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THE TORY IIC TEST OPERATIONS

(Title: Unclassified)

Charles S. Barnett

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THE TORY IIC TEST OPERATIONS

Charles S. Barnett

Lawrence Radiation Laboratory, Livermore, California

The Tory IIC reactor was subjected to two high power tests at the Atomic Energy Commission's Nevada Test Site during the month of May, 1964. Both tests were highly successful. The reactor is now stored in the hot bay of the Pluto test site disassembly building.

After completion of the Tory IIA tests, the Pluto test facility was extensively modified. The air storage capacity was increased to 1.2 million pounds, the flow rate capability was increased to 2000 pounds per second, and the inlet air heater size was increased to accomodate the larger air storage capacity.

These extensive modifications made necessary a comprehensive pre-nuclear test program to qualify the facility. This test program began on November 17, 1962 during the construction phase and ended on March 5, 1964. Eighty-two major tests were performed during this period. The three main types of tests conducted were: (1) air supply cleanup tests (2) qualification tests of large facility components (3) integrated tests of complete facility with the test vehicle in place.

Several significant problems were exposed by these facility tests. The most important problem uncovered was extensive weld restraint cracking of the large hot air piping joints located in the test bunker complex. Correction of this problem consisted of re-design of a portion of the piping so that some joints could be eliminated "and a beefing up" of those joints which remained. This repair required a three month delay in the program.

Other important problems which were exposed and corrected were: (1) high temperature electrical connector faults in control rod actuator packages, (2) insufficient nozzle coolant flow, (3) need for design changes in the pressure and temperature probe mount which was located downstream of the core.

The non-nuclear facility proof testing was terminated with an integrated test of facility and test vehicle. Nuclear power and reactor temperature were electronically simulated, and all operators participated in a formal manner. After completion of this test, attention was directed to low power nuclear runs.

Five low or zero power tests were conducted subsequent to installation of the core in the test vehicle and prior to the high power runs. Some of the more important objectives of these tests were: (1) position nuclear detectors relative to the core to obtain proper sensitivity to reactor power, (2) determine the open loop reactivity-power transfer function by rod oscillator tests, (3) close the reactor power loop on ion chamber current for the first time, (4) determine if air flow through the core would excite any serious vibration of core components, (5) determine which of the many core thermocouples would be suitable for control purposes, (6) measure reactivity temperature coefficient. Two of the five tests required negligible coolant air flow rate; the other three runs required flow rates up to 1800 pps.

Most of the effort during this low power phase was put into establishing that no serious vibration problems existed within the core. The first vibration study run was aborted at a flow level of 400 pps because of apparent excessive axial motion of the core and core duct. Post-run study of the vibration data indicated that some of the transducers were giving faulty signals. Consequently, more extensive and more carefully designed instrumentation was installed on the test vehicle, and a second run was performed. During this test a flow rate of 1800 pps was reached without indication of excessive vibration.

The final test prior to high power operation was a hot (850 F), high flow (1800 pps) run with the reactor power loop closed on ion chamber current. This test exposed a faulty rod actuator pressure switch and a noisy actuator. Although these and other minor troubles were exposed during this run, all were explained and corrected. It was decided to proceed with high power operation.

The reactor was taken to significant power and temperature for the first time on May 12, 1964, during the Intermediate Power Test. This test was designed to simulate a Mach 2.8, hot day, 10,000 feet altitude flight which is somewhat less severe than the 1000 feet altitude flight which represents the Tory IIC design condition.

The reactor was controlled by closing the automatic loop on ion chamber current. The nuclear operator observed core temperature and adjusted the power demand to yield the desired temperature. Inlet air temperature was controlled manually. The coolant flow rate was controlled by an automatic electronic programmer over the main high flow portion of the program. The temperature indicator observed by the nuclear operator was the output of a device which computed a weighted average of 12 selected core thermocouples.

The Intermediate Power Test was executed without incident. The average values of several parameters during the high power portion of the plateau are given in the following table:

Item	Average value during plateau	Plateau length
Coolant flow rate	1250 pps	298 sec
Calorimetric Power	313 MW	245 sec
Inlet air Temperature	822°F	825 sec
Apparent fuel element wall temperature at x/L = 0.7 station	1995°F	248 sec
Corrected wall temperature	2270°F	---

The temperature correction referred to in the table arises because the instrumented fuel columns were adjacent to unfueled columns which carried the thermocouple leads. Consequently, the unfueled columns depressed the temperature in the instrumented columns.

The final Full Power Test was conducted on May 20, 1964. This test simulated the Mach 2.8, sea level, hot day Tory IIC design condition. Except for the values of various parameters which were attained, the Full Power Test was quite similar to the Intermediate Power Test. The following table gives a list of parameters:

Item	Average value during plateau	Plateau length
Coolant flow rate	1660 pps	300 sec
Calorimetric Power	480 MW	285 sec
Inlet air Temperature	880° F	390 sec
Apparent fuel element wall temperature at x/L = 0.7 station	2250° F	285 sec
Corrected wall temperature	2590° F	---

The Full Power Test was executed without incident.

The reactor has been inspected by direct observation with optical instruments and by photography. Other than slight changes in shading there has been no change in the base plates. An inspection of the area forward of the core indicates no change in the actuators or forward support structure. There is no evidence of coolant channel blockage. In summary, there is no observable physical change in the reactor core.

Two experiments were designed to detect fission product loss during a run. One used radiochemical analysis of a sample of the effluent. The other depended upon observation of cloud size and measurement of gamma ray intensity of the cloud. The former, which has much less uncertainty than the latter, indicated a loss of less than 0.2% of the fission products. The latter measurement was in substantial agreement when its large uncertainty was considered. A calculation of fission product recoil suggested a loss of 0.2%. Evidently no significant diffusion occurred.

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