors will follow. The modified sampling program for the example is also illustrated in Figure 2. The rejection criterion is based on probable anchors with 20% or more defectives.

4.4 Measured Capacity

It can be noted that the testing program does not directly evaluate the capacity of anchors but verifies the quality of installation.

If the installation is satisfactory it can be said that the ultimate capacities of the anchors will be developed.

4.5 Rejected Anchors

If the anchors in a plant are not of acceptable quality based on a sampling program, the screening process may follow to track down all the defective anchors for future strengthening.

4.6 Recommended Initial Survey

For a nuclear plant with a large number (say, 5000 or more) of concrete expansion anchors in the supports of Seismic Category I piping systems, it is prudent to conduct an initial survey, as described below, to quickly assess the quality of anchors.

- Select at random 92 anchors by walking the plant. An attempt should be made to distribute the selected anchors more or less equally among various locations (floor, ceiling, wall, etc.) and among various types (shell type, wedge type, etc.); and in proportion to the number of anchors in various buildings.

- Determine the number of defectives among the 92.

- If there is none or only one defective, the plant has anchors of good quality and no more testing would be

required unless the sampling is questionable.

- If there are 12 or more defectives, the plant has anchors of inferior quality and each and every anchor would have to be tested.

- If the number of defectives is more than one but less than 12, the plant has anchors of marginal quality. In this case, a decision has to be made based on convenience either to test anchors according to a formal sampling program as described in this report or to test each and every anchor.

5.0 SUMMARY

1. A statistical sampling program to demonstrate by testing the quality of a large number of concrete expansion anchors in a nuclear plant is presented.

2. Various items involved in and limitations of the sampling program are discussed.

3. The alternate to sampling program is screening in which each and every anchor would be tested.

4. If it is decided to conduct a sampling program, the quality (p) for demonstration and the confidence level (c) should be decided first. Also, the sampling program will require the random selection of a few sample anchors.

5. In order to assess quickly the quality of anchors in a plant, an initial survey as described in Section 4.6 is recommended.

REFERENCES

1. "Pipe Support Base Plate Design Using Concrete Expansion Anchor Bolts", IE Bulletin No. 79-02, United States Nuclear Regulatory Commission, March 8, 1979.

2. "Procedure for Inspection and Testing Concrete Expansion Bolts for Pipe Supports", SFPD-7902-5.

TABLE 1. SEQUENTIAL SAMPLING PROGRAM BY ATTRIBUTES

Sample size (n)	Accept if the number of defectives encountered (m) is less than or equal to	Screen (100% testing) if the number of defectives encountered (m) is larger than or equal to
58	0	7
92	1	12
123	2	17
152	3	22
180	4	27
207	5	
233	6	
259	7	
285	8	
310	9	
335	10	
360	11	
385	12	
409	13	
433	14	
457	15	
481	16	
505	17	

Note: Confidence level (c) = 0.95
Accept if defectives are less than 5%
Reject if defectives are greater than 20%

TABLE 2. TYPICAL NUMBERING OF ANCHORS

Base Plate Number	No. of Anchors	Anchor Numbers	Location
1	4	1 - 4	Control Bldg., 1st floor.
2	6	5 - 10	Control Bldg., 2nd floor.
.	.	.	.
.	.	.	.
.	.	.	.
37	10	1028 - 1037	Aux. Bldg., 1st floor, hanger 1
38	4	1038 - 1041	Aux. Bldg., 2nd floor, hanger 1
39	4	1042 - 1045	Aux. Bldg., 2nd floor, hanger 2
40	8	1046 - 1053	Aux. Bldg., 4th floor, hanger 3
41	6	1054 - 1059	Aux. Bldg., 4th floor, hanger 4
.	.	.	.
.	.	.	.
.	.	.	.
1060	4	4997 - 5000	Turbine Bldg., 2nd floor

TABLE 3. RANDOM NUMBERS FROM 5000 ANCHORS

Serial No.	Random Number	Serial No.	Random Number	Serial No.	Random Number
1	1	20	1796	39	3394
2	38	21	1826	40	3396
3	172	22	1917	41	3433
4	235	23	2079	42	3505
5	237	24	2087	43	3613
6	267	25	2102	44	3680
7	302	26	2293	45	3766
8	334	27	2308	46	3778
9	363	28	2432	47	3782
10	459	29	2597	48	3810
11	657	30	2634	49	3832
12	832	31	2640	50	4154
13	1094	32	2803	51	4230
14	1108	33	2944	52	4423
15	1236	34	3150	53	4480
16	1312	35	3163	54	4546
17	1363	36	3257	55	4551
18	1374	37	3260	56	4602
19	1641	38	3355	57	4673
				58	4912

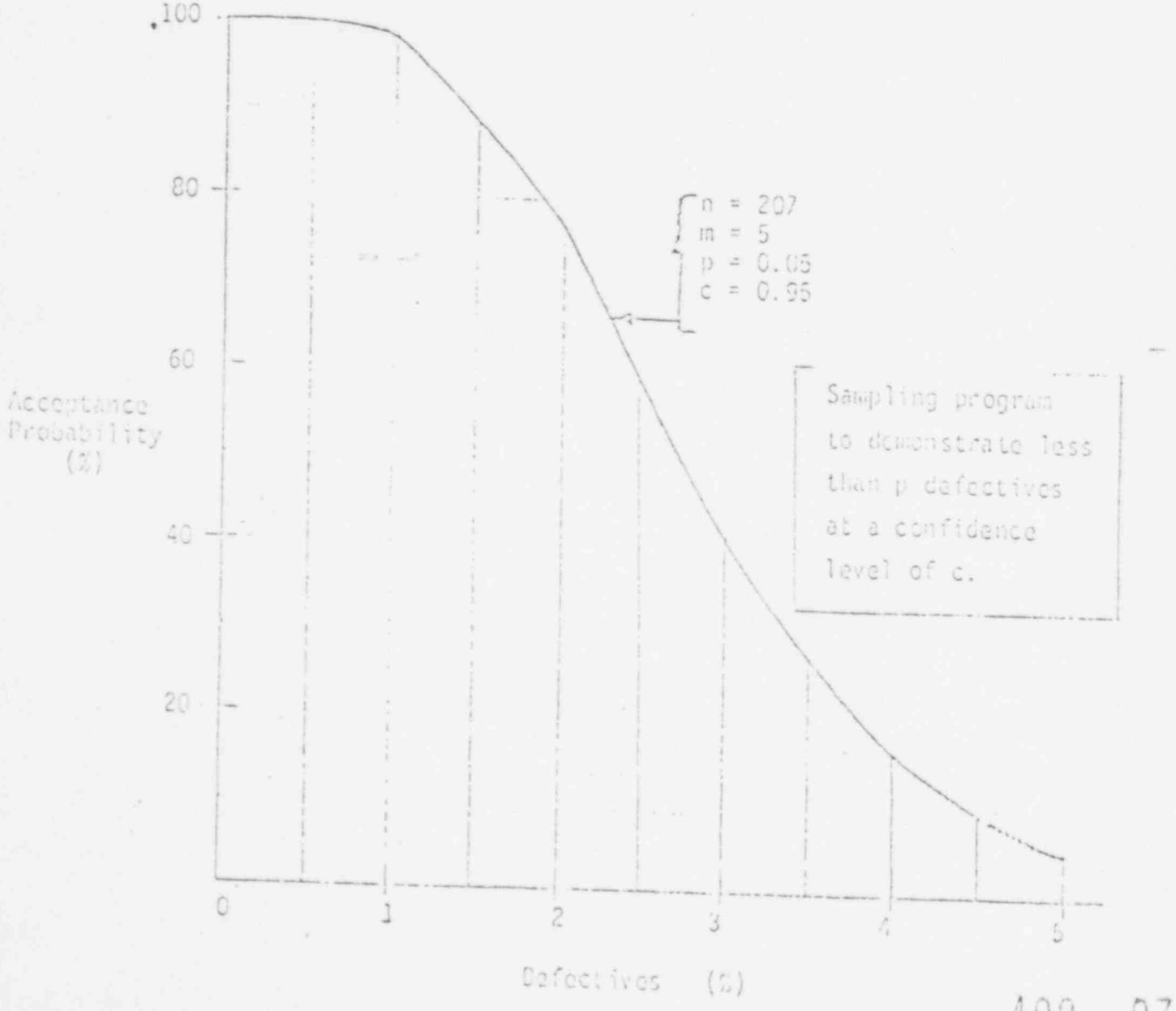


FIGURE 1. ACCEPTANCE PROBABILITY VS. ACTUAL DEFECTIVES

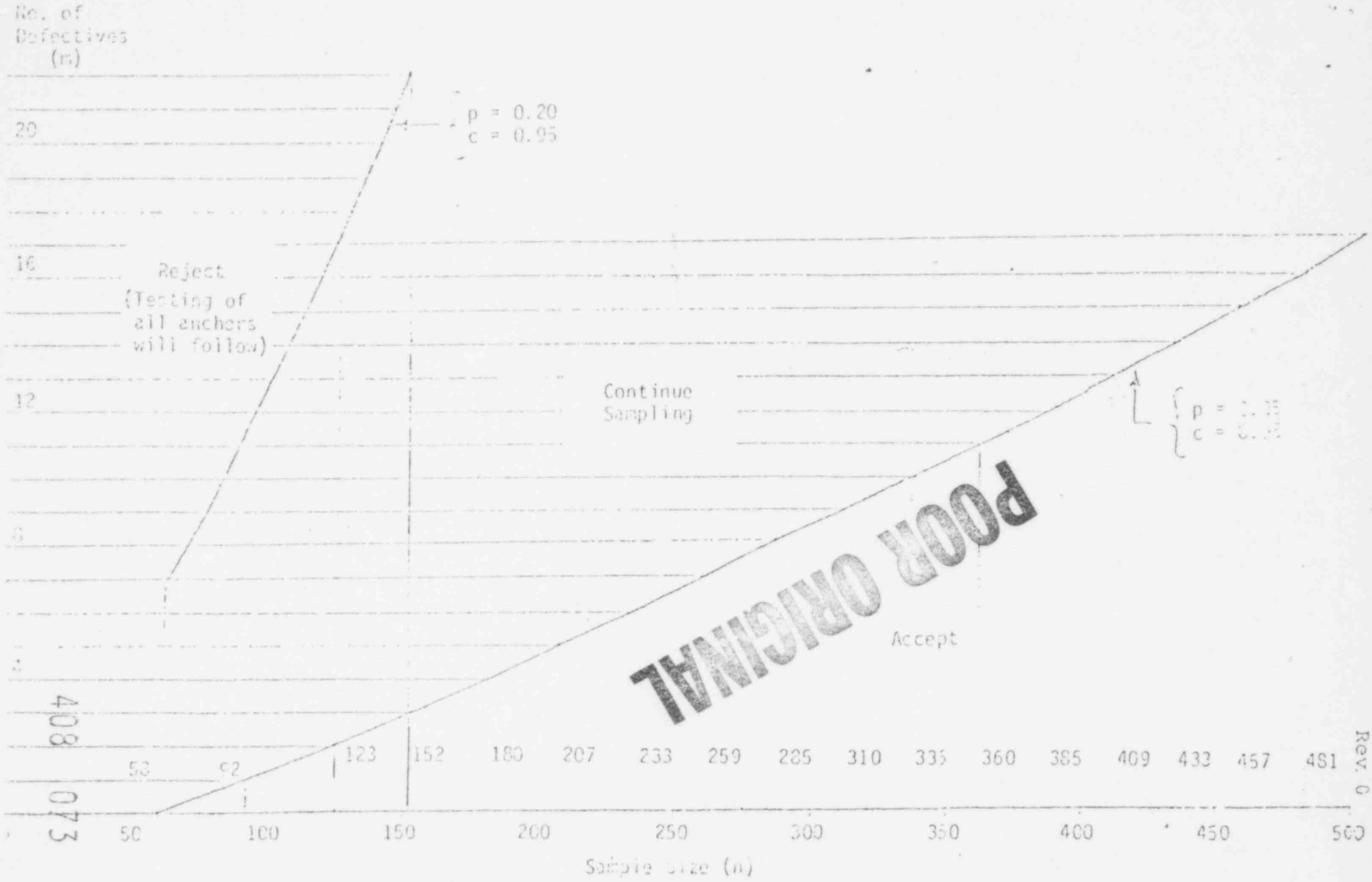
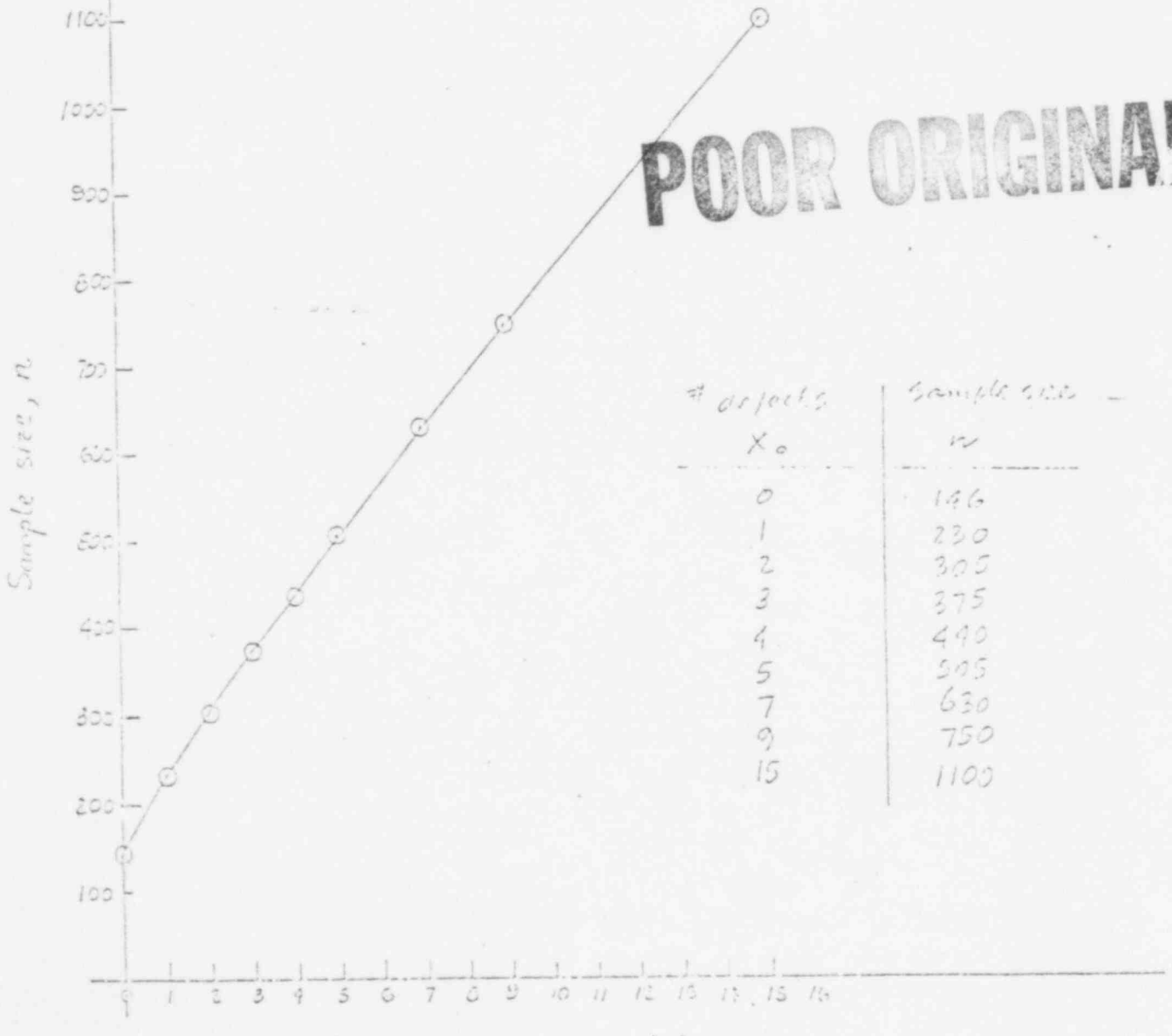


FIGURE 2. MODIFIED SAMPLING PROGRAM

ATTACHMENT 1

95% Confidence level
2% Defectives



# defects X_o	Sample size n
0	146
1	230
2	305
3	375
4	440
5	505
7	630
9	750
15	1100

PROCEDURE FOR INSPECTION AND TESTING CONCRETE EXPANSION BOLTS FOR PIPE SUPPORTS FULFILLING REQUIREMENTS OF NRC I.E. BULLETIN NO. 79-02, DATED MARCH 8, 1979

FOR

ARKANSAS NUCLEAR ONE - UNIT 1

JOB 11406-276

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Inspection of Concrete Fasteners

1.0 PURPOSE, SCOPE AND APPLICATION

This procedure specifies the method for performing and documenting concrete expansion bolt (CEB) inspections. The requirements of this procedure apply to CEB used in safety-related pipe hanger installations, as directed by Engineering.

2.0 GENERAL REQUIREMENTS

2.1 CEBS will consist of two types:

- o The self-drilling shell or sleeve type (such as "Phillips Snap-Off Anchor")
- o The wedge-type (such as "Wej-it" and "Phillips Wedge Anchors")

2.2 Recommended sampling programs are summarized in 11406-276-8, Paragraph 4.0.

Note: CEB are not considered as failing if the minimum required torque value can be achieved without exceeding the allowable 1/16" slip. However, if this occurs, the remaining bolts on the plate shall be torqued without recording the data (unless a failure occurs).

2.3 Data sheets will be completed for the inspections (See Attachment 1, 11406-276-5).

3.0 PROCEDURE FOR INSPECTING

3.1 Wedge-Type

The inspection of wedge-type expansion anchors shall be performed as follows:

A. Perform torque test using a calibrated torque wrench on nut; apply torque to nut in accordance with the minimum values listed in the torque table (See Attachment 2, 11406-276-5). The test shall be considered successful if torque is achieved in two turns or less of the nut.

B. Determine stud length by ultrasonic testing. The person performing the ultrasonic test shall sign the data sheet (Attachment 1A, 11406-276-5).

C. Determine the stud diameter. This determination may be by slipping a washer of known size over the stud.

D. Determine stud projection. This determination is by measuring from the concrete to the end of the stud (Dimension F).

E. Verify the nut is not bottomed out on stud threads. This verification may be accomplished by backing nut off prior to torque test and visually inspecting stud to assure that at least two threads are below the surface of the plate or, in obvious cases, by comparing manufacturer's thread length data with measured length.

F. Check for full thread engagement. The thread engagement is considered acceptable if it has a minimum of one complete thread above the nut.

G. Check the concrete surrounding the plate for signs of failure.

H. Check that hanger and support plate conform to sketch.

I. For "Wej-its", determine rods do not protrude past lugs of washer.

3.2 Shell-Type

A. Perform torque test using a calibrated torque wrench. The appropriate torque value listed on the torque table (See Attachment 2, 11406-276-5) shall be applied to the bolt.

B. Verify anchor length. Determine if anchor length conforms with vendor catalog data by removing bolt prior to torque test. Measure depth of anchor to its plug, compare with new anchor depth dimension of same type.

C. Determine bolt diameter (See Paragraph 3.1.C.).

D. Determine the shell is not in contact with hanger plate. This verification may be made by visually inspecting or measuring the gap between the plate and the expansion anchor.

Note: If clearance cannot be certified, the plate must be shimmed away from the concrete and another torque testing applied. (See Attachment 3 of 11406-276-5 for a recommended procedure.)

E. Retorque bolt - replace bolt and retorque to the appropriate value listed on Attachment 2, 11406-276-5.

F. Check the concrete surrounding the plate for signs of failure.

G. Check that hanger and support plate conform to sketch.

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[illegible]	[illegible] NO.	[illegible]	DATA BY / DATE	FINAL ACCEPTANCE BY / DATE	COMMENTS

POOR ORIGINAL

408 080

TORQUE VALUES

ATTACHMENT 2 OF 11406-276-5 REV. 1

Anchor Size (In.)	HEAT-IN (FT-LBS)	DRILLING (with tap bolt or all thd. rod) (FT-LBS)
1/2	30	30
5/8	55	40
3/4	75	65
7/8	105	90
1	150	130
1-1/8	260	240
1-1/4	300	240
1-1/2	330	310

Attachment 3

SHIMMING RECOMMENDATIONS

1. Replace all bolts with "all thread" studs one at a time and tighten nut on each stud before removal of the next bolt.

2. Move plate away from surface by backing off on all nuts evenly until 1/4" shims can be inserted behind the plate.

3. When placing shims insure they will not interfere with the insert should it pull out during the test.

4. Tighten all nuts on threaded studs enough to pinch shims.

5. Test each nut with the torque wrench and check for anchor movement.

6. Restore CEB to original condition using manufacturer's recommendations or if anchor has failed, replace it in accordance with Spec. 6600-C-2305.

Q

TECHNICAL SPECIFICATION

FOR

INSTALLATION OF CLASS I AND NON-CLASS I CONCRETE EXPANSION-TYPE

6 SHELL OR STUD ANCHORS AND TYPE 10 GROUTED ANCHOR BOLTS

FOR THE

ARKANSAS NUCLEAR ONE - UNIT 2

ARKANSAS POWER & LIGHT COMPANY

LITTLE ROCK, ARKANSAS

PREPARED BY:

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P.O. BOX 3965
SAN FRANCISCO, CALIFORNIA 94119

NO.	DATE	REVISIONS	BY	CHK'R	APP'R
6	11/15/77	Added Type 10 Anchor Bolts and General Revisions	[illegible]	[illegible]	[illegible]
5	8/25/76	Revised Sec. 3.0 and Tables I & II	[illegible]	[illegible]	[illegible]
4	11/6/75	Revised Sec. 2.1 Per FCR 2-C-249 and Minor Revisions	[illegible]	[illegible]	[illegible]
3	4/18/75	Revised Sec. 4.1, 4.2.1.1, 5.2.1, 6.2, 6.2.1, 6.2.2, 7.2 & 7.3	[illegible]	[illegible]	[illegible]
2	2/28/75	General Revisions	[illegible]	[illegible]	[illegible]
1	6/28/74	Iss. for Const., Rev. Sec. 2.0, 3.0, 4.2, 5.2, 5.4, Tables I & II	[illegible]	[illegible]	[illegible]
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ORIGIN

INSTALLATION OF CLASS I AND NON-CLASS I CONCRETE EXPANSION TYPE SHELL OR STUD ANCHORS ARKANSAS NUCLEAR ONE-UNIT 2

JOB No. 6600-2

SPEC. DES. GUIDE No. C-2305

REV. 6

408 083

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FOR

INSTALLATION OF CLASS I AND NON-CLASS I CONCRETE EXPANSION-TYPE

SHELL OR STUD ANCHORS AND TYPE 10 GROUTED ANCHOR BOLTS

FOR THE

ARKANSAS NUCLEAR ONE – UNIT 2

ARKANSAS POWER & LIGHT COMPANY

LITTLE ROCK, ARKANSAS

SECTION	TITLE
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7.0	DOCUMENTATION

1.0 SCOPE OF WORK

This specification covers the installation, inspection, testing and documentation requirements of Class I and Non-Class I anchors as indicated below.

Item/Scope of Work	Class I Anchor	Non-Class I Anchor
Anchor Installation	x	x
Anchor Inspection	x	
Anchor Testing	x	
Anchor Documentation	x	

(x denotes applicability)

2.0 APPLICATIONS

2.1 Expansion Anchors

The specification applies to expansion anchors used in the following categories installed in concrete and masonry block walls.

2.1.1 Seismic Class I Supports

The concrete expansion anchors belonging to this category shall meet the requirements of Sections 3.0, 4.0, 5.0, 6.0 and 7.0 of this specification.

This category is limited to the following, except as noted on design drawings:

2.1.1.1 Nuclear Class II and Seismic Class I Pipe Hanger Supports.

2.1.1.2 Seismic Class I Electrical Cable Tray Supports.

2.1.1.3 Seismic Class I HVAC Duct Supports.

2.1.1.4 Seismic Class I Equipment Foundation Supports.

2.1.1.5 Seismic Class I Concrete Block Walls.

2.1.1.6 Seismic Class I Conduit Supports.

2.1.1.7 Seismic Class I Tubing.

2.1.2 Non-Class I Supports

Concrete expansion anchors belonging to this category need to conform only to the requirements of Section 3.0 and 4.0.

2.2 Type 10 Grouted Anchor Bolts

This specification applies to grouted anchor bolts used in the following categories.

2.2.1 Seismic Class I Supports

The grouted anchor bolts belonging to this category shall meet the requirements of Sections 3.0, 4.0, 5.0, 6.0 and 7.0 of this specification.

This category is limited to the following:

2.2.1.1 Type 10 anchor bolts may be substituted for expansion anchors in Section 2.1.1.

2.2.1.2 Type 10 anchors shall be as specified on Design Drawings.

2.2.2 Non-Class I Supports

Grouted anchor bolts belonging to this category need to conform only to the requirements of Section 3.0 and 4.0.

3.0 ACCEPTABLE ANCHORS

This section is applicable to Class I and Non-Class I categories as defined in Section 2.0.

3.1 Expansion Anchors

Only concrete expansion-type shell or stud anchors and manufacturers as listed in this section are acceptable. No substitution of either anchor type or manufacturer shall be made without approval by the Project Engineer. When a drawing indicates a specific anchor type or manufacturer without indicating "or approved equal", there shall be no substitution of anchor type.

a. Wej-It Stud Anchor – Wej-It Expansion Products Inc.
b. Phillips Wedge or Stud Anchor – Phillips Drill Co.
c. Phillips Self-Drilling Snap-off or Flush-type Shell Anchor – Phillips Drill Co.
d. Cinch Type Expansion Anchor – National Lead Co.
e. Kwik Bolt Stud Anchor – Hilti Fastening Systems, Inc.
f. Molly Parabolt Stud Anchor – USM Corporation, Construction Products Division
g. For Concrete Masonry Block Wall – use only Phillips Self-Drilling Snap-off – Phillips Drill Co.

3.2 Type 10 Grouted Anchor Bolts

Only grouted anchor bolts conforming to the details on Drawing C-2260, Sheet 5 are acceptable unless approved by the engineer.

4.0 INSTALLATION

This section is applicable to Class I and Non-Class I categories as defined in Section 2.0.

4.1 Expansion Anchor

4.1.1 General

Installation of the expansion concrete anchors shall be performed by qualified installers. The installers shall be qualified by a field procedure approved by the Project Engineer on test blocks or on production anchors.

4.1.1.1 Concrete anchors shall be installed after concrete has reached an adequate strength for installation of concrete expansion anchors as determined by the Project Field Engineer.

4.1.1.2 Unless otherwise specified on the drawings, concrete anchors shall have a minimum center to center spacings and concrete edge distances as specified in Table 1.

4.1.1.3 Concrete anchors shall not be installed in the vicinity of tendons in prestressed concrete members except as approved by the Project Engineer.

4.1.1.4 No erection stress shall be induced in the expansion anchors during the installation of supports.

4.1.1.5 Welding on either shell or stud anchor inserts shall not be permitted.

4.1.2 Installation Procedures

Expansion type anchors called for in this specification shall be installed according to manufacturers' instructions and recommendations.

4.1.2.1 Nuts and studs shall be torqued to within the range of the installation torque values given in Table 1. The torque shall be applied by a manually operated torque wrench which shall be calibrated.

4.1.2.2 Minimum anchor embedments shall not be less than those specified in Table 1.

(6) 4.2 Type 10 Grouted Anchor Bolts

4.2.1 Installation Procedure

Grouted anchor bolts called for in this specification shall be installed in accordance with the details shown on Drawing C-2260, Sheet 5.

5.0 INSPECTION AND TESTING

This section is applicable only to the Seismic Class I applications as defined in Section 2.1.1 for expansion anchors and Section 2.2.1 for Type 10 grouted anchor bolts.

5.1 Inspection Procedure

Concrete anchors used for the applications defined in Sections 2.1.1 and 2.2.1 shall be visually inspected for correct installation. If inspection reveals that an anchor does not conform to Section 4.1.1 or 4.2.1, this anchor shall be either tested in accordance with the requirements of Section 5.2 below, or shall be relocated as permitted by the design, or shall be removed and another anchor installed in accordance with Section 4.0.

5.2 Testing Procedure

The testing of concrete anchors used for the applications defined in Sections 2.1.1 and 2.2.1 may utilize either the method described in Section 5.2.1 or 5.2.2. The frequency of testing shall be in accordance with Section 5.4. Documentation shall be in accordance with Section 7.0. Shell type expansion anchors shall be tested in a manner which insures that the shell shoulder does not bear against the grout or mounting bracket during testing.

5.2.1 Torque Test Method

Testing of the installed anchors shall consist of a torque test of the installed anchors with a calibrated torque wrench. Loosen the nut about a 1/4 turn (90°) and retighten to the approximately original position. The torque reading during retightening shall be within the range of torque installation values shown in Table IA, IB or IC.

5.2.2 Tensioner Method

All acceptable anchors shall be able to take the specified tension load applied by means of a tensioner. The minimum proof loads to be used are listed in Table IIA, IIB or IIC.

5.3 Acceptance Criteria

5.3.1 Torque Test Method

An installed anchor shall be considered acceptable if failure does not occur due to concrete breakout, anchor breakage and/or bolt rotation.

5.3.2 Tensioner Method

An installed anchor shall be considered acceptable if failure does not occur due to concrete breakout or anchor breakage and if the proof load specified in Table IIA, IIB or IIC is attained.

5.4 Testing Frequency

5.4.1 One out of each group of twenty anchors, installed by each installer, shall be tested in accordance with the requirements of Section 5.2. The anchors to be tested shall be chosen in such a manner so that all anchors are adequately represented. If the test anchor satisfies the acceptance criteria of Section 5.3, all anchors in that group are deemed acceptable.

5.4.2 Should a test anchor not satisfy the acceptance criteria of Section 5.3, the installer shall be identified and five additional anchors installed in this group by this installer shall be tested in accordance with the requirements of Section 5.2.

5.4.3 Should all of the five additional test anchors satisfy the acceptance criteria of Section 5.3, all remaining anchors in that group of anchors shall be deemed acceptable and testing shall proceed in accordance with the requirements of Section 5.4.1.

5.4.4 Should any of the additional test anchors defined in Section 5.4.2 fail, all of the remaining anchors installed in this group by this installer shall be tested in accordance with the requirements of Section 5.2. This installer shall be requalified before he can continue installation work.

△6 5.4.5 In the case of Type 10 grouted anchors, the testing may be conducted on a room by room basis rather than by the installer. All other provisions concerning test frequency given in Section 5.4.1, 5.4.2, 5.4.3 and 5.4.4 shall apply.

6.0 REPAIR OF ANCHOR FAILURES

This section is applicable to Class 1 and Non-Class 1 categories as defined in Section 2.0.

Test anchor failures may be replaced in accordance with Sections 6.1 and 6.2. Anchors which cannot be replaced in accordance with the requirements of Sections 6.1 and 6.2 may be relocated as approved by the Project Engineer.

6.1 Expansion Anchors

6.1.1 Failure due to concrete breakout.

6.1.1.1 If failure occurred due to concrete breakout, stud anchors may be reinstalled provided that the required embedment is obtained beyond the breakout depth.

6.1.1.2 If failure occurred due to concrete breakout, shell anchors may not be reinstalled. However, a stud anchor of equivalent capacity may be installed at the same location provided that the required embedment is obtained beyond the breakout depth.

6.1.1.3 The broken out concrete shall be repaired by patching in accordance with Specification 6600-C-2302 after the replacement anchor has been installed.

6.1.2 Failure due to anchor breakage.

6.1.2.1 If failure occurred due to anchor breakage, stud anchors may be removed, the hole redrilled and the next larger size anchor installed at the same location provided that the integrity of the surrounding concrete has not been disturbed.

6.1.2.2 If failure occurred due to anchor breakage, shell anchors may not be installed. However, a stud anchor of equivalent capacity may be installed provided that the required embedment is obtained beyond the breakout depth.

6.1.2.3 The concrete surface shall be repaired by patching in accordance with Specification 6600-C-2302 after the anchor bolt has been installed.

△6 6.2 Type 10 Grouted Anchor Bolts

6.2.1 Failure due to concrete breakout.

6.2.1.1 If failure occurred due to concrete breakout, anchors may be reinstalled provided that the required embedment is obtained beyond the breakout depth.

6.2.1.2 If failure occurred due to concrete breakout and there is insufficient concrete depth beyond the breakout to obtain proper embedment, then the anchor should be relocated. Where it is not practical to relocate the anchor bolt, engineering shall be advised. Engineering will investigate the problem and issued revised details as required.

6.2.1.3 The broken out concrete shall be repaired by patching in accordance with Specification 6600-C-2302 after the replacement anchor has been installed.

6.2.2 Failure due to anchor breakage.

6.1.2.1 If failure occurred due to anchor breakage, anchors may be relocated in accordance with Specification 6600-C-2316, Section 3.0.

6.2.3 Failure due to anchor twisting.

6.2.3.1 If failure occurred due to anchor not being capable of resisting installation torque values shown in Tables IA, IB or IC, anchor may be reinstalled in accordance with Section 4.2.1.

7.0 DOCUMENTATION

This section is applicable only to the Seismic Class I applications as defined in Section 2.1.

7.1 Installer qualification record

7.2 Test Inspection Report

7.2.1 Installer Name
7.2.2 General Location
7.2.3 Test Result
7.2.4 Inspectors Name
7.2.5 Date of Test

7.3 Failed Anchor Test Report

7.3.1 Installers Name
7.3.2 Exact Location of Tested Anchor
7.3.3 Repair Steps Taken
7.3.4 Inspectors Name
7.3.5 Date of Test

7.4 In the case of Type 10 grouted anchors, the installer's name will not be required.

TABLE 1A EXPANSION ANCHOR INSTALLATION REQUIREMENTS IN CONCRETE

ANCHOR DIAMETER (INCHES)	TORQUE AT INSTALLATION (FT.-LB.)		MINIMUM EMBEDMENT** (INCHES)	MINIMUM CENTER TO CENTER SPACING (INCHES)	MINIMUM CONCRETE EDGE DISTANCE (INCHES)
	CONCRETE TYPE (D_1,B_2,C_1,C_2 E_1,E_2)	CONCRETE TYPE (D_1,D_2)			
1/4	5	5 – 10	1-1/2	3"	1-3/4"
3/8	25	25 – 35	2	3-3/4"	1-7/8"
1/2	45 – 55	55 – 65	2-1/2	5"	2-1/2"
5/8	80 – 85	85 – 90	3	6-1/4"	3-1/8"
3/4	125 – 150	150 – 175	3-1/2	7-1/2"	3-3/4"
7/8**	200 – 210	210 – 250	4	8-3/4"	4-3/8"
1*	250 – 275	275 – 300	4-1/2	10"	5"
1-1/8	310 – 340	340 – 380	5-1/2	11-1/4"	5-5/8"
1-1/4	400 – 450	450 – 500	5-1/2	12-1/2"	6-1/4"
1-1/2	675 – 750	750 – 800	6	15"	7-1/2"

*See manufacturer's recommendations for minimum embedment for Wej-It spade type anchors.

**Minimum Embedments shall be increased by 2 anchor diameters for Molly Parabolt and KWIK-bolt concrete anchors. Minimum Embedments for Lead Ring Cinch type Anchors shall be as noted on the design drawings. For concrete type see Specification 6600-C-2026.

4 TABLE 1B EXPANSION ANCHOR INSTALLATION REQUIREMENTS IN MASONRY BLOCK WALLS IN PILL CELLS ONLY

ANCHOR DIAMETER (INCHES)	TORQUE AT INSTALLATION (FT.-LB.)	MINIMUM EMBEDMENT (INCHES)	MINIMUM CENTER TO CENTER SPACING (INCHES)	MINIMUM CONCRETE EDGE DISTANCE (INCHES)
1/4	2 - 4	1-1/8	3	3
3/8	7 - 11	2	4	4
1/2	12 - 18	2-1/2	5	4

For Concrete Unit Masonry, see Specification 6600-A-2011.

4 TABLE 1C TYPE 10 GROUTED ANCHOR BOLT INSTALLATION REQUIREMENTS IN CONCRETE

ANCHOR DIAMETER (INCHES)	TORQUE AT INSTALLATION (FT. LB.)	MINIMUM EMBEDMENT (INCHES)	MINIMUM CENTER TO CENTER SPACING (INCHES)	MINIMUM CONCRETE EDGE DISTANCE (INCHES)
1/2	25 - 30	3-1/2	5	6
5/8	55 - 60	4-1/2	6-1/4	6
3/4	100 - 110	5-1/4	7-1/2	6
7/8	160 - 175	6	8-3/4	6
1	240 - 265	6-3/4	10	6
1-1/4	475 - 520	8-1/2	12-1/2	6

6

TABLE IIA MINIMUM PROOF LOADS FOR EXPANSION-TYPE ANCHORS*

ANCHOR DIAMETER (INCHES)	WEDGE SPADE TYPE ANCHOR*		REDHEAD WEDGE ANCHOR**		RED HEAD SNAP-OFF TYPE SHELL ANCHOR†	
	CONCRETE Type $B_1, B_2, C_1, C_2, E_1, E_2$	CONCRETE Type D_1, D_2	CONCRETE Type $B_1, B_2, C_1, C_2, E_1, E_2$	CONCRETE Type D_1, D_2	CONCRETE Type $B_1, B_2, C_1, C_2, E_1, E_2$	CONCRETE Type D_1, D_2
1/4"	410	770	680	1010	1030	1550
3/8"	985	1830	1150	1720	1590	2400
1/2"	1265	2375	1660	2480	2390	3590
5/8"	2390	4480	2200	3300	3290	4950
3/4"	4300	8060	3230	4850	4550	6820
7/8"	4750	8910	3340	5000	5000	7530
1"	5610	10,580	4600	6880	--	--
1-1/8"	8000	15,000	-	-	-	-
1-1/4"	8750	16,420	11,400	17,100	-	-
1-1/2"	12,300	23,100	-	-	--	--

* All values shown are in pounds.

**Minimum proof loads apply also to Molly Para bolt and Hilti KWIK-Bolt Stud Anchors.

† Minimum proof loads apply also to Lead Ring Cinch Type Anchors.

Minimum embedment length as shown on Table 1A.

For concrete type see Specification 6600-C-2026.

(6) TABLE IIB MINIMUM PROOF LOADS FOR EXPANSION-TYPE ANCHORS IN MASONRY BLOCK WALLS*

ANCHOR DIAMETER (INCHES)	REDHEAD SNAP-OFF ANCHOR
1/4	280
3/8	410
1/2	560

*All values shown are in pounds.
Minimum embedment length as shown on Table IB.
For Concrete Unit Masonry, see Specification 6600-A-2011.

(6) TABLE IIC MINIMUM PROOF LOADS FOR TYPE 10 GROUTED ANCHOR BOLTS*

ANCHOR DIAMETER (INCHES)	TYPE 10
1/2"	1600
5/8"	2600
3/4"	3900
7/8"	5400
1"	7000
1-1/4"	11400

*All values shown are in pounds.

BECHTEL POWER CORPORATION

ARKANSAS NUCLEAR ONE

JOB 6600 - 2

FIELD INSTRUCTION

FOR

INSTALLATION OF CLASS I

CONCRETE EXPANSION ANCHORS

CONTROLLING SPECIFICATION 6600-C-2305

CONTROLLING [illegible]

APPROVED BY:

PFE — Date 8-11-75

PFQCE — Date 8-11-75

#2

FOR

No.	DATE	REVISIONS	BY	CH'K	DESIGN SUPV	ENG'R	PROJ ENGR	APPR PFQCE
5	5 20 77	Add to Sec. 2.3 - 2.3.2 & renumber						
4	5 02 77	Revise and Add To Appendix "D"						
3	2 21 77	Revise Para. 1.1 and 7.0						
2	9-24-75	Deleted Section 5.4.4						
1	8-11-75	Revise Appendix C. Sht. 1						
0	7-23-75	Issued for Construction						

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ORIGIN

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ARKANSAS NUCLEAR ONE
UNIT TWO

JOB No. 6600 - 2

DRAWING No. 2FI-129 | REV. 5

"A" SIZE

INDEX

1.0 Scope

2.0 Assignment of Responsibilities

3.0 Acceptable Anchors

4.0 Installation Procedures

5.0 Inspection, Testing, Qualification and Documentation

6.0 Operational Flow

7.0 Retro-fit Testing of Anchors

APPENDICES

A. Organization Chart

B. Installation Procedures

C. Installers Qualification Procedure

D. Retro-Fit Directive

E. Forms

F. Rubber Stamps

G. Test Procedures

1.0 Scope

1.1 This field instruction applies to all Class I anchors installed or to be installed in Unit II by Bechtel forces and HVAC subcontractor. Retro-fit testing of anchors shall be per Section 7.0. (3)

1.2 The controlling Specification is C-2305, latest revision. Refer thereto for all technical provisions.

1.3 This F.I. covers all Field operations necessary to control the qualification, installation, inspection, testing, recording, repairing, logging and controls, documentation forms, review and documentation turnover to Q.C.

2.0 Assignment of responsibilities for implementing and monitoring this instruction are as follows:

2.1 The Project Field Engineer shall designate Field Engineers to implement, co-ordinate and monitor this FI.

2.2 The discipline Field Engineer shall:

2.2.1 Initiate requests for installer qualification as requested by superintendent.

2.2.2 Initiate production installation.

2.2.3 Either utilize available drawings and/or date cards or have them prepared that will indicate the installation area. Detail and description shall be sufficient

so that anchors can be identified. The drawing shall have the following data: (See rubber stamp, Appendix F)

a. Installers name and brass no.

b. No. of Anchors and Room No.

c. Type and size of Anchor

d. Embedment of Stud Anchors

e. Field Engineers signature

f. Work week date

2.3 The Expansion Anchor Control Engineer shall: (E. A. C. Engr.)

2.3.1 Receive the Drawing and data from the discipline Engineer.

△5 2.3.2 Select the anchor to be tested. Anchors will be selected so that all anchors are adequately represented. The selection is made by viewing, in the field, the portion of supports which are being qualified by the test. An anchor is selected, based on judgement, so that the various combinations of installation positions and difficulty of installation are represented during the testing program.

2.3.3 Logs the anchor against the installer (Form 2FI-129-1)

2.3.4 Issues the test report (Form 2FI-129-2) to the Field Test Engineer when required to meet the test frequency.

2.3.5 Review the test report for completeness and concurrence, and initial report.

2.3.6 Record Test Data on Form 2FI-129-1.

2.3.7 Assemble the documentation package and forward to the designated reviewing engineer.

2.4 The Field Test Engineer shall:

2.4.1 Arrange for a test crew.

2.4.2 Determine that there is proper access to the designated anchor.

2.4.3 Visually inspect the test anchor.

2.4.4 Witness the anchor test.

2.4.5 Complete the test report, sign it and return it to the E.A.C. Engineer.

2.4.6 Should a test anchor fail, he shall initiate and complete the failed expansion anchor report (Form 2FI-129-3) covering additional tests and retests after reinstallation. He shall also prepare an NCR should it be required.

2.4.7 Perform Installer Qualifications

2.5 The Review Engineer shall review the documentation package for completeness. When he is satisfied that the package is complete, he shall initial it and turn the package over to Q.C.

3.0 Acceptable anchors used on this project shall be limited to those listed below:

3.1 Wej-it Stud Anchor

3.2 Phillip Wedge or Stud Anchor

100

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3.3 Phillip Self-drilling Snap-off or Flush Type Shell Anchor.

3.4 Hilti Kwik-Bolts Stud Anchor.

4.0 Installation procedures for each of the above listed anchor types are found in Appendix B. These procedures shall be followed for all anchor installations. Should any deviation be required, prior written approval shall be obtained through the Discipline Field Engineer to the Reviewing Engineer.

5.0 Inspection, testing, qualification and documentation.

5.1 Inspection shall be by the Discipline Field Engineer per Spec. C-2305.

5.2 Testing, retesting and repair of anchors shall be per the requirements of the Spec. C-2305 and test procedures in Appendix G.

5.3 Installer Qualification Procedure is included as Appendix C utilizing Form 2FI-129-4. (Completed forms shall be kept in the Q.C. vault.)

5.4 Documentation - Each package shall include following forms:

5.4.1 Test Inspection Report (Form 2FI-129-2)

5.4.2 Expansion Anchor Bolt Installers Status Report (Form 2FI-129-1)

5.4.3 Failed Anchor Test Report - as required (Form 2FI-129-3)

2

6.0 Operational flow shall be as outlined on the Data and Document Flow Diagram (next sheet).

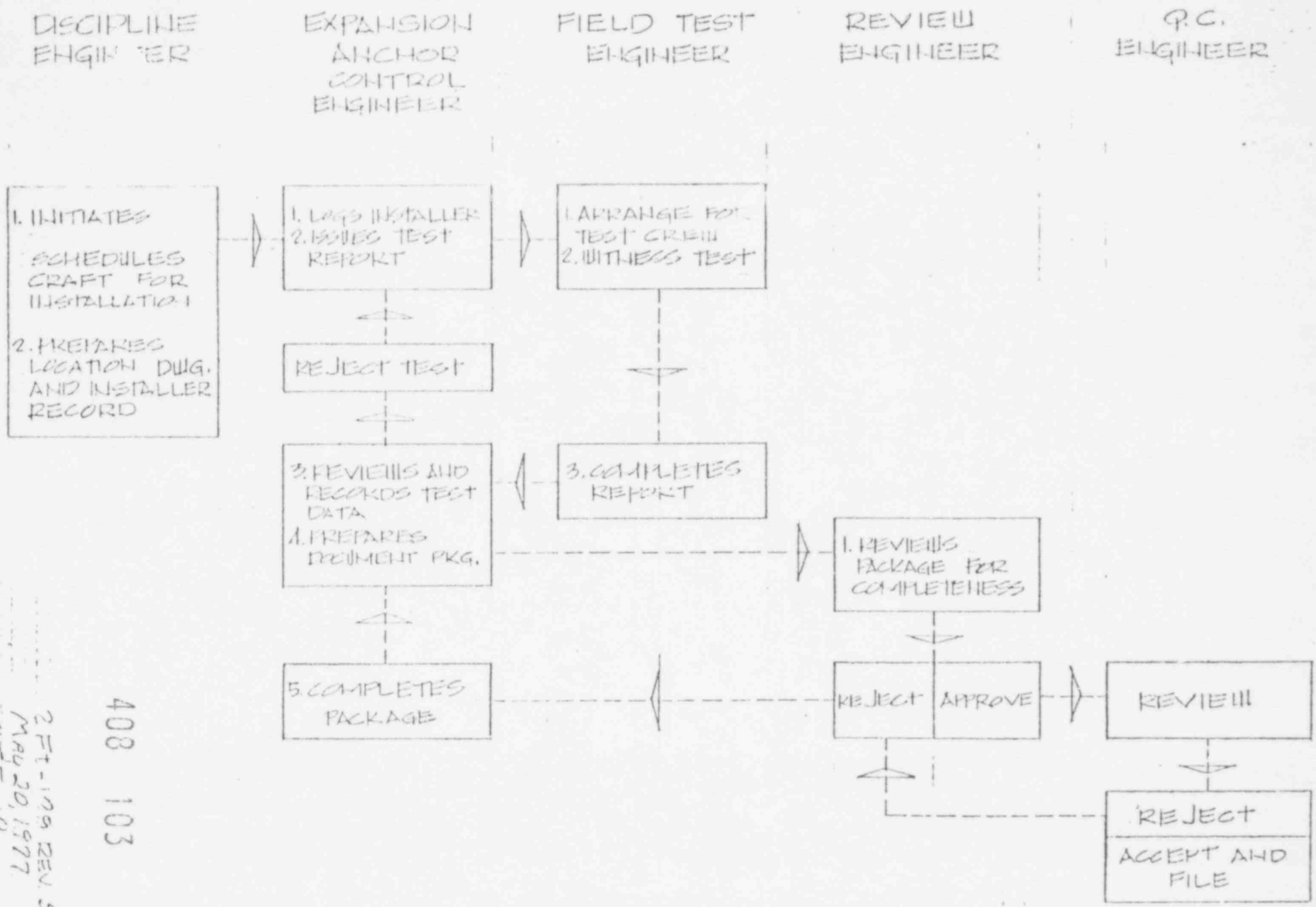
△3 7.0 Retro-fit testing of anchors shall be by SFHO directive incorporated as Appendix D.

8.0 Time Schedule to put C-2305 and this FI into affect shall be as follows:

8.1 Installer qualifications may begin on FI issue date.

8.2 Full program initiation shall commence four weeks after FI issue date. All anchors installed prior to full program initiation shall be retro-fit.

DATA AND DOCUMENT FLOW



APPENDICES INDEX

A. Organization Chart

B. Installation Procedures

1. Phillips Flush Type

2. Phillips Self-Drilling Snap-Off Type

3. Phillips Wedge Anchor

4. Wej-it Stud Anchor

5. Hilti's Kwik-Bolt Stud Anchor

C. Installers Qualification Procedure

D. Retro-Fit Directive

1. E. H. Smith's Memo FM-2-1091

2. E. H. Smith's Memo FM-2-1200

4 3. E. H. Smith's Memo FM-2-2749

E. Forms

1. 2FI-129-1 Installers Status Report

2. 2FI-129-2 Anchor Test Report

3. 2FI-129-3 Failed Expansion Anchor Report

4. 2FI-129-4 Installer Qualification Record

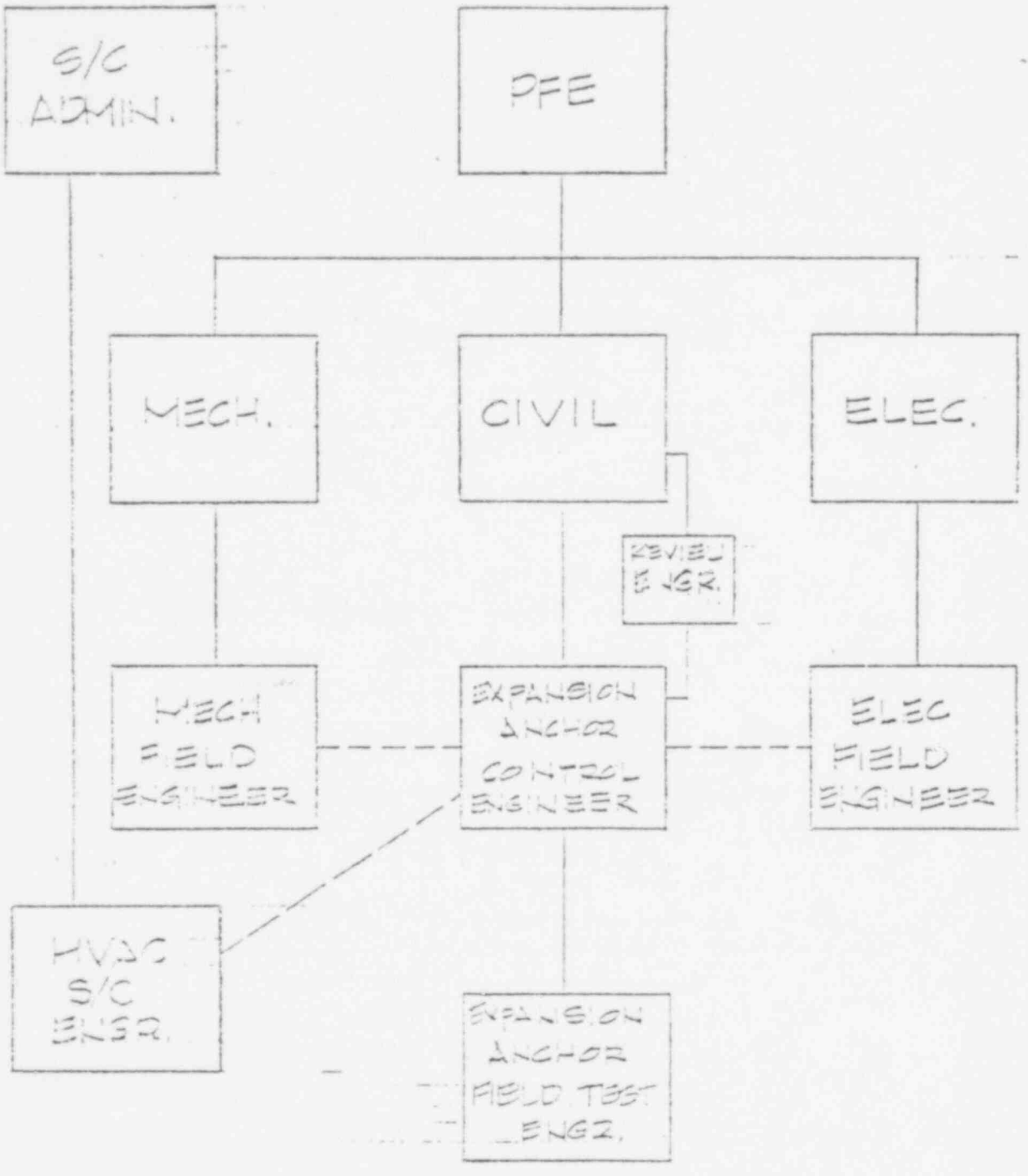
F. Rubber Stamp

G. Test Procedures

1. Torque Wrench Test Procedure

2. Tension Test Procedure

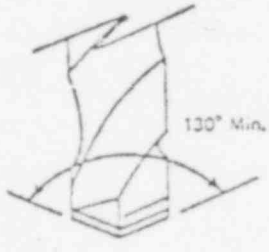
APPENDIX A
ORGANIZATION CHART



EXPANSION ANCHOR INSTALLATION PROCEDURE

1. Anchor Type - Phillips Flush Type
2. Anchor Dia. - 3/8" through 7/8"
3. Installation requirements (per C-2305, Table I)

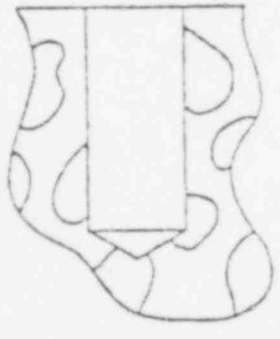
Anchor Dia. Inches	Tightening Torque FT-LB		Minimum Embedment Inches	Minimum	
				C to C Spacing Inches	Edge Dist. Inches
Concrete Type	B, C, & E	D	Below		
3/8	-25	25- 35		3-3/4	1-7/8
1/2	45 -55	55- 65		5	2-1/2
5/8	80 -85	85- 90		6-1/4	3-1/8
3/4	125 -150	150-175		7-1/2	3-3/4
7/8	200 -210	210-250		8-3/4	4-3/8

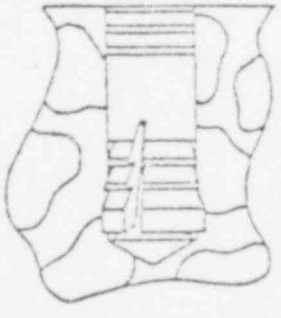


(1) Drill hole with quality carbide tipped bit having 130° or greater tip angle using rotary impact hammer. Hole depth should not exceed anchor length more than 1/8".

(2) Clean all cuttings from the hole.

(3) Place red plug into anchor and insert in hole. Expand until flush or slightly below flush with hand hammer using tool provided or high-strength bolt threaded into the anchor.





408 106

NO.	DATE	REVISIONS	BY	CHK	ENGR'G SUPV	PROJ. ENGR	PROJ. MGR	APPR.
1	8-11/8-29-75	No Change						
0	7-23-75	Issued for Construction						

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ORIGIN

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UNIT TWO

JOB NO. 6600 - 2
DRAWING NO. 2FI- 129
REV. 5
Appen. B

EXPANSION ANCHOR INSTALLATION PROCEDURE

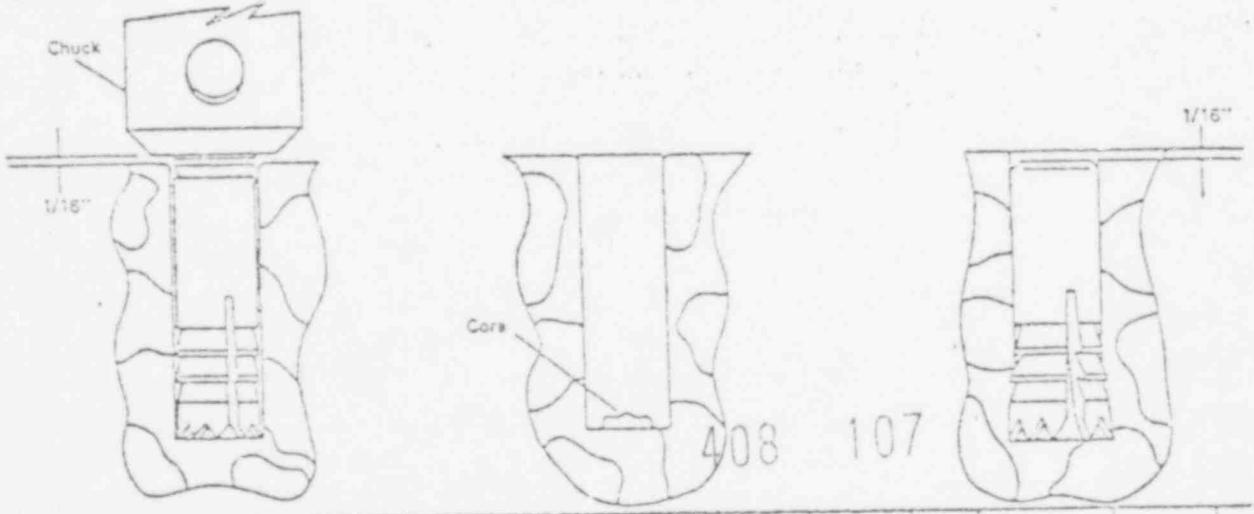
1. Anchor Type - Phillips self-drilling snap-off type
2. Anchor Dia. - 3/8 through 7/8"
3. Installation requirements (per C-2305, Table I)

Anchor Dia. Inches	Tightening Torque FT-LB		Minimum Embedment Inches	Minimum C to C Spacing Inches	Minimum Edge Dist. Inches
Concrete Type	B, C, &E	D			
3/8	-25	25- 35		3-3/4	1-7/8
1/2	45-55	55- 65		5	2-1/2
5/8	80-85	85- 90		6-1/4	3-1/8
3/4	125-150	150-175		7-1/2	3-3/4
7/8	200-210	210-250		8-3/4	4-3/8

(1) Drill with anchor using 747 Roto Stop Hammer or impact hammer with appropriate chuck assembly until face of chuck is within 1/16" from surface of concrete. Withdraw anchor from hole and expel cuttings.

(2) Holes drilled with 5/8 (5/8") or larger anchors may have a piece of concrete core in bottom which should be broken up with a star-drill, chisel or other tool. Clean all cuttings from the hole.

(3) Place red plug into anchor and insert anchor in hole. Expand with impact hammer without rotation until top of anchor is approximately 1/16" below surface of concrete. If necessary, use hand driver to fully expand anchor.



408 107

NO	DATE	REVISIONS	BY	CHK	DESIGN ENGR OFFICE CHIEF	CIVIL ENGR	PROJ ENGR	APPR
1	9-11/12-74	1-5 Per Change						
2	7-23-75	Issued for Construction						

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ORIGIN

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ARKANSAS NUCLEAR ONE
UNIT TWO

JOB NO. 6600 - 2
DRAWING NO. 2FI-129
REV. 5
Appen. B - 2

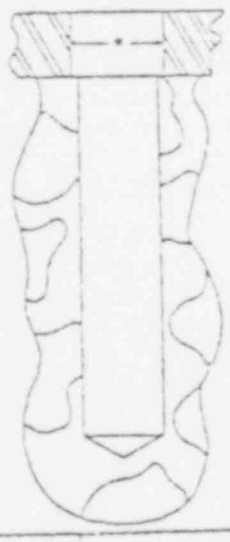
EXPANSION ANCHOR INSTALLATION PROCEDURE

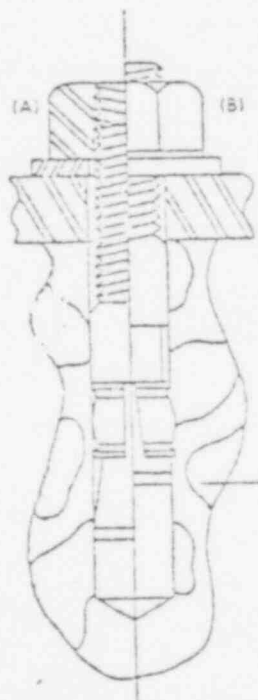
1. Anchor Type - Phillips Wedge Anchor
2. Anchor Dia. 3/8" through 1¼"
3. Installation requirements (per C-2305, Table I)

Anchor Dia. Inches	Tightening Torque FT-LB		Minimum Embedment Inches	Minimum C to C Spacing Inches	Minimum Edge Dist. Inches
Concrete Type	B,C,&E	D			
3/8	- 25	25- 35	2	3-3/4	1-7/8
1/2	45- 55	55- 65	2-1/2	5	2-1/2
5/8	80- 85	85- 90	3	6-1/4	3-1/8
3/4	125-150	150-175	3-1/2	7-1/2	3-3/4
1	250-275	275-300	4-1/2	10	5
1-1/4	400-450	450-500	5-1/2	12-1/2	6-1/4

(1) Drill hole through work (if desirable) with quality carbide tipped bit using hammer drill (1/4" – 3/8" sized) or rotary impact hammer (1/2" – 1-1/4" sizes). Hole should not exceed nominal diameter by more than 5% for smaller sizes to 3% for larger sizes. Hole depth should be greater than anchor embedment to accommodate cuttings or hole must be cleaned.

(2) Assemble washer and nut as shown at (A) to protect threads from damage. Drive into hole until washer bears against work. Tighten anchor to recommended torque to expand as shown at (B).





*Hole in work should be larger than nominal anchor diameter by 1/16" for 1/4" – 5/8" sizes, 3/32" for 3/4" – 1" sizes and 1/8" for 1-1/4" sizes and larger.

o - Embedment

408 108

NO.	DATE	REVISIONS	BY	CHK	DESIGN ENGR.	CHIEF ENGR.	PROJ. ENGR.	APPR.
2	9-11/12-24	No Change						
1	7-23-75	Issue for Construction						

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ORIGIN

ARKANSAS POWER & LIGHT CO.
ARKANSAS NUCLEAR ONE
UNIT TWO

JOB NO. 6900 - 2
DRAWING NO. 2FI- 129
FILE 5
Appen. B 3

EXPANSION ANCHOR INSTALLATION PROCEDURE

1. Anchor Type - Wej-it Stud Anchor
2. Anchor Dia. - 3/8" through 1-1/2"
3. Installation requirements (per C-2305, Table I)

Anchor Dia. Inches	Tightening Torque FT-LB		Minimum Embedment Inches	Minimum C to C Spacing Inches	Minimum Edge Dist. Inches
Concrete Type	B,C,&E	D			
3/8	- 25	25- 35	2	3-3/4	1-7/8
1/2	45- 55	55- 65	2-1/2	5	2-1/2
5/8	80- 85	85- 90	3	6-1/4	3-1/8
3/4	125-150	150-175	3-1/2	7-1/2	3-3/4
7/8	200-210	210-250	4	8-3/4	4-3/8
1	250-275	275-300	4-1/2	10	5
1-1/8	310-340	340-380	5-1/2	11-1/4	5-5/8
1-1/4	400-450	450-500	5-1/2	12-1/2	6-1/4
1-1/2	675-750	750-800	6	15	7-1/2

4. Hole Drilling - Carbide drill - same size as anchor using rotory impact hammer.

5. The hole shall be dry and blown free from all cuttings.
6. The anchor shall be free from oil and all other detrimental coatings.
7. The anchor shall be expanded per manufacturers recommendation and tighted against the fixture as required in the table above.

408 109

NO.	DATE	REVISIONS	BY	CHK	DESIGN SUPV.	UNDER. SUPV.	PROJ. ENGR.	APPD.
[illegible]	5-1/2-4-75	Re Change						
0	7-23-75	Issued for Construction						

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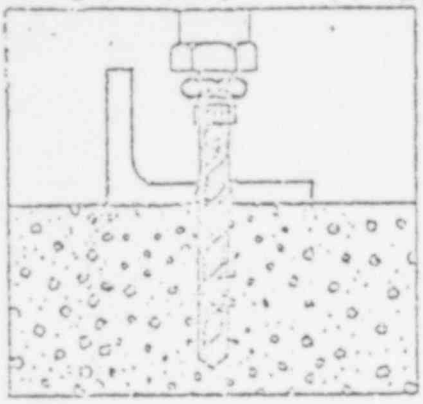
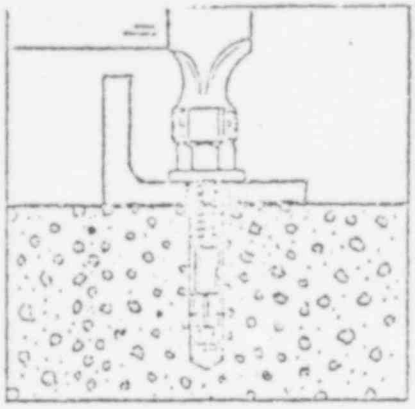
UNIT TWO

JOB NO. 6600 - 2
DRAWING NO. 2FI-129 REV. 5
Appen. B A4

1. Anchor Type - Hilti Kwik-Bolt Anchor
2. Anchor Dia. 3/8" thru 1-1/4"
3. Installation requirements (per C-2305, Table I)



DRILL — Simply drill a hole the same diameter as the KWIK-BOLT. Don't worry about drilling too deep — KWIK-BOLT works in a "bottomless" hole. You can drill into concrete with or without the fixture in place.



INSERT — Drive the KWIK-BOLT far enough into the hole so that at least six threads are below the top surface of the fixture.

ANCHOR — Merely tighten the nut. Resistance will increase rapidly after the third or fourth turn.

Anchor Dia. Inches	Tightening Torque FT-LB		Minimum Embedment Inches	Minimum C to C Spacing Inches	Minimum Edge Dist. Inches
	Concrete Type				
	B, C, & E	D			
3/8"	- 25	25- 35	2-3/4	3-3/4	1-7/8
1/2"	45- 55	55- 65	3-1/2	5	2-1/2
5/8"	80- 85	85- 90	4-1/2	6-1/4	3-1/8
3/4"	125-150	150-175	5	7-1/2	3-3/4
1"	250-275	275-300	6-1/2	10	5
1-1/4"	400-450	450-500	8	12-1/2	6-1/4

4. Hole Drilling - Carbide drill - same size as anchor using rotary impact hammer.
5. The hole shall be dry and blown free from all cuttings.
6. The anchor shall be free from oil and all other detrimental coatings.
7. The anchor shall be expanded per manufacturers recommendation and tighted against the fixture as required in the table above.

NO.	DATE	REVISIONS	BY	CHK	ENGR SUPV	PROJ ENGR	QUAL	APPD.
	5-11-72	No Change						
	7-24-75	Issue for Construction						

SCALE: DESIGNED DRAWN PROJECT ENGR CHIEF

ARKANSAS POWER & LIGHT CO.
ARKANSAS NUCLEAR ONE
UNIT TWO

JOB NO. 6600 - 2
DRAWING NO. 2FI-126 REV. 5
SHEET Appen. B - 3

APPENDIX C

CONCRETE EXPANSION ANCHOR INSTALLER QUALIFICATION PROCEDURE

1.0 Procedure for qualification of installer of concrete expansion type shell or stud anchors per Specification C-2305. Installer qualification under this procedure is required for Class I and Non-Class I Anchor Installations.

2.0 Prior to the installation of production Concrete Expansion Anchors, the installer shall be qualified under this procedure in the presence of the Field Test Engineer.

3.0 Test Anchors may be production anchors or anchors installed in a test block at the Field Test Engineer's discretion.

4.0 The installer shall install two (2) anchors of the type, size and position most frequently installed by applicants craft and one (1) anchor of the type, size, and position specified by the testing engineer.

5.0 Acceptance criteria of qualification test anchors shall be in accordance with Specification C-2305, Section 5.3.

6.0 Should any of the three (3) anchors in 4.0 fail acceptance, the qualification test may be repeated. The applicant will be allowed three (3) tests in any twelve (12) month period beginning on date of first test. Should an applicant fail to qualify, he will not be allowed to install any Class I or Non Class I anchors.

7.0 Qualification Record shall be kept on file in the Q.C. Vault. The document (Form 2FI-129-4) shall be completely filled out, dated and signed by testing engineer.

8.0 An installer qualified under this procedure shall be eligible to install any type of anchor for duration of project unless it has been found during production testing that two (2) anchors failed testing out of any one anchor group. An installer shall be re-qualified if his inactivity exceeds twelve (12) months.

Bechtel Power Corporation

Interoffice Memorandum

To L. E. Davis

File No. C-2305

Subject Arkansas Nuclear One - Unit 2
Job 6600-002 - Installation of
Concrete Expansion Type Anchors.

Date February 24, 1975

From E. H. Smith

San Francisco Division

Log: FM-2-1091

RECEIVED
MAR 3 1975
BECHTEL POWER CORPORATION
6600

At MET 29/A19 Ext. 4418

Copies to G. Katanics
W. Ginn
K. Lam

Reference: Refer to your IOM FME-2-883 and FME-2-888.

Your comments in IOM FME-2-883 and FME-2-888 have in general been adopted, except that on item 4.1 in both memos. We strongly feel that a qualified installer is also required to install expansion anchors on non-class I supports. As you know, workmanship is the major factor for the performance of expansion bolts. In order to avoid a similar failure as encountered on Unit One, we feel upgrading of the installation is essential.

The following directive concerning testing shall be applied to the expansion anchors already installed:

1.0 Specification 6600-C-2305 shall be the controlling document except as noted otherwise in the following items.

2.0 Application is to be per Section 2.0. (Anchors installed for section 2.1.5 and for which documentation is available need not be retested. Engineering shall be appraised of any instance where this has not been done for evaluation).

3.0 Installation is to be per Section 4.0, exception in 4.1, the installer's qualification is not required.

4.0 Groups of anchors shall be determined by room location and the application per Section 2.1.1 through 2.1.4.

5.0 Inspection and testing is to be per Section 5.0 except in 5.4, the identification of the installer related to the group of anchor is not required and test groups shall be as defined in item 4.0 above. The last sentence in 5.4.4 is not applicable.

408 113

2FI-129, Rev. 5
"D" Sht. 1 of 4

8024-(2-74)

6.0 Documentation required.

6.1 Test Inspection Report

6.1.1 Inspector's Name
6.1.2 General Location
6.1.3 Test Result

6.2 Failed Anchor Test Report

6.2.1 Inspector's Name
6.2.2 Exact Locaion of Tested Anchor
6.2.3 Installer's Name ← cannot identify.
6.2.4 Repair Steps Taken

deleted 4-17-75 FM-2-1200

E. H. Smith

E. H. Smith

KL:rg

Bechtel Power Corporation

Interoffice Memorandum

To L. E. Davis

File No. C-2305

Subject Arkansas Nuclear One - Unit 2
Job 6600-2-Installation of
Concrete Expansion Type Anchors

Date April 17, 1975

From E. H. Smith

LOG: FM-2-1200

Of San Francisco Division

Copies to W. Ginn
P. Verrios
K. Lam

At MET 29/A19 Ext. 1846

References: (a) FME-2-956, dated March 21, 1975.
(b) FM-2-1091, dated February 24, 1975.

The concrete expansion anchor installer qualification procedure attached with Reference (a) is approved without comment.

Revision 3 of Specification 6600-C-2305 is presently being prepared and will be issued in the very near future. This revision eliminates excessive slippage as an anchor failure mode and allows the production anchors to be utilized as the test anchor as an alternate to the use of test blocks.

We hereby delete Item 6.2.3 "Installers Name" from the directive for acceptance of existing anchors which was included with Reference (b).

E. H. Smith

KL:rq

Bechtel Power Corporation

Interoffice Memorandum

To L. E. Davis

File No. J-2-296, J-5800

Subject Arkansas Nuclear One - Unit 2
Job 6600-2 - Anchor Bolts,
Corrective Action for Audit
Report QFR 2-42

Date April 15, 1977

From E. H. Smith

Of San Francisco Division

LOG: FM 2-2749

At MET-29-D 12 Ext. 1846

Copies to

C. R. Davis
A. Nispeling
V. R. Uhouse
E. Y. Wong
A. Karadi
R. Redford (Field)

RECEIVED
APR 18 1977
BECHTEL POWER CORP.
JOB 6600

Installation drawings 6600-M2511 sheets J-G111-1 through J-G113-1 are revised to require installation of tray support mounting bolts in accordance with specification 6600-C-2305. Advance copies of the revised details are attached for your information.

Field is hereby directed to select at random, one in twenty of those anchor bolts already installed for testing in accordance with the C-2305 specification.

E. H. Smith

E. H. Smith

Attachment
Advanced copies
of drawings

WPB/icd

403 116

2FI-129, Rev. 5
"D" Sht. 4 of 4

EXPANSION ANCHOR BOLT INSTALLERS STATUS REPORT C-2305

3. RECORD CONTROL
CONTROL NO. ______
FILE NO. ______

1. PROJECT NO. 6600-2 2. DATE ____________ 4. PAGE ____ OF ____

INSTALLERS NAME: BRASS NO.:

ANCHOR	WEEK OF	LOCATION	DWG. NO.	TEST RESULTS

FIELD ENGINEER ____________

DATE ____________

REVIEW ____________

FORM CFI-129-1 REV-5

408 117 "E" SHT. 1 OF 4

EXPANSION ANCHOR TEST REPORT

C-2305

3. RECORD CONTROL
CONTROL NO. _____
FILE NO. _____

1. PROJECT NO. 6600-2 2. DATE _____ 4. PAGE ___ OF ___

5. INSTALLER :
ANCHOR NO. :
ANCHOR ID. :
EMBEDMENT :
TYPE :
ANCHOR SIZE :

BLDG NO. :
DWG. NO. :
CRAFT :
PRODUCTION : YES ☐ NO ☐
QUAL. TEST : YES ☐ NO ☐

6. LOCATION
BLDG. :
ROOM NO. :
FLOOR ELEV. :

7. TEST RESULTS
TORQUE VALUE :
TENSION VALUE :
SATISFACTORY: YES ☐ NO ☐ (EXPLAIN)

8. TORQUE WRENCH
NO. :
RECALIBRATION DATE:

FIELD ENGINEER _____
DATE _____
REVIEW _____

FORM PFT.-129-2 REV. 5

FAILED EXPANSION ANCHOR REPORT

C-2305

3. RECORD CONTROL
CONTROL NO. _____
FILE NO. _____

1. PROJECT NO. 6600-2 2. DATE _____ 4. PAGE ___ OF ___

5. INSTALLER: BRASS NO.:

ANCHOR NO.: DWG. NO.:

ANCHOR ID.: SIZE:

FAILURE MODE: ANCHOR FAILED DUE TO: TEST ☐

INSPECTION ☐

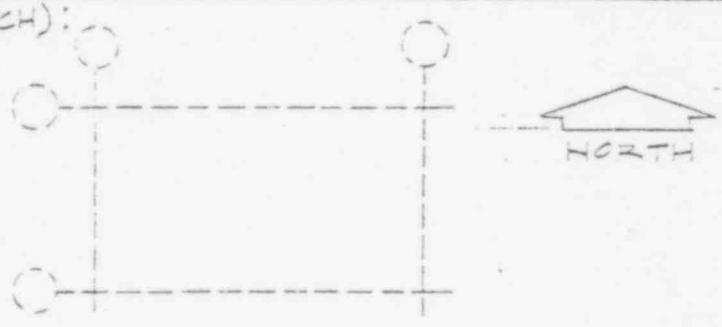
QUALIFICATION TEST ☐

6. LOCATION (EXACT-MAKE SKETCH):

BLDG. :

ROOM NO. :

FLOOR ELEV.:



7. CORRECTIVE ACTION: N.C.R. NO.

8. RESULTS OF TESTS:

ANCHOR NO.	TORQUE	TENSION	RESULTS	COMMENTS

9. TORQUE WRENCH NO.: _____
CALIBRATION DATE _____

FIELD ENGINEER _____

DATE _____

FORM 2FI-129-5REV 5 REVIEW _____

CONCRETE EXPANSION ANCHOR
C-2905 INSTALLER QUALIFICATION RECORD

3. RECORD CONTROL
CONTROL NO. _____
FILE NO. _____

1. PROJECT NO. 6600-2 2. DATE _____ 4. PAGE ___ OF ___

NAME _____ BRASS NO. _____

TEST ANCHOR	EMBEDMENT	TORQUE/ TENSION	RESULTS
1.			
2.			
3.			

TORQUE WRENCH NO. _____ RECALIBRATION DATE _____

RETEST: DATE _____

	EMBEDMENT	TORQUE/ TENSION	RESULTS
1.			
2.			
3.			

TORQUE WRENCH NO. _____ RECALIBRATION DATE _____

RETEST: DATE _____

	EMBEDMENT	TORQUE/ TENSION	RESULTS
1.			
2.			
3.			

TORQUE WRENCH NO. _____ RECALIBRATION DATE _____

INSTALLER _____ DATE _____

THE ABOVE NAMED INSTALLER HAS BEEN TESTED AND HAS PASSED ALL REQUIREMENTS.

TESTING ENGR. _____ DATE _____
REVIEW _____

FORM 2FT-129-4REV. 5

APPENDIX "F"

INSTALLERS NAME_____BRASS NO _____
NUMBER OF ANCHORS_____ROOM NO._ _____
TYPE ANCHOR_____SIZE ANCHOR_____
EMBEDMENT OF STUD ANCHOR_____
FIELD ENGINEERS SIGNATURE_____ _____
WORK COMPLETED IN WEEK OF_____DATE_____

APPENDIX G

TEST PROCEDURES

1. Torque Wrench Test

   1.1 Loosen the nut about 1/4 turn.

   1.2 Retighten to approx. original position noting max. tightening torque. Record value on form 2FI-129-2. Do not exceed values shown in Table I, Spec. C-2305.

   1.3 An installed expansion type anchor bolt shall be considered acceptable if a failure does not occur due to concrete breakout or anchor breakage.

   1.4 Special instruction when testing Phillips flush type and self-drilling type anchors.

      1.4.1 Determine if anchor is "recessed" or "flush or projecting".

      1.4.2 Should the anchor be "flush or projecting", a 1/8" thick slotted washer shall be installed between the concrete surface and the fixture.

      1.4.3 Tighten bolt to the value shown in Table I Spec. C-2305. Record torque value on Form 2FI-129-2.

2. Tension Test Procedure

   2.1 Flush and self-drilling type anchors where a bolt is required.

(Cont'd.)

2.1.1 Remove the bolt and determine if a slotted washer is required between concrete surface and fixture (see 1.5 above). Install a stud and nut. Torque the nut to the values shown on Table I, Specification C-2305.

2.1.2 Add a coupling nut to the stud, turning down a min. of 1 stud diameter. Screw in a pull rod (min. 1 dia.) and set tensioning device over pull rod. Secure pull rod by tightening wing nut against jack cylinder. Adjust the three legs to minimize bending in the anchor and pull rod.

2.1.3 Apply the tension load per Table II, Specification C-2305. Record value on Test Report.

2.2 Stud Type Anchors

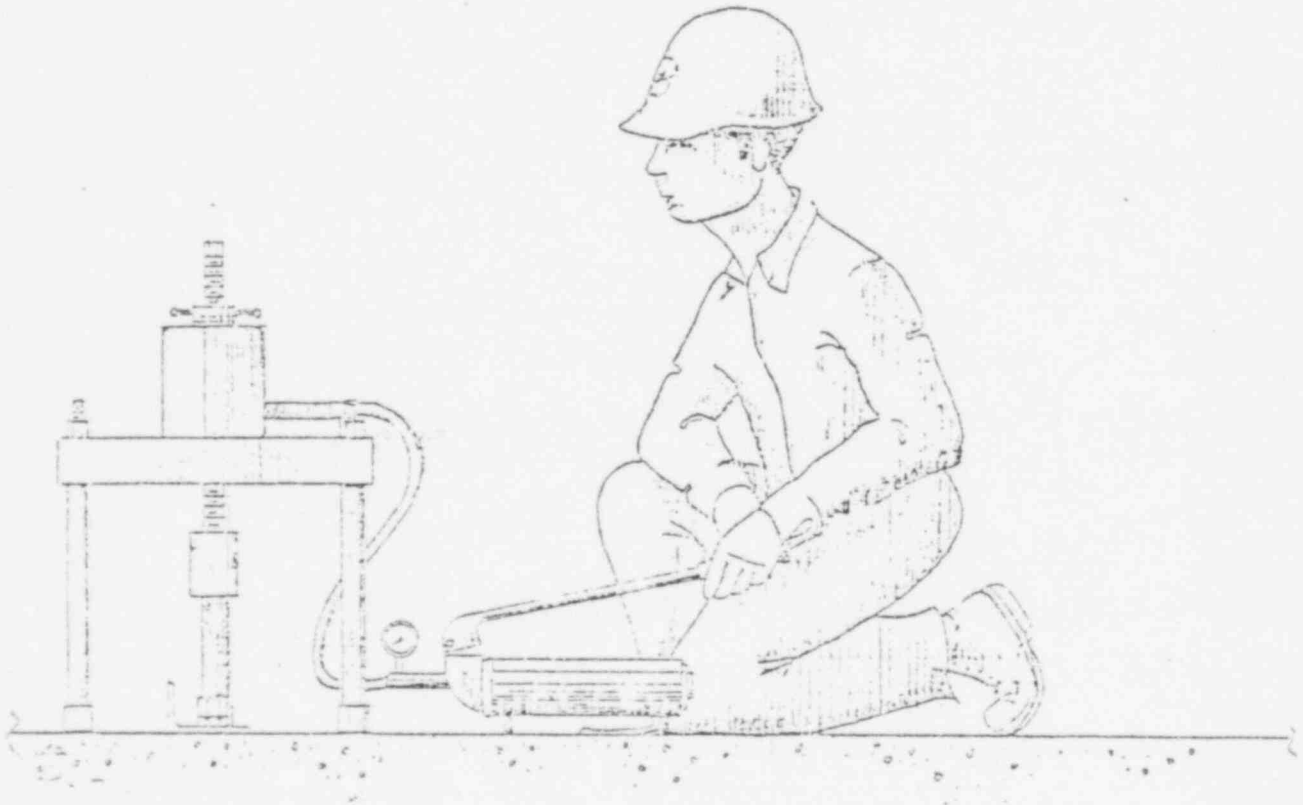
2.2.1 Either add a coupling nut or remove existing nut and add a coupling nut depending on available free thread length (min. length is one bolt dia.). Washers may be used as required. Tighten nut to values shown on Table I, Specification C-2305. Proceed as outlined in 2.1.2 above.

An installed expansion type anchor bolttension tested shall be considered acceptable if a failure does not occur due to concrete breakout or anchor breakage and if the

(Cont'd.)

proof load specified in Table 2 is attained.

2.4 The next sheet depicts a test set up.



EXPANSION ANCHOR TENSION TEST OPERATION SET UP

408 125

NO.	DATE	REVISIONS	BY	CHK	DESIGN SUPV.	ENGR. APCH.	PROJ ENGR	APPR.
A	7-23-75	ISSUED FOR CONSTRUCTION						

SCALE	DESIGNED	DRAWN	OFFICE CHIEF		TPO CHIEF	

ORIGIN

BECHTEL

ARKANSAS POWER & LIGHT CO.
ARKANSAS NUCLEAR ONE
UNIT TWO

JOB NO. 6600 - 2

DRAWING NO.	REV.
2FI 129	5

AFFEN. G

ED 29