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July 17, 1973

Mr. John F. O'Leary, Director  
Directorate of Licensing  
US Atomic Energy Commission  
Washington, DC 20545



Re: Docket 50-255  
AO-3-73

Dear Mr. O'Leary:

The purpose of this letter is to report an abnormal occurrence (AO-3-73) at our Palisades Plant.

On July 5, 1973 while doing in-core analysis calculations to update core burnup for power produced in the period from July 1 through July 4, it was noted that the computer power level was 10% below that established by the plant heat balance (calorimetric based on feed-water flow). This was discovered to be a result of incorrect in-core flux values supplied from the primary data logger. It was further and more specifically determined to be a result of incorrect conversion constants (sensitivity values) being used to convert detector current from the self-powered rhodium neutron detectors (in cores) to flux levels. This error was subsequently determined to have been propagating since 2200 hours on June 28, 1973.

The self-powered rhodium neutron detectors in use at Palisades become less sensitive with exposure to neutron flux. The loss of sensitivity with time follows the equation:

$$S(t) = S_0 \left[ 1 - \frac{Q(t)}{Q(\infty)} \right] \quad (1)$$

where  $S(t)$  is the sensitivity at any time "t"  
 $S_0$  is the initial (unburned) sensitivity  
 $Q(t)$  is the total charge produced by the  
detector from new to time "t"  
 $Q(\infty)$  is the total charge available from (to  
completely deplete) a new detector

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The Palisades data logger automatically integrates current out of each detector and periodically updates the sensitivity factors. Since the sensitivity varies linearly with charge out of the detector, the data logger uses equation (1) in the following form:

$$S(t_i) = S(t_{i-1}) - K \sum_{n=t_{i-1}}^{n=t_i} i_n \Delta t \quad (2)$$

where  $S(t_i)$  is the present sensitivity  
 $S(t_{i-1})$  is the previous sensitivity  
 $K$  is  $S_0/Q(\infty)$   
 $i_n$  is the current measured at any data logger scan  
 $\Delta t$  is the time between data logger scans

The updated value of the sensitivity resides in computer memory and is used to convert detector readings to flux units at every detector scan. The flux is proportional to the detector signal divided by the sensitivity factor.

The sensitivity values along with other values are periodically dumped (translated into proper format and outputted) onto paper tape by maneuvering push buttons on the plant operator's terminal. This dump is used as input to the in-core analysis program as well as to restore the proper values of the sensitivity factors in the data logger should they be lost in memory through computer malfunction or maintenance activities.

It should be noted that the "system program" tape which is used to "initialize" computer memory also contains values for the sensitivity factors. Since the "system program" was generated early in plant life, the sensitivity factors contained therein are for the detectors in the essentially unburned condition. When restoring computer memory at any later point in time, the "system program" tape is loaded first. The most current good "dump tape" is then loaded behind it. This "overlays" the appropriate portion of memory and insures that the appropriate values of the sensitivity factors for that particular point in time again reside in memory.

Late on the evening of June 28, 1973, the data logger malfunctioned. An instrument and control technician was called in to repair the system. At about 2200 hours on June 28, 1973, he reloaded the "system program" and returned the data logger to service. Apparently, at that time, the sensitivity factors were not loaded from the last "dump tape." Upon returning the following morning, the technician reloaded the most current "dump tape." Unfortunately, the tape he loaded had been dumped after 2200 hours on June 28, 1973. As a result, the erroneous sensitivity factors from the "system tape", in effect, remained in the data logger memory.

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The data logger again failed to function properly on several occasions between June 29 and July 3, 1973. Some of these occurrences resulted in reloading the "system tape" as well as the then current "dump tape." Although conducted properly, none of these memory restorations served to correct the out-of-date sensitivity factors since the factors were perpetrated on the "most current dump tape," which, in all cases, had been dumped after 2200 hours on June 28, 1973.

The incorrect sensitivity factors were theoretically non-conservative when used to calculate flux. This is due to the fact that as in-cores burn up a constant flux is represented by a weaker electrical signal. Thus, the old factors calculate less flux (power) than is truly present. Since in-core alarms are based upon percent increase in flux levels required to reach a given power level (13.2 kW/ft), this situation essentially resulted in employing in-core alarms that were approximately 10% higher than were justified by Interim Special Technical Specifications, Section 3a.

Subsequent review of good "dump tapes" run prior to June 28 shows a nominal 17% margin above the requirements of Section 3a. Calculations on good tapes run on July 5, 1973 also show a nominal 17% margin. Since control rod positions did not vary appreciably over the period and power remained constant, it is reasonable to assume that 17% margin above Section 3a existed during the entire period and no operating limits were exceeded.

It should be noted that, since 17% margin apparently existed, the requirements of Interim Special Technical Specifications Section 6 were met for operation at nominal 100% power without the data logger in service. This incident appears to qualify as an abnormal occurrence only under Definition "f" in the Technical Specifications (Procedural Control Inadequacy).

Upon realizing that faulty sensitivity factors were entered in the data logger, immediate corrective action was taken at 1800 hours on July 5, 1973. This action consisted of loading the last "dump tape" that was known to be good (from earlier on June 28, 1973). Subsequently, in-core power distribution calculations were run and new flux alarms were entered in the data logger by 1200 hours on July 6, 1973.

In final disposition of this occurrence, a formal maintenance procedure has been approved by the Plant Review Committee for reloading primary data logger program tapes. This procedure includes a stepwise sign-off sheet which will insure complete loading of program tapes, proper dump tape, and other changeable constants required for proper data logger operation.

Yours very truly,

Russel B. DeWitt (Signed)

Russel B. DeWitt  
Nuclear Production Administrator

WJB/WGF/pb

CC: BHGrier,  
USAEC