Southern California Edison Company

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August 28, 1990

F. R. NANDY
MANAGER, NUCLEAR LICENSING

TELEPHONE
(714) 587-5400

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Subject: **Docket No. 50-206**
Information Regarding
Thermal Shield Support System Replacement
San Onofre Nuclear Generating Station Unit 1

The purpose of this letter is to provide the NRC with the following information:

1. Results of qualification testing of the thermal shield fasteners (Enclosure 1).

2. Information regarding the corrosion testing of the fastener locking devices (Enclosure 2).

This information was requested by the NRC in our meeting of May 7, 1990, and during a July 16, 1990 telephone conversation.

Qualification Test Results

During our May 7, 1990 meeting, you requested that the results of the qualification testing of the thermal shield support system fasteners be provided for your review. The tests have just been completed by Kraftwerk Union (KWU) in Germany, and have met all their objectives which are:

- o Determine the torque required to break the fastener lock, and examine the crimped locking cup for evidence of cracks. ("B" Series Tests)

- o Determine the expected dowel pin push in and push out forces, and locking system push out and fatigue characteristics. ("D" Series Tests)

- o Establish the relationship between the torque applied and bolt preload for different combinations of thread types and bolt diameters. ("T" Series Tests)

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"T" Series Tests

Objective: Establish relationship between torque applied and bolt preload.

Status: Complete.

Results:

Table 5
Torque vs. Preload

Bolt Dia. (in.)	Thread Type	Specified Preload (kips)	At 95% Confidence Level Specified Torque ($ft\text{-}lb_f$)	Range +/- ($ft\text{-}lb_f$)
1	EDM	19.5	284	34
1	cut	19.5	302	38
7/8	cut	17.25	192	10
3/4	cut	13.5	127	10
1/2	cut	5.6	31	2
1	cut	24.5	541	29

The efficiency of the remote bolt installation machine is 98.75%.

ENCLOSURE 2
STRESS CORROSION CRACKING ISSUE

Westinghouse Electric Corporation
Energy Systems

MT-MNA-231(90)
Nuclear and Advanced
Technology Division

Box 2728
Pittsburgh Pennsylvania 15230-2728

July 31, 1990

Mr. Majid Motamed
Southern California Edison, Co.
23 Parker Street
Irvine, CA 92718

Dear Mr. Motamed:

Enclosed is a copy of the letter regarding the use of 316Ti SST bolts with integral locking cups as part of the bolt head. Westinghouse concurs with the technical aspects of the letter and is prepared to support SCE in discussions with the NRC if the need arises.

David A DelSignore

D. A. DelSignore
Senior Metallurgical Engineer
Materials, Mechanics & Diagnostics Technology

cc: B. W. Bevilacqua, STC 701/308
C. H. Boyd, STC 701/306
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J. E. Goossen, STC 701 308
R. D. Rishel, STC 701/401

Stress Corrosion Cracking Issue

Westinghouse commonly uses 316 Stainless Steel (316 SS) bolts cold worked 10-20% for reactor internals applications. Many of these bolts have had additional cold work introduced by means of a thread rolling operation. Many bolts are currently in service with rolled threads, which provide an experience base for additional cold work associated with the rolling operation.

Kraftwerk Union (KWU) uses fasteners made of 316 SS with Titanium added (316 SS Ti). The mechanical properties of 316 SS and 316 SS Ti are similar. KWU bolt design uses an integral locking cup on the bolt head. Some additional cold work is introduced in the crimped area when the integral locking cup is deformed to lock the bolt in place. With approximately 5000 bolts currently in service (some for over four years) and subject to regular inspections, KWU has not observed any instances of crimped locking cups failing due to Stress Corrosion Cracking (SCC).

We believe that the additional cold work introduced in the crimped area of the integral locking cup is no greater than the amount of cold work introduced by a thread rolling operation.

SCE proposes to use 316 SS bolts with integral locking cup design. Since 316 SS and 316 SS Ti in a solution annealed and quenched condition will react identically in any corrosive media, no significance is attributed to the slight alloy difference. With equivalent amounts of cold work they would still react identically. The addition of Ti in 316 SS Ti acts as a guard against sensitization, which is not a concern in this application because of the relatively low temperatures experienced by these bolts. Therefore, the crimped area of a 316 SS bolt is expected to perform as well as the crimped area of a 316 SS Ti bolt.

Another point to consider is that if the locking crimp does develop a crack, the locking feature is not lost.

To summarize the preceding points:

1. Cold work introduced by the locking crimp is no greater than the cold work introduced by thread rolling.

2. KWU has successfully used the integral locking cup design and, with approximately 5000 bolts in service (some for over four years) and subject to regular inspections, has not observed any particular problems due to the locking crimp.

3. A crack in the locking crimp does not result in loss of the locking feature.

These three points support SCE's position that bolts with integral locking cups are acceptable for service without undue concerns regarding the additional cold work introduced by the locking crimp.

The NRC has suggested that extended corrosion testing should be performed to determine the susceptibility of the crimped area to SCC. We believe this is not necessary, since periodic visual inspection of the heads of the installed bolts would be sufficient and has already been committed to by SCE. Any cracks discovered during the inspections could be evaluated by test or analysis to validate functionality.

Therefore, installation of the 316 SS bolts with the integral locking cup design, and performing periodic visual inspections to verify the integrity of the locking crimp is acceptable. SCE has already committed to inspect the thermal shield including the locking devices during each refueling outage.