

U.S. NUCLEAR REGULATORY COMMISSION  
OFFICE OF INSPECTION AND ENFORCEMENT

Docket No.: 99900906/82-01

Environmental Qualification Program: Washington Public Power Supply  
System (WPPSS) Qualification Testing of Target Rock Solenoid Operated  
Valve

Equipment Identification:

Test Specimen: Solenoid Operated Valve  
Type: 1" Globe Valve  
120 VAC, Normally Closed (Energize to Open)  
Type RH Insulation, TRC Model 79LL-001 Valve  
No. 1032110-4-6-1-S

Manufacturer: Target Rock, Inc.  
East Farmindale, Long Island, New York

Test Organization: East-West Technology, Inc.  
West Babylon, Long Island, N.Y.  
Docket No.: 99900906

Licensee: WPPSS; Richland, Washington  
Docket Nos. 05000.460/513

Inspection Conducted: December 21-23, 1981  
January 12-13, 1982

Inspectors: *J. R. Agee* 7/26/82  
J. R. Agee, RIV Date

*A. C. Finkel* 7/26/82  
A. C. Finkel, RI Date

Reviewed by: *N. B. Le* 7/26/82  
N. B. Le, Electrical Engineer Date

Approved by: *Robert F. Heishman* 7/28/82  
Robert F. Heishman, Acting Chief Date  
Reactor Construction Programs Branch, IE

Details Section

Prepared By: J. R. Agee

A. Persons ContactedTarget Rock Corporation

Mr. J. Frange, Environmental Engineer  
Mr. S. Karidas, Project Engineer  
Mr. R. Langesetter, Program Manager

East-West Technology Corporation

Mr. A. Davis, President, American Environments Lab  
Mr. K. Burkhard, Project Engineer

United Engineers and Constructors

Mr. R. Rock, Equipment Qualification Coordinator  
Mr. M. K. Sharma, Electrical Engineer

B. Summary

The purpose of the inspection was to witness the LOCA test portion of the equipment qualification test program on the Target Rock Solenoid Valve (SOV). The test was conducted by the American Environments Division of the East-West Technology, Inc. in West Babylon, Long Island, New York.

The test was started on 12/22/81, however, because of modification to the test facility, it was interrupted shortly after the first transient, and was resumed on 1/19/82. This inspection report covers both periods, i.e., the LOCA and POST LOCA portions of the test.

Several anomalies were observed during the inspection, and are listed as follows:

1. The test plan did not provide adequate details for the conduct of the test.
2. No back up specimens or test instrumentation was provided. For example only one solenoid valve was provided for the program.
3. The test was delayed several times to allow repairing of test instrument that failed because of environmental conditions.

4. Sufficient test instruments and measuring devices were not installed from the beginning of the test.
5. The test was halted several times to allow repairing of the pressure recorder and replacing of pressure sensing devices.
6. There was no flow measuring device provided to monitor chemical spray flow rate at the beginning of the test. Later, during the down-time for repairing of the pressure recorder, a local flow indicator (1/4" rotometer) was installed, however, no provision was made to record flow rate.
7. There was no provision to monitor the power supplies and loading current at the beginning of the test. This provision was later provided when the test was halted for repairing of other test instruments.
8. The quartz heaters used to maintain specified temperature for the test specimen failed during the test and were replaced.
9. There was no provision for recording or read-out of test temperature profile. This condition was corrected during the first test interruption for instrument repair. Thermocouples were added, and several interruptions were made to correct the thermocouples' reading. The test chamber was opened several times to reposition thermocouples, however, erratic read-outs persisted. It was finally determined that the direct impingement of the chemical spray on the thermocouple heads was the cause of the problem, and hence, thermocouples were reoriented away from the effect of the impingement.
10. No baseline data, test instrument margins, or failure criteria were specified prior to start of the test.
11. Because of numerous interruptions, the test data does not represent the required LOCA profile. The 20-day interruption between the LOCA transients and other interruptions during the POST-LOCA test tend to render the test data inconclusive.
12. The test procedure did not prescribe the voltage and frequency range during operability test cycling.

### C. Results

The test specimen failed its scheduled cycling on the 38th day of the required 100-day POST-LOCA portion of the qualification test. The interval for the cycling of the test specimen is 7 days, therefore, the specimen failed the test sometime between the 31st day through the 38th day of the scheduled 100-day POST-LOCA test.

## D. LOCA Environment Test

### 1. Objectives

The objectives of the inspection were to:

- a. Review the adequacy of the test plan, test facility and the test set-up.
- b. Observe the performance of the LOCA test for compliance with the Target Rock Specification 2549 B, Project 79LL dated March 24, 1980, during the environmental (LOCA and POST-LOCA) test.

### 2. Findings

#### (1) LOCA Performance Test

On December 21, 1981 during the initial simulated design basis accident (DBA) transient, (test temperature ranges from 120° to 340°F in 010 seconds), the pressure recorder failed, leaving the local pressure gauge as the only measurement of pressure. No measurement of flow of the borated water spray from the boron storage tank to the test chamber was provided, therefore, it was not possible to determine that the flow requirement of the Target Rock specification 2549, paragraph 6.3.2.3 was followed during test conduct. Also, in contrast to the specification requirement, the test instrumentation configuration made no provision for solenoid insulation resistance measurement, thus the coil insulation resistance was not recorded.

Prior to the start of testing the boron tank heaters failed and the boron solution was stored inside the test building overnight. The boron tank was filled prior to the start of the first DBA transient. It was estimated that the boron solution was at 70°F, but no measurement was made by the test facility personnel to verify the boron solution temperature.

After the first DBA transient, the test chamber temperature was reduced to approximately 140°F and was held at that value for approximately sixteen (16) hours. The second DBA transient was started at approximately 8:30 a.m. the morning of December 22, 1982. The quartz heaters which surrounded the specimen (SOV) in the chamber failed and the test was halted to allow replacement of heaters. Following reclosure of the test chamber and reestablishment of the test temperature at 140°F, the specimen was soaked at this temperature for two (2) hours after which the second DBA transient test was again started. Due to recognition of several limitations in the test set-up by the test personnel, the test was stopped on December 23, 1981.

2. Test Chamber Temperature Profile for Environment Simulation (Combined PWR/BWR) Figure A1 of Appendix A of IEEE 323-1974.

The test chamber was returned to 140°F plateau after the first DBA transient and held at this temperature overnight before testing was resumed. The test procedure did not define the time it takes for the test specimen to return to 140°F nor did it define how long it would be before the second DEA transient would start. It appeared that this part of the test profile did not meet the profile of figure 1A of IEEE 323-1974.

3. Summary of Data Obtained During the Initial Stage of the Environmental Test.

The failure of the pressure recorder, the lack of measuring the solenoid coil insulation resistance during testing and the absence of instrumentation to record boron flow, pressure and temperature left some doubt concerning continuation of the LOCA testing on SOV without repairing or modifying the test equipment.

Based on the above observations, the test personnel chose to terminate the test until both the test procedure and the test set-up could be reevaluated by the licensee.

The test was halted on December 23, 1981.

E. POST-LOCA Test

1. Objectives

The objectives of this area of the inspection were to:

- (a) Verify that the proposed modifications to the test plan and whether test equipment had been incorporated.
- (b) Observe the continuation of the LOCA testing of the environmental qualification of the Target Rock solenoid valve.

2. Findings

The LOCA portion of the test was restarted approximately 1:30 p.m. on January 19, 1982. Following normal heatup of the test chamber and introduction of steam and borated water flow spray to the test chamber, the test facility coordinator stated the test was ready for the second transient to the LOCA test. The recorders were marked; however, miscellaneous mechanical and electrical problems occurred and caused delays in the reestablishing of LOCA test temperature conditions of 355°F. After approximately three (3) minutes



at this temperature conditions, the temperature readings began to decrease, signifying either the test temperature was dropping or the thermocouple signal was reversing polarity. Chemical spray was stopped when the recorder recorded an erroneous value of minus (-) 71°F. After the chemical spray was stopped, the thermocouple readings began to increase.

It was observed that when chemical spray was resumed, the thermocouple readings began to decrease. The test was halted and the test chamber was opened to examine the thermocouples. The thermocouples were repositioned; the test chamber was closed and secured. The POST-LOCA test condition was reestablished and chemical spray restarted, again the thermocouple problems recurred. After three attempts to solve the thermocouple problem without success, the test was stopped. The system was left intact from the night of January 19, 1982 until the morning of January 20, 1982 at which time the thermocouples were oriented to prevent direct impingement of the chemical spray. The test chamber was closed, secured and the system returned to POST-LOCA test condition at approximately 215°F and 11 psig. The chemical spray was actuated and no problem on the thermocouple read-outs were observed. The POST-LOCA test condition was reestablished and the test continued on for its 100-days POST-LOCA functional test.

### 3. Test Monitoring

On January 20, 1982, the Target Rock test personnel initiated a schedule to cycle the test SOV daily for a week, then weekly for the duration of the POST-LOCA test. Additional random inspection of the test system operations would also be performed.

Subsequent to January 20, 1982, the NRC inspector verified the status and progress of the LOCA test by unscheduled telephone contacts, the Target Rock test engineer advised the NRC inspector that the test had been terminated due to failure of the SOV to cycle on the thirty-first (31st) day of the POST-LOCA test. At that time the cause of the failure was attributed to the opened coil, however detailed investigation of the failure was to be continued.

### F. Post Test Findings

Subsequent to the termination of the POST-LOCA test, it was observed that the SOV's cover gasket has broken and split at the top side of

the cover, however, no effort was made to repair or replace the broken gasket. The split created a gap on the top side of the valve allowed spray water to collect and drip inside the valve during the test. Water collected in the valve enclosure and caused various internal component to corrode, leading to the open circuit of the solenoid coil and causing failure of other parts of the control units.

Target Rock test personnel indicated that causes for the failure of the test will be further determined and reported to the staff when the findings are complete.

FOOTNOTES: On May 4, 1982, prior to the issuance of this report, Target Rock personnel and representative from the Washington Public Power Supply System (WPPSS) met with the NRC staff in Bethesda to present their findings on the investigation of anomalies observed during test conduct. Target Rock personnel has recommended 3 options to resolve problems identified in the report and the WPPSS is to evaluate these options and advise the NRC staff of their decision.