ORGANIZATION: WYLE LABORATORIES
HUNTSVILLE, ALABAMA

REPORT NO.: 99900902/82-09	INSPECTION DATE(S) 8/16-21/82	INSPECTION ON-SITE HOURS: 32

CORRESPONDENCE ADDRESS: Wyle Laboratories
Scientific Services & Systems Group
ATTN: Mr. W. W. Holbrook, General Manager
Eastern Test and Engineering Operations
7800 Governors Drive
Huntsville, AL 35807

ORGANIZATIONAL CONTACT: Mr. E. W. Smith, Director, Contracts and Purchasing
TELEPHONE NUMBER: (205) 837-4411

PRINCIPAL PRODUCT: Research, Engineering, and Test Operations

NUCLEAR INDUSTRY ACTIVITY: Wyle Laboratories, Huntsville, Alabama, provides a variety of nuclear services to the industry, which include environmental and seismic qualification of safety-related equipment, refurbishment and recertification of valves, valve and component flow testing, and mechanical and hydraulic snubber testing, decontamination, and repair.

ASSIGNED INSPECTOR: G. T. Hubbard — 11/9/82
G. T. Hubbard, Equipment Qualification Section (EQS) — Date

OTHER INSPECTOR(S):

APPROVED BY: H. S. Phillips — 11/9/82
H. S. Phillips, Chief, EQS — Date

INSPECTION BASES AND SCOPE:

A. BASES: 10 CFR Part 50, Appendix B.

B. SCOPE: The purpose of this inspection was: (1) to review the Terry Turbine test specification and the Wyle test plan and test procedures; and (2) to witness the dynamic testing of the turbine.

PLANT SITE APPLICABILITY:
Hope Creek Nuclear Station, Unit 1, Docket 50-354; Limerick Generating Station, Units 1 and 2, Docket 50-352/353; Shoreham Nuclear Power Station, Docket 50-322; Susquehanna Steam Electric Station, Units 1 and 2, Docket 50-387/388.

ORGANIZATION: WYLE LABORATORIES
HUNTSVILLE, ALABAMA

REPORT NO.: 99900902/82-09	INSPECTION RESULTS:	PAGE 2 of 6

A. VIOLATIONS:

None

B. NONCONFORMANCES:

None

C. UNRESOLVED ITEMS:

None

D. OTHER FINDINGS OR COMMENTS:

1. Background: The General Electric Corporation (GE) contracted with Wyle Laboratories, Norco, California (Wyle-Norco), to conduct environmental and seismic qualification tests of Terry Corporation's turbine system for the high pressure coolant injection (HPCI) system used in Boiling Water Reactors (BWR). Test requirements were defined in Terry's specification entitled "Environmental Qualification Test Specification for CCS*/HPCI Turbine and Electrical and Mechanical Accessories," EL-20474, Revision 5, dated March 2, 1982. Wyle-Norco wrote its qualification plan based on the Terry specification and entitled it "Final Qualification Plan for CCS/HPCI System and Electrical and Mechanical Accessories for Terry Corporation," Qualification Plan (QP) 57598, Revision B, dated April 20, 1982. Wyle-Norco issued Wyle Laboratories, Huntsville, Alabama (Wyle-Huntsville), an interdivisional contract job order (CJO) for the dynamic test effort described in QP 57598.

2. Test Program:

   a. Test Plan:

      Dynamic test requirements of Wyle QP 57598, Revision B, required the following tests:

      (1) Uniaxial resonance searches;

      (2) Biaxial "upset," which includes the random vibration spectrum of an operating basis earthquake (OBE), plus vibration from safety relief valve (SRV) releases and IEEE Standard 323 test margins; and

*Terry designation for "double wheel" steel turbine.

(3) Biaxial "faulted", which includes the random vibration spectrum of a safe shutdown earthquake plus SRV vibration, loss-of-coolant-accident (LOCA) vibration, and IEEE Standard 323 test margins.

Two additional test categories were identified to Wyle in documentation from Mr. J. Kelso of GE. One additional test required was a 7½-minute, biaxial test in each of two horizontal axes to simulate the "SRV aging" that the turbine system would experience during a 40-year plant life. The other test was for a 15-minute, biaxial test in each of two horizontal axes to simulate the effect of "post-LOCA chugging." Since these tests were not included in the documented and approved test plan, Wyle performed them as requested and documented them as test anomalies.

The QP also required the application of forces and moments, per Appendix G-8 of the Terry specification, to "inlet and exhaust nozzles" during all biaxial testing. This requirement was deleted in the original Wyle-Norco interdivisional CJO to Wyle-Huntsville and was considered to be a test anomaly since it was required by the approved QP at the time of testing.

b. System Installation:

(1) Tests were performed on Wyle's biaxial high force seismic simulator with a force rating of 160,000 force pounds in both the vertical and horizontal axes over a frequency range of 1 to 100 Hertz. Maximum displacement of the simulator is 6 inches double amplitude with a maximum transient acceleration of 6 g's.

(2) The turbine system was mounted to the simulator table in such a manner as to represent the attaching mechanism that the turbine system would see in a nuclear plant. The first horizontal axis for testing was defined such that the equipment's longitudinal horizontal axis was parallel to the horizontal axis of excitation. The second horizontal axis was defined as being 90° from the first horizontal axis with rotation being around the vertical axis.

(3) In addition to the turbine system, a nonoperating Woodward electronic control panel was installed separately on the table by a bookend-type attachment fixture. This panel had been

radiation and thermally aged for a 10-year life expectancy. The panel was being subjected to all the QP tests to determine if it could be qualified for a 10-year life. The electronic control panel controlling the turbine system during testing had only been aged for a 5-year life. The 5-year life was in keeping with the predicted life expectancy defined by Woodward, the panel manufacturer.

(4) Also mounted separately on the table was a Nash gland condenser system which prevents steam leakage from the turbine system to atmosphere. The GE representative stated that the unit was not classified as safety-related equipment, but was being tested according to the QP to determine if it could meet the requirements for safety-related equipment. Both the 10-year control panel and the gland condenser system were rotated around their vertical axis, as was the entire turbine system, to provide vibration along both horizontal axes.

(5) Instrumentation for the test included two input accelerometers (one for the vertical axis and one for the horizontal axis) mounted on the table and 24 accelerometers mounted on the turbine system, 10-year aged electronic control panel, and gland condenser system to measure the equipment response. In addition, "contact chatter" detectors were used on contacts where chatter requirements were defined in the test specification. Other instrumentation was provided as appropriate.

(6) Since some of the test sequences required the turbine to be operating during vibration, a 3-inch steam line was provided to the turbine inlet to provide turbine operational capacity. With the steam available, maximum turbine speed obtained was 2400-2500 rpm.

c. Test Results:

Testing was started with uniaxial resonance searches on August 17, 1982, and was completed on August 21, 1982, with a 15-minute "LOCA chugging" test. Turbine system functional operation was demonstrated at required times during the testing and after completion of the final "LOCA chugging" test. During the testing, four test anomalies were identified and were documented by Notice of Anomalies (NOA) per Wyle's QA plan.

The four NOA's are summarized as follows:

(1) NOA concerning the added SRV, "LOCA chugging," additional resonance searches, and change in test sequencing per written GE request.

(2) NOA concerning the deletion of nozzle loading requirements during vibration testing.

(3) NOA documenting limitations of Wyle's steam and its effect on turbine system operation. Two items were identified and are as follows:

(a) During OBE quick start demonstrations, the turbine speed was approximately 700 rpm prior to the quick start signal. Final turbine speed obtained following the quick start signal and just before the end of vibration input was less than 2000 rpm. Even though turbine speed did not reach Wyle's previously demonstrated steady-state no-load speed of 2200-2400 rpm, the test was considered acceptable since the turbine system demonstrated quick start control capability considering the limitations of Wyle's steam system.

(b) Wyle was required to perform a functional check of the turbine system which included taking oil pressure readings. Acceptance criteria for oil pressure was defined as a minimum of 100 psi at 4000 rpm turbine speed. Since turbine speeds of 4000 rpm could not be obtained with Wyle's steam system, oil pressure readings were taken at 2200-2250 rpm. Oil pressure readings recorded were 95-97 psi. Since oil pump performance data was not available for the obtained turbine speed, GE will have to address the question in their final turbine system qualification package. This matter is considered a followup item and will be reviewed at the next inspection of GE, San Jose, California (8209-01).

(4) NOA documenting added bracing to components of the turbine system. Three areas of added bracing are as follows:

(a) The oil feed line to driven equipment was braced with angle iron prior to any testing at Wyle.

(b) The oil supply tubing to the turbine overspeed trip system normally is braced, but the system provided Wyle for testing was not braced. After initial testing in the first horizontal axis, the tubing was taped together to provide support.

(c) Prior to the start of the LOCA chugging tests, the tubing between the hydraulic actuator and servo was taped to prevent vibration.

Since items (b) and (c) above were braced in a temporary manner, they are considered as a followup item and will be reviewed at the next inspection of GE, San Jose, California (8209-02).

3. Inspection Results:

The NRC inspection was accomplished by interviewing Wyle, GE, and Terry personnel, review of documentation and test data, and observations of test operations. The results of the inspection performed are as follows:

(a) The dynamic sections of the Wyle test plan were in accordance with the GE-approved Terry test specification.

(b) The testing of the Terry turbine was tested in accordance with the Wyle test plan and documented test changes as provided by GE.

(c) Two test anomalies were identified, documented, and properly dispositioned.

(d) Two test anomalies were identified, documented, and properly dispositioned by Wyle, but required analysis by GE; therefore, they are considered followup items.

(e) No instances were found where the requirements of NUREG-0588, Revision 1, or IEEE Standard 344-1975 were not met.

PERSONS CONTACTED

Company Wyle Laboratories, Eastern Operations

Dates August 16-21, 1982

Docket/Report No. 99900902/82-09

Inspector George Hubbard

Page 1 of ____

NAME(Please Print)	TITLE(Please Print)	ORGANIZATION(Please Print)
Edward W. Smith	Director of Contracts & Purchasing	Wyle Laboratories
Bobby Quinn	Project Test Engineer	Wyle Laboratories
Jim Powell	Supervior, Sejsmic Testing	Wyle Laboratories
Phil Knoll	Test Engineer	Wyle Laboratories, Norco, Ca.
Jim Kelso	Project Engineer	General Electric
Ken Wheeler	Engineer	Terry Corporation
Steve Beckman	Engineer	Terry Corporation

Inspector George Hubbard

Scope/Module _____

Report No. 82-09

Page 1 of _____

DOCUMENTS EXAMINED

1	2	TITLE/SUBJECT	3	4
1	8	Final Qualification Plan for CCS/HPCI System and Electrical and Mechanical Accessories for Terry Corporation, Qualification Plan 57598	Dec 14, 1981	Rev A
2	2	Environmental Qualification Test Specification for CCS/HPCI Turbine and Electrical and Mechanical Accessories, EL-20474	Mar 2, 1982	Rev 5
3	8	Memo of Change, Test Specification Supplement Revision	Aug 16, 1982	
4	8	Supplement to Terry Corporation Environmental Test Specification EL-20474, Revision 5, VPF No 2763-308(1)-1	July 30, 1982	
5	8	Technical Justification for Application of SRV Cycles to High Pressure Coolant Injection Turbine Qualification, Signed by C W. Dillman, Mgr. Reactor Assembly & Plant Equipment Qualification, General Electric	No Date	
6	8	Interdivisional Work Order # ND-58738-91Y from Wyle Laboratories, Norco, CA to Wyle Laboratories, Huntsville, Alabama	Feb 19, 1982	
7	8	Change Order # 1 to Item 6 above	Aug 12, 1982	

Document Types:
1. Drawing
2. Specification
3. Procedure
4. QA Manual
5. Purchas Order
6. Internal Memo
7. Letter
8. Other (Specify-if necessary)

Columns:
1. Sequential Item Number
2. Type of Document
3. Date of Document
4. Revision (If applicabl