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U.S. ATOMIC ENERGY COMMISSION

REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS

REGULATORY GUIDE 1.80

PREOPERATIONAL TESTING OF INSTRUMENT AIR SYSTEMS

A. INTRODUCTION

General Design Criterion 1, "Quality Standards and Records," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that structures, systems, and components important to safety be tested to quality standards commensurate with the importance of the safety functions to be performed. Criterion XI, "Test Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 requires that a test program be established to assure that all testing, including preoperational testing required to demonstrate that structures, systems, and components will perform satisfactorily in service is identified and performed. This guide describes a method acceptable to the Regulatory staff for complying with the Commission's regulations with respect to verifying the operability of safety-related instrument air systems [1] before placing these systems into service.

B. DISCUSSION

Operation experience has shown that there is a need for guidance in conducting an adequate preoperational test on the instrument air systems. There have been valve operator failures due to foreign matter in the instrument air, which would indicate either inadequate cleaning of the system after installation or inadequate filtering of the supply air taken into the system during operation. There have been several incidents in which the air supply to vital instruments was cut off due to the freezing of excessive moisture in the instrument air line. In one case, the freezing was the result of an improperly set dryer refrigerant expansion valve. In other cases, the freezing was caused by unusually cold weather.

The applicant is responsible for the development of a suitable preoperational test program for the instrument air system, the preparation of adequate procedures for carrying out the program, the proper conduct of the preoperational tests, and the validity of the test results.

A significant consideration related to the performance of the instrument air system is how the valves controlled by the system will respond to the loss of instrument air supply. Valves are designed to respond in a given manner, i.e., fail open, fail closed, or fail as is, if the instrument air supply is lost. Verification of design response to a loss-of-instrument-air accident is an essential part of testing at the preoperational stage, at which time it can be accomplished with a minimum risk to power plant equipment and personnel. The test will also provide a means for determining the adequacy of operating and emergency procedures for coping with a loss of instrument air supply.

C. REGULATORY POSITION

As part of the initial preoperational testing program, and also after major modifications or repairs to a facility, the instrument air system should be tested as described below to verify that all components function properly and that the systems respond as designed to a loss-of-instrument-air-supply accident.

1. The test program for the instrument air system and its associated equipment should include applicable checks, verifications, tests, and reports outlined in Regulatory Guide 1.68, "Preoperational and Initial Startup Test Programs for Water-Cooled Power Reactors" as a prerequisite to or in conjunction with the tests of this regulatory guide.

2. Compressors, aftercoolers, oil separator units, and air receivers should be tested to verify proper operation according to system design. Check operation of compressor unloaders, automatic and manual start and

[1] This guide should also be considered applicable to instrument systems utilizing other gases such as nitrogen.

stop circuits of standby compressors, high and low pressure alarms, pressure indicators, and temperature indicators. Verify validity of relief valve settings.

3. Test air dryer units for proper functioning and operate units through at least one regeneration cycle. Verify operation at maximum flow rates. Verify appropriate differential pressures and proper operation of pressure switches, high and low pressure alarms, safety and/or relief valves, bypass valves and alarms, and resets.

4. Verify by test that the instrument air system will meet specifications relating to flow, pressure, and temperature of the product air.

5. Verify by test that the system will meet cleanliness requirements with respect to oil, water, and particulate matter contained in the product air by analyzing the air at the end of each main feeder line using continuous flow techniques or by the analysis of a discrete sample.

6. When redundant components of the instrument air system are required, verify by test that the failure or loss of function of one component will not prevent the proper operation of the others.

7. Test and check for proper operation all safety-related instruments, controls, and valves served by the instrument air system. Verify that all safety-related instruments, controls, and valves served by each branch of the system are properly labeled and that their remote controls, indicators, and alarms are correctly identified. Verify by test that the failure of any non-safety-related instruments, controls, and valves served by the instrument air system or the lines leading thereto will not jeopardize the safety-related parts of the system.

8. Conduct a loss-of-instrument-air-supply test on all branches of the system simultaneously, if practicable, or on the largest number of branches of the system that can be adequately managed as follows:

a. Prior to the test, place the valves to be tested, except for those valves which fail as is, in a position other than the failed position. Maintain the rest of the plant in as close to normal operating condition as is possible. (It should be noted that not all valves can be placed in the required positions because of operating procedure requirements or personnel or equipment safety factors.)

b. Shut off instrument air supply in a manner that would simulate an instrument air pipe break and verify the movements of the affected components. Also verify the adequacy of the various feeders or branches to sustain an adequate share of the decaying air supply as required by the operational mode; i.e., verify that branches of smaller pipe sizes are not starved by flow to branches of larger capacity.

9. Rerun the test outlined in Regulatory Position C.8 with the exception that, during this test, shut off instrument air supply very slowly to simulate the loss of instrument air by moisture freezing and plugging the main supply line.

10. Rerun the tests outlined in Regulatory Positions C.8 and C.9 with the exception that, during these tests, place the valves in their normal operating position.

11. The results of each test performed in accordance with Regulatory Positions C.1 through C.10 above should be included in the startup report[2] which should present a description of the test, a comparison of test results predicted by the test procedures, identification of conditions encountered which were not anticipated, corrective actions, if any, and an evaluation of test results.

[2] See Regulatory Guide 1.16, "Reporting of Operating Information," Revision 1, October 1973., Section C.1.a.(1).