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LICENSING TOPICAL REPORT

HIGH PRESSURE CORE SPRAY SYSTEM POWER SUPPLY UNIT

Amendment 3

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1. INTRODUCTION

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The HPCS Power Supply was developed to power the high pressure core spray (HPCS) system for BWR/5 and BWR/6 plants. Historically, the HPCS system replaced the steam turbine driven high pressure coolant injection (HPCI) system of BWR/4 and earlier plants as part of the emergency core cooling system (ECCS). The HPCS system, like the HPCI system, complements other portions of the ECCS system to meet core cooling requirements.

Similar to the HPCI system which is driven by a steam turbine, an independent prime mover was needed for the HPCS system. Since the system predominately consists of a single pump, originally, the concept of a direct diesel engine driven pump was contemplated. However, this proved to be impractical because of the location of the pump. A motor driven pump electrically connected to a diesel generator (DG) was found to be favorable for meeting all the requirements of the ECCS without sacrificing any redundancy requirements. At this point, it potentially exceeded the HPCI system from the core cooling point of view.

The independence of the system was further enhanced by supplying all auxiliary loads, such as motor operated valves, heating and ventilating loads, DG cooling water pumps, water leg pumps, etc., for this system from an independent bus supplied by a dedicated HPCS DG. Later, another off-site power source was added to further enhance the availability of the system. It should be noted that this power supply was never intended to be operated as a "standby power supply" in the general sense. Loads, other than HPCS related, were restricted from being connected to this bus.

An extensive analytical study was made in selecting an optimum diesel generator for performing this important core cooling function. Engine torque, generator reactances, system inertia, motor performance and other loads were considered within the study. The total system performance was found to meet the core cooling requirement, i.e., establish the design core cooling flow in the design time, with margin. To confirm the validity of the analytical studies, several factory prototype tests were conducted on the DG with the actual pump motor. The pump load and other small loads were electrically approximated. The test results demonstrated that the analytical studies could conservatively predict

the performance of the system. The analytical study and the factory prototype tests are documented in Sections 3 and 6 of the originally submitted licensing topical report on the HPCS power supply, NEDO-10905, May 1973.

The NRC staff reviewed the topical report and Amendments 1 and 2 of same and concluded that "the analysis and simulated tests provide reasonable assurance that the concept, though unique for diesel generator loading is workable, however, due to the marginal nature of the design concept, and partial testing performed, the staff will require that an actual test be performed which simulates as close as practicable the actual HPCS system configuration."[1]

As discussed in a meeting on September 22, 1976 with the NRC staff, the intent of an actual pump loop test is to further confirm that the analytical studies and factory prototype tests could conservatively predict the engine generator performance. It was agreed one such test would demonstrate the validity of the concept.

2. TEST PLAN

In accordance with the staff's requirement,[1] a test program was arranged. The test program was to satisfy two requirements.

2.1 THE REGULATORY POSITION IN OLAN D. PARR'S LETTER DATED DECEMBER 17, 1976 ON GENERAL ELECTRIC TOPICAL REPORT NEDO-10905 (Appendix A):

a. Demonstrate that the HPCS diesel generator unit can successfully accelerate[1] and carry the bulk HPCS system load and meet the design requirement when tested in a configuration which simulates as close as practicable the actual HPCS system; and

b. Confirm that the analytical studies supported by factory tests with approximated loadings are adequate to conservatively predict the actual performance of the DG. This is a one time test to demonstrate the HPCS power supply concept.

2.2 COMMENT NO. 9 AS DOCUMENTED IN NEDO-10905-2:

Establish a 0.99 reliability for DG set for starting and accepting design load in the desired time. With the exception of those diesel engine/generator designs that are identical (minor changes may be justified by analysis) to the DG units which have been previously qualified for the HPCS application, all other DG combinations will be individually tested for reliable test and load acceptance requirements. It should be noted that this test establishes the reliability of all uniquely built DG units.