



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
REGION II  
101 MARIETTA STREET, N.W.  
ATLANTA, GEORGIA 30323

Report Nos.: 50-280/90-32 and 50-281/90-32

Licensee: Virginia Electric and Power Company  
Glen Allen, VA 23060

Docket Nos.: 50-280 and 50-281

License Nos.: DPR-32 and DPR-37

Facility Name: Surry 1 and 2

Inspection Conducted: October 9-11, 1990

Inspector:

G. A. Belisle  
G. A. Belisle

10/24/90  
Date Signed

Accompanying Personnel: A. E. Levin

Approved by:

C. A. Julian  
C. A. Julian, Chief  
Engineering Branch  
Division of Reactor Safety

11/2/90  
Date Signed

SUMMARY

Scope:

This routine, announced inspection was conducted in the areas of reviewing the licensee's calculations and test procedures for determining flow through the recirculation spray heat exchangers (RSHXs).

Results:

In the areas inspected, violations or deviations were not identified.

The licensee made basic engineering mistakes in the calculation for determining which RSHX train to test. These mistakes, however, did not significantly impact the results. The calculation for determining RSHX fouling appeared adequate (paragraph 2). The special test to determine RSHX flow appeared adequate (paragraph 2).

## REPORT DETAILS

### 1. Persons Contacted

#### Licensee Employees

- \*W. Benthall, Supervisor, Surry Licensing
- R. Cherry, Licensing
- A. Hall, System Engineer
- J. Kelly, System Engineer
- J. Niland, Project Engineer
- J. Pak, Nuclear Engineering Services
- \*A. Price, Assistant Station Manager
- R. Rasnic, Nuclear Engineering Services
- J. Waddill, Nuclear Engineering Services
- S. Wiser, Nuclear Engineering Services
- \*T. Towers, Superintendent of Engineering

Other licensee employees contacted during this inspection included engineers, operators, and administrative personnel.

#### NRC Resident Inspectors

- \*S. Tingen, Resident Inspector

#### \*Attended exit interview

Acronyms and initialisms used throughout this report are listed in the last paragraph.

### 2. RSHX Testing (61701)

VEPCO calculation ME-0262, Equivalent Length Comparison of Service Water Piping to Recirculation Spray Heat Exchangers, Revision 0, was performed to show that the single train of RSHX scheduled for service water flow testing was representative of the four trains at Surry (two for Unit 1, two for Unit 2). The comparison was performed by converting all service water piping, valves, fittings, and the heat exchangers themselves to equivalent lengths of 24-inch OD piping. The conversion was done by first determining the equivalent lengths of all fittings and valves at their actual diameters in accordance with conventional length-to-diameter ratios (such as those published in the Crane manual), and then using a pressure drop equation to calculate the length of 24-inch OD pipe that would result in an equal pressure drop for the same volumetric flow. A similar conversion was done for the RSHXs using specifications data from the heat exchanger manufacturer.

The inspectors review of this calculation found that the conversion of pipe lengths was not done properly because it omitted the effect of changing the pipe diameter on the friction factor for the pipe. Furthermore, the inspectors also discovered that, in determining the overall equivalent length of 24-inch OD piping for each RSHX train, parallel branches of piping had been added together as if they were in series, giving erroneous answers. These errors were brought to VEPCO's attention by telephone and were discussed further onsite on October 9. During the discussion on October 9, VEPCO admitted that errors had been made, but claimed that the impact of the errors on the conclusions reached by means of these calculations were minimal. The inspectors agreed that the errors did not affect the conclusions reached, but expressed concern about the ability of VEPCO's engineering staff to do fundamental fluid mechanics calculations properly. VEPCO stated that a modification of the original calculation was being prepared to correct these errors. An additional meeting was conducted on October 10 to discuss the modification and to resolve any remaining differences. During this meeting, VEPCO's modified approach was examined; VEPCO engineers attempted to calculate directly the pressure drop for each RSHX train properly accounting for different pipe sizes and parallel branches. However, additional errors were found in this revised calculation, stemming from VEPCO's failure to account for changes in velocity with changes in pipe diameters. The friction factors and effective resistance terms were calculated correctly, but, rather than account individually for each different pipe diameter, a "representative" diameter of 36 inches was chosen, and the velocity in that pipe was used for all pipe pressure drop calculations. This error was brought to the attention of the VEPCO engineers and, after extended discussions, VEPCO agreed that the calculation would be redone from the beginning in a rigorous manner.

The inspectors conclusion drawn from ME-0262 was that the RSHX train scheduled for testing was representative of those in the two units. The inspectors also concluded that the calculation demonstrated that ample flow would be available to meet RSHX service water-side requirements. The errors found in the ME-0262 and its revisions did not invalidate the above conclusions; however, VEPCO should be especially careful in these types of calculations to follow fundamental fluid mechanics principles in developing estimates for the performance of thermal-hydraulic systems.

The inspectors reviewed ME-0266, Evaluation of Recirculation Spray Heat Exchangers, Revision 2. This calculation was developed to model the RSHXs and assess their ability to remove long term DBA heat loads under microfouling conditions. This calculation concluded that the RSHXs can be effectively 20 percent blocked after 24 hours and 80 percent blocked after 30 days and still remove containment heat loads. An allowable rate of macrofouling was also calculated. The inspectors concluded that this calculation, after discussion with VEPCO personnel to resolve questions, was acceptable.

The inspectors reviewed I-ST-90, Recirculation Spray Heat Exchangers Source Water Flow Test, Revision 0, and subsequent procedure change, Number 90-132. The purpose of this test was to collect data in order to determine that the DBA flow and long term cooling is adequate to reject design basis heat loads from containment. The other purpose of this test was to collect data necessary to validate pressure drop values provided by the manufacturer and estimate reduction in heat transfer capability due to macrofouling. This test appeared adequate.

Within this area, no violations or deviations were identified.

3. Exit Interview

The inspection scope and results were summarized on October 11, 1990, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results. Dissenting comments were not received from the licensee.

4. Acronyms and Initialisms

DBA	Design Basis Accident
NRC	Nuclear Regulatory Commission
OD	Outside Diameter
RSHX	Recirculation Spray Heat Exchanger
SR	Special Test
VEPCO	Virginia Electric and Power Company