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Reference: Vogtle Electric Generating Plant - Unit 2; 50-425
ESF Filtration Unit Bolts
GPC Letter GN-1465 dated 6/28/88

In the referenced letter, Georgia Power Company notified the NRC of a potentially reportable condition involving the engineered safety feature filtration unit bolts. Georgia Power Company has completed its reportability evaluation and has determined that a reportable condition as defined by the reporting requirements of 10CFR Parts 21 and 50.55(e) does exist. Based upon NRC guidance in NUREG-0302, Revision 1, and other NRC correspondence, Georgia Power Company is reporting this condition pursuant to the reporting requirements of 10CFR50.55(e). A summary of our evaluation for Unit 2 is attached.

This correspondence contains no proprietary information and may be placed in the NRC Public Document Room.

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EVALUATION OF A POTENTIALLY REPORTABLE CONDITION
ESF FILTRATION UNIT BOLTS

Initial Report: On June 1, 1988, Mr. C. W. Hayes, the Vogtle Quality Assurance Manager, notified Mr. Charles Patterson of the USNRC - Region II, of a potentially reportable condition under 10CFR50.55(e). The potentially reportable condition concerned certain engineered safety features (ESF) air filtration unit foundation bolts.

Background Information: There are four ESF air filtration units in the current Unit 2 design. Two redundant ESF filtration units are provided for the control room and two for the piping penetration area. The electrical penetration area filtration system has been deleted from the Unit 2 design and the filtration units are abandoned in place; as such, they are not addressed in this evaluation. Each filtration unit consists of a steel housing containing the following sections in series: (a) moisture separator, (b) electric heater, (c) upstream HEPA, (d) charcoal adsorber, (e) downstream HEPA, (f) cooling coil (a cooling coil is part of this assembly only for the control room units.), and (g) fan. The ESF filtration units are designed to Seismic Category 1 requirements, and are energized upon receipt of an emergency signal to recirculate the air and remove potential airborne radioactivity. All filtration units are activated upon receipt of a safety injection signal; only the control room units are activated upon receipt of a control room isolation signal. The filtration units also provide the required differential pressure to minimize unfiltered leakage into the control room or out of the piping penetration area.

The filtration units are attached to the foundation via a "C" channel on the base of the unit bolted to 4" clip angles anchored to the concrete. The holes in the clip angles are slotted to accommodate field adjustment.

While investigating an NRC unresolved item on the foundation installation, several other concerns were noted that appeared to violate installation procedures. The high strength bolts utilized for the "C" channel to clip angle connection were not pre-tensioned. As a result, NRC violation 50-425/88-20-01: "Failure to Install HVAC Systems In Accordance with the FSAR" was issued. Three other discrepancies noted in the violation are: (1) the bolted contact surfaces were not free of defects, (2) washers were not installed under the bolt heads over the slotted holes, and (3) one 5/8-inch diameter bolt was used when a 3/4-inch diameter bolt was required. Communication with the vendor, American Air Filter (AAF), to resolve the initial concern revealed that the installed condition did not meet their criteria for seismic qualification.

These discrepancies are based on comparisons with procedure JP-513, "Installation and Inspection of High Strength Bolts," which is the procedure used by the HVAC contractor, P/KF, for the installation of high strength bolts.

Engineering Evaluation: This foundation design was supplied by AAF along with the connection hardware to be used. However, the connection hardware was evidently lost while in storage. The parts list on the vendor drawing for the control room filtration unit fan assembly defined each set of the bolting hardware for the control room filtration unit fan assembly as a bolt, nut, and plated washer. A parts list was not provided for the filtration unit, but the detail is similar. The vendor drawings did not specify a material or torque value for the bolting hardware. The drawings do show a slotted hole in the clip angle, but do not show an oversized washer or a lock washer for the connection. Since the drawings do not specify either a bolt material or a torque requirement, it was assumed that standard bolting material was to be used. In Unit 2, high strength bolts were chosen. The torque value was specified to be snug tight. This is an acceptable substitute for standard bolting per procedure JP-513, except that per JP-513, a lock washer should have been installed to prevent the nut from loosening, and an oversized washer should also have been installed under the bolt head since there is a slotted hole in the clip angle. Procedure JP-513 also requires full contact between the bearing surfaces. However, the requirements for extra washers and full bearing surface contact of procedure JP-513 were not followed since this was a vendor designed connection.

While investigating the NRC unresolved item on the lack of full contact between the bearing surfaces, AAF stated in their April 1, 1988 letter:

"To meet the seismic qualification, the angle clips should be bolted to the base channels with type A-449 high strength bolts, or equivalent, pretensioned to meet the friction connection requirement. Full contact of the two surfaces is not necessary as the friction force is a function of the friction coefficient and the pressure applied (tension of the bolts in this case) is independent of the contact area. (Example reference: O.W. Eshbach's Handbook of Engineering Fundamentals)."

Thus, full contact of the bearing surfaces is not required for this connection, but high strength bolts pretensioned to meet the friction connection requirement are required. The bolts were not pretensioned because the AAF drawing did not specify this as a high strength connection and no torque values were given.

Because the vendor drawings did not specify a bolting material or torque requirement, it was mistakenly assumed that standard bolting material was originally supplied. However, high strength bolts were substituted as allowed by site procedures JP-14.2 and JP-513. No lock washers or oversized washers were installed because the vendor drawings did not show the requirements. Plated flat washers were installed on the nut side. Therefore, the installed condition was consistent with the parts list and drawing supplied by the vendor, with the exception of the one undersized bolt. On completion of the installation, QC also used the vendor drawings as the verification documents for inspection and acceptance. The use of the one undersized bolt is considered to be of minor significance in relation to the total population of over 100 bolts.

Since high strength bolts were installed without a lockwasher or without being pretensioned, the nut may eventually loosen and potentially back off. Therefore, the integrity of the as-found connection cannot be assured for the life of the plant. If the connection were to relax or loosen from snug tight, as they were installed, the connection could potentially fail during a seismic event.

The root causes for this condition were determined to be incomplete vendor design information and a judgement mistake by the installation contractor for hardware replacement. The existing procedures require modification to a design to be reviewed and approved by the design agency. Therefore, when the supplied hardware was replaced, and the vendor information was unclear, the vendor should have been contacted for their review and approval per the existing site procedures for field change requests (FCR) and field equipment change orders (FECO).

Broadness Review: Normally, bolted connections installed by P/KF, the installation contractor for HVAC, without specific vendor design are in accordance with procedure JP-14.2 for standard bolts, or JP-513 for high strength bolts. These procedures require either lock washers or torquing which will prevent loosening of the bolted connection. All other equipment within P/KF scope was reviewed. This deficiency occurred in equipment for which P/KF was responsible for field engineering, installation and QC inspection; and for which the bolting design and hardware were supplied by the vendor to be installed in the field. Only the ESF filtration units discussed above and the supply fans for the control room ESF filtration system fit into this category. There are two supply fans for the control room ESF filtration system. Their foundation detail, also designed by AAF, is similar to the filtration system. Type A-307 standard bolts with lock washers were found to be installed. A calculation was performed based on the installed condition which indicated that the A-307 bolts would have met the seismic design. Therefore, this is considered to be a unique situation which does not affect any other installation.

Analysis of Safety Implication: Whether the high strength bolts will actually relax and loosen during the life of the plant cannot be determined since the connection was not properly torqued, nor was a locking device installed. Should this connection become disengaged, the filtration units may move away from the foundation, thereby possibly separating the filtration units from the ductwork, and rendering them inoperable. In the case of a potential accident involving a release of radiation, this condition may cause a loss of pressurization of the control room and an increase in radiation exposure to the operators. An analysis to determine the dose to the operators that could result from failure of the control room ESF filtration system, or the increase in radioactive release due to a failure of the piping penetration area filtration unit has not been performed for this condition. A loss of these ESF filtration systems could potentially result in a substantial safety hazard as defined by 10CFR21 and a significant deficiency relating to the construction of a system as defined by 10CFR50.55(e). Therefore, Georgia Power Company has concluded that this condition is reportable for Vogtle Unit 2 under 10CFR50.55(e) and 10CFR21.

Evaluation of a Quality Assurance Program Breakdown: The ESF filtration units were installed and QC inspected per the requirements of an approved mechanical installation package (MIP) and the vendor drawings. The original hardware supplied by the vendor was lost. In replacing the lost hardware, it was mistakenly assumed that standard hardware was originally supplied since the vendor drawings and parts list did not give any other requirements. High strength bolts were substituted and installed at a snug tight condition. This is a normally acceptable substitution and was not construed as a design modification. Therefore an FCR or FECO was not written. In retrospect, the vendor drawings were not as clear as they needed to be and the vendor should have been consulted before replacement bolts were specified. We believe this indicates a mistake in judgement by P/KF field engineering and not a significant breakdown of the quality program.

Conclusion: It has been concluded that the long term seismic qualification of these ESF filtration units was not assured since the untorqued, high strength bolts may loosen over the life of the plant. An analysis to determine the consequences of these loose bolts has not been performed, but conservatively assuming the ESF filtration units come off their foundations and separate from the ductwork results in a situation outside of the design bases of the plant. This could cause the operators to receive a higher radiation dose during a potential accident, as well as a higher off-site release from the piping penetration area. Therefore, this condition is considered to be reportable under the requirements of 10CFR50.55(e) and 10CFR21. Based on guidance in NUREG-0302, Revision 1, concerning duplicate reporting of an event, Georgia Power Company is reporting this condition per the criteria of 10CFR50.55(e).

Corrective Action: Two deviation reports were generated to replace the existing bolting hardware between the clip angles and the "C" channels under the filtration unit housings (Deviation Report's PK-4208 and PK-4211). High strength bolts and oversized washers were installed, torqued to the requirements of AISC slotted hole configuration, including replacement of the undersized bolt. This work has been completed.

Another Deviation Report (CD-9372) was written for the control room ESF filtration system supply fans (also supplied by AAF) which have a similar foundation design. Type A-307 standard bolts and lockwashers were originally installed in accordance with procedure JP-14.2. A calculation was performed based on the installed condition which indicated that the A-307 bolts would have met the seismic design. However, all of the accessible bolts (12 out of 20 per fan) were replaced with high strength bolts and oversized washers, torqued to the requirements of AISC. This work has also been completed.

To prevent future occurrence of this mistake, the contractor (P/KF) has conducted a training session for personnel associated with equipment installation to stress the importance of clarifying possible incomplete drawing information and the requirements of the bolting procedures. Also, MFCRB-18601 has been issued to add the material specification, oversized washers and torque requirement to the appropriate AAF drawings.