



September 26, 1983

Docket No. 50-461

Mr. James G. Keppler  
Regional Administrator  
U. S. Nuclear Regulatory Commission  
Region III  
799 Roosevelt Road  
Glen Ellyn, Illinois 60137

Subject: Potential 10CFR50.55(e) Deficiency 55-83-05  
1/4"-20 Hex Head Cap Screws on  
Electrical Conduit Straps

Dear Mr. Keppler:

On April 12, 1983 Illinois Power Company verbally notified Mr. F. Jablonski, U. S. NRC Region III (ref: IP memorandum Y-15851, 1605-L dated 4/12/83) of a potentially reportable deficiency per 10CFR50.55(e) concerning the failure of certain 1/4"-20 hex head cap screws during installation of conduit strap attachments to supports. This initial notification was followed by one (1) interim report (Ref: IP letter U-10055, D. P. Hall to J. G. Keppler dated May 23, 1983, 1605-L). Our investigation of this matter is complete. It has been determined that a reportable deficiency per 10CFR50.55(e) does not exist. This letter represents a final report in accordance with 10CFR50.55(e)(3).

Statement of Potentially Reportable Deficiency (Withdrawn)

During installation and torquing of ASTM A307, 1/4"-20 hex head cap screws used in conduit strap attachments, some failures of the cap screws were occurring. Bolt heads were also not marked to identify the manufacturer as required by ASTM A307.

Background/Investigation Results

An Illinois Power Quality Assurance Surveillance in February, 1983 of conduit support installation activities identified a concern regarding the installation of 1/4"-20 hex head cap screws lacking identification marks on the heads. This surveillance resulted in the initiation of a Nonconformance Report (NCR 8808) which identified the problem and also noted that 1/4" cap screws were elongating. On April 6, 1983, Baldwin Associates reported to Illinois Power the details of 1/4" cap screw failures being experienced due to the hex heads twisting off during tightening. Samples of previously installed screws showed signs of threads being stripped and/or elongated.

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An investigation of this matter was initiated to examine the above concerns and included the identification and evaluation of requirements and practices in the following areas:

1. Design requirements provided in drawings and specifications for cap screws;
2. Installation and inspection requirements and practices for cap screws;
3. Purchasing practices for cap screw materials; and
4. Application of ASTM A307 cap screws at CPS.

#### Design

A review of the electrical installation specification K-2999 and applicable design drawings showed that 1/4"-20 hex head cap screws are specified for straps on electrical conduit of 1 1/2" diameter and smaller. Design documents specify that cap screws are to be furnished that meet the material requirements of ASTM A307 and are electrogalvanized or cadmium plated per ASTM A164/A165. Installation torque values of 6-8 ft-lbs. are specified for 1/4" cap screws used in conduit strap attachments.

Investigation of the design basis showed that the rated load capacities for conduit strap attachments are qualified using 1/4", ASTM A307 grade A cap screws with a 6 ft-lb installation torque. Design loads (including seismic) for conduit strap attachments used at CPS are less than the rated load capacities divided by an appropriate factor of safety. The design calculations show the capacity of strap attachments, using 1/4" cap screws at a 6 ft-lb installation torque, is three to ten times greater (depending on conduit diameter) than the seismic design load. It has therefore been concluded that a 1/4" - ASTM A307 cap screw installed at 6 ft-lbs is acceptable for design requirements.

#### Installation

The cap screws have been installed using a calibrated torque wrench with a range of 5 to 80 ft-lbs. The accuracy of these torque wrenches in the 6-8 ft-lb range may vary between ±1 to 2 ft-lbs. Normal construction practice is to torque to 8 ft-lbs to assure acceptance during subsequent quality control inspections. Quality Control inspection practices include a 100% torque verification of accessible cap screws to a value of 96 inch-lbs (8 ft-lbs) using a dial-type torque wrench of 0-300 inch-lb range. The above procedure prevents an undertorqued condition, but does not detect or prevent an overtorque condition.

The 1/4" cap screws have occasionally failed during installation and were replaced with new cap screws. This failure is caused by a number of factors, that include variances in the type of plating of the cap screws and in the screw installation

torque. These factors affect the torsional load on the cap screw during installation. If the torsional load becomes high enough, the head of the cap screw will twist off. Once the tightening of the screw stops, the torsional load is eliminated while the desired pretension load in the cap screw remains. In some cases with a high applied pretension due to overtorquing and depending on the type of plating, the cap screw may yield beyond the elastic range causing a permanent elongation. This case has been evaluated and the elongation is not detrimental to the capacity of the assembly in view of the large factor of safety over design loads. Each assembly completed without failure of the screw constitutes an individual severe load test that the screw functions to the design intent. On this basis, the cap screws that were previously installed satisfactorily to 6-8 ft-lbs or higher without breaking will perform to the design requirements.

#### Purchasing

Hex head cap screws (ASTM A307 1/4"-20), standard commercial grade material, are procured as non-safety related with a certificate of conformance and a quality control inspection at receipt to assure that the specified material was provided. The certificates of conformance normally stated that the material met the requirements for ASTM A307 cap screws. Since the cap screws were purchased as commercial grade non-safety related, suppliers did not always back up their certificate of conformance with other than their industry knowledge, and tracking back to the manufacturer of the unmarked cap screws was not always possible. However, the actual proof of the strength of the cap screws is the installation pretension load, which was confirmed above.

#### Applications of ASTM A307 Cap Screws

1/4" hex head cap screws, type ASTM A307, are also specified for lighting installation, electrical equipment mounting, cable lug connections and instrument tubing supports. These cap screws were also provided unmarked and to the requirements of ASTM A307. These installations are acceptable on the basis of an assembly load test to 6-8 ft-lbs as stated above.

#### Corrective Action

The following measures have been or are being taken to improve and further assure quality installations at CPS:

1. Cap screws will be purchased as safety-related in the future and only marked cap screws will be used for new installations.
2. Plating for cap screws will be specified to ASTM B633 Fe/Zn5, Type I, to provide closer control of installation pretension and torsion.

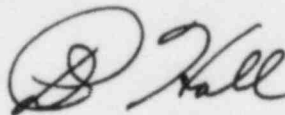
3. The installation torque requirements and quality inspection procedures of 1/4" cap screws will be revised to 75-85 in-lbs., and the use of a more accurate torque wrench with  $\pm 4\%$  accuracy will be required.

Safety Implications/Significance

Investigation of this issue has determined that some failures of 1/4"-A307 hex head cap screws during installation does not indicate a deficiency in either design requirements or in construction that could adversely affect the safety of operation of CPS. Hardware affected by this issue will satisfactorily perform to the design requirements. However, improvements are being made to assure a high degree of quality installation.

We trust that this final report provides you sufficient background information to perform a general assessment of this potential deficiency, and adequately describes our investigation and resolutions.

Sincerely yours,



D. P. Hall  
Vice President

REC/lf

cc: NRC Resident Office  
Director-Office of I&E, USNRC, Washington, DC 20555  
Illinois Department of Nuclear Safety  
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