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To	OPERATIONS CENTER		
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U-602532  
 L16-93(12-20)LP  
 4F.140

JGC-536-95  
 December 20, 1995

10CFR21.21

Docket No. 50-461

Document Control Desk  
 Nuclear Regulatory Commission  
 Washington, D.C. 20555

Subject: 10CFR21 Final Report 21-95-018: Asea Brown  
 Boveri/ITE/Gould/Brown Boveri Power Shield  
Type SS-13 Solid State Trip Device Failures

Dear Sir:

Illinois Power (IP) issued 10CFR21 Interim Report 21-95-018 on October 6, 1995, via letter U 602502, to notify the Nuclear Regulatory Commission (NRC) of a potentially reportable condition discovered at Clinton Power Station (CPS). The issue involves the failure of Power Shield Type SS-13 solid state trip devices (SSTDs) manufactured by Asea Brown Boveri (ABB)/ITE/Gould/Brown Boveri. At the time of the October 6, 1995 report, IP had not completed the reportability evaluation for this issue. The final report of this issue is provided herein.

On August 7, 1995, during an attempt to shift the Control Room Heating, Ventilating and Air Conditioning (VC) system operation from the A train to the B train, the B train return air fan would not start. An investigation of the failure to start found the fan's circuit breaker, OAP06E5D, in a tripped condition. Upon discovery of the tripped breaker, IP staff reset the circuit breaker and attempted to start the fan but the breaker tripped again. The breaker was replaced with a spare breaker, and the fan started and operated satisfactorily. Testing of the deficient breaker on August 8, 1995, identified that its Power Shield Type SS-13 SSTD, serial number 45779, was causing the breaker to trip. The device was returned to the supplier for further evaluation.

On August 10, 1995, IP determined that the deficient device was a condition potentially reportable under the provisions of 10CFR21.

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On August 21, 1995, IP identified another potentially deficient Power Shield Type SS-13 SSTD. This device, serial number 45778, was installed in the B Switchgear Heat Removal (VX) system condensing unit motor circuit breaker 1A12F6D. The trip device in the VX system exhibited symptoms similar to those of the VC system device discussed above. This device was also returned to the supplier for further evaluation.

The investigation of the two deficient Type SS-13 SSTDs identified broken solder connections on circuit card edge connectors. Since the serial numbers of the two devices were sequential, the broken solder connection problem was considered potentially generic. Therefore, on October 20, 1995, the scope of potentially affected devices was expanded to include all Power Shield Type SS-13 SSTDs. An additional Type SS-13 device problem was identified in a non-Class 1E breaker application.

On October 31, 1995, the scope of potentially affected devices was expanded to include Type SS-14 solid state trip devices. Although CPS had not experienced failures of this type of device the design of the circuit card edge connection is identical for the Type SS-13 and SS-14 SSTDs.

On November 20, 1995, ABB submitted a report to the NRC under the provisions of 10CFR21 discussing the results of their evaluation of the devices returned to them by CPS. The report identifies that defective solder connections in the Power Shield solid state trip devices caused the false trips of the CPS circuit breakers. The report identifies the cause of the defective solder connections and provides recommended actions and repair instructions. The report recommends that purchasers inspect all Power Shield SS series trip units (includes Types SS-13 and SS-14) having serial numbers less than 80,000 for defective solder connections.

IP provides the following information in accordance with 10CFR21.21(c)(4). Initial notification of this matter will be provided by facsimile of this letter to the NRC Operations Center in accordance with 10CFR21.21(c)(3) on the date this letter is signed by the responsible officer.

- (i) J. G. Cook, Senior Vice President of IP, Clinton Power Station, Post Office Box 678, Clinton, Illinois, 61727, is the responsible officer notifying the NRC of a condition reportable under the provisions of 10CFR, Part 21, by means of this report.
- (ii) The basic components involved in this condition are Power Shield solid state trip devices, Type SS-13, manufacturer part number 609901-T012. The Type SS-13 SSTDs provide electrical overcurrent protection of motor circuit breaker loads.
- (iii) The SSTDs were manufactured under the following company names: Asea Brown Boveri, IIE, Gould, and Brown Boveri.

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- (iv) The two Type SS-13 SSTDs installed in the VC and VX systems were electrically tested and inspected by ABB. Testing of the VC system unit identified an intermittent output signal that would cause the breaker to false trip. During disassembly and inspection of the unit, a 360-degree break was identified in the solder connection of a pin on the printed circuit board edge connector located on the control board. The pin connects the anode of diode D-205 to a terminal connected to the R-11 power supply external load resistor. Opening this circuit causes the device to trip. The edge connector is a Molex right angle type 2145 with gold plated brass terminals.

Testing of the VX system device did not identify any malfunctions. During disassembly and inspection of the device a 360-degree break was identified in the same solder connection as discussed above for the VC system device. In addition, a second pin showed some partial signs of cracking, but less than 360 degrees.

ABB identified that the root cause of the broken solder connections was grain coarsening and copper diffusion embrittlement of the solder fillets. The embrittlement aided fatigue cracks brought on by mechanical and thermal stress.

IP has concluded that the deficiency in the Type SS-13 solid state trip devices could have created a substantial safety hazard if it had gone uncorrected. The safety function of the VC system is to maintain a habitable environment and ensure the operability of all components in the main control room under all operating and accident conditions. The VC system is comprised of two redundant trains. A failure of the VC system B train return air fan due to the deficient Type SS-13 SSTD, combined with a single failure in the VC system A train, could prevent the VC system from performing its safety function. Loss of safety function is considered to be a substantial safety hazard.

- (v) The Type SS-13 solid state trip device in the VC system was identified as potentially deficient on August 8, 1995. IP determined that the trip device was potentially reportable under the provisions of 10CFR, Part 21 on August 10, 1995.
- (vi) Type SS-13 solid state trip devices are typically installed on auxiliary power 480-volt circuit breakers used for motor control at CPS. CPS has 12 Class 1E Type SS-13 SSTDs installed in safety-related circuit breakers and 9 Class 1E Type SS-13 SSTDs installed in spare safety-related breakers. The applications of these breakers include the following heating, ventilating, and air conditioning (HVAC) systems: Switchgear Heat Removal, Diesel Generator Room HVAC, Drywell Cooling HVAC, and Control Room HVAC. In addition, CPS has 22 Class 1E Type SS-13 SSTDs in stores.

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- (vii) IP inspected and reworked, as needed, the 12 Type SS-13 SSTDs installed in safety-related breakers in accordance with instructions provided by ABB.

Eight of the 9 Type SS-13 SSTDs installed in spare breakers have been returned to ABB with their breakers and will be replaced with new units during refurbishment of the breakers. The remaining one Type SS-13 SSTD installed in a spare breaker is currently scheduled to be replaced during breaker refurbishment by ABB in 1996.

IP inspected and reworked, as needed, the 22 Class 1E Type SS-13 SSTDs located in stores.


Failures of Power Shield Type SS-14 solid state trip devices have not occurred at CPS to date. However, CPS has developed a plan to inspect the solder connections and rework or replace the Class 1E Type SS-14 SSTDs as needed.

- (viii) IP's advice to other licensees and purchasers of Type SS-13 SSTDs is that false trips of breakers containing Type SS-13 SSTDs should be considered to be symptomatic of the deficiency described herein.

ABB submitted a report to the NRC under 10CFR21 on November 20, 1995. That report indicates that ABB will notify all purchasers about the issue.

Additional information about the CPS issue may be obtained by contacting D. G. Lukach, system engineer, at (217) 935-8881, extension 3952.

Sincerely yours,

  
J. G. Cook  
Senior Vice President

RSF/csm

cc: NRC Clinton Licensing Project Manager  
NRC Resident Office, V-690  
Regional Administrator, Region III, USNRC  
Illinois Department of Nuclear Safety  
INPO Records Center  
Asea Brown Boveri