ECONOMIC GENERATION CONTROL (EGC)
PRE-OPERATIONAL TESTING
Quad-Cities Unit 2

Pre-operational testing of the EGC system has been performed on Quad-Cities Station Unit 2. The testing was divided into two groups. The first group of tests, conducted on April 26, 1979 and April 29, 1979, consisted of controlling only the EHC Load Reference Indicator with both local and remote programming, and the second group of tests performed on May 24, 1979, consisted of actually controlling load with local and remote programming.

EGC TEST DESCRIPTION - Preliminary construction testing of EGC circuitry was performed on April 26, 1979. This testing consisted of applying test input signals to the EGC to simulate unit electrical output and load dispatcher control impulse signals. Output signals were then checked to verify proper corresponding responses. In addition, various trip functions, alarms and indications were checked for proper operation. All results were found to be satisfactory.

On April 29, 1979 the EGC pre-operational test was performed without actually controlling the unit load. This phase of testing consisted of verifying the proper EGC local control preset ramp rate (1.5 MWE/MIN) by monitoring the EHC load limit indications.

The second group of testing, performed on May 24, 1979, involved actual EGC control of Unit 2. Since EGC requires Master-Auto Control of the recirculation pumps, special care was taken to constrain operation so as not to exceed fuel pre-conditioning limits or Minimum Critical Power Ratio (MCPR) limits using Automatic Flow Control (AFC) K_f factors. Data were collected and reviewed, prior to each mode of testing to prevent any pre-conditioning or MCPR violations. In addition, AFC mode MCPR limits were calculated and plotted as an aid to the operator.

The two modes of EGC operation were tested as follows:

Local EGC Control - First the EGC local control ramp rate was tested. This was done by selecting the RAISE program and then the LOWER program while monitoring the unit power change. Although the power changes averaged approximately 1.5 to 2.0 MWE/MIN over the test periods, it was found that the actual ramp rate was between 3.5 and 4.0 MWE/MIN when the initial response time delays were removed. A work request was written to have the EHC local control ramp rate reset to 1.5 MWE/MIN.

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Following the ramp rate determination, the EGC HIGH LIMIT (650 MWE) and LOW LIMIT (610 MWE) for local operation were tested. The RAISE and LOWER programs were selected, and the actual high (643 MWE) and low (605 MWE) limit trips were determined. Both limit trips were found to be conservative.

Remote EGC Control - For this phase of the test, a HIGH LIMIT of 640 MWE, a LOW LIMIT of 590 MWE and a ramp rate of 1.5 MWE were selected. The load dispatcher was contacted and asked to verify these setpoints from his indication. The unit was then allowed to be controlled remotely in the Primary EGC mode, until the EGC tripped on its high limit. The HIGH LIMIT and LOW LIMIT were then changed to 640 MWE and 610 MWE, respectively, and the unit was controlled remotely in the Backup mode of EGC until the end of the test.

ANALYSIS - Unit 2 responded to the EGC system control as expected, over the limited conditions of this pre-operational test. The ramp rate during EGC local control was greater than desired, but its misadjustment was to be expected since the Unit 2 EGC-EHC ramp rate interfacing was initially adjusted without consideration of minor unit EGC-EHC-Recirculation Pump response characteristic differences. A simple adjustment of the EHC interface card should rectify this problem. Otherwise, all EGC indication, trips and ramping functions operated properly.

Although this test has demonstrated proper electrical and mechanical EGC control, actual operating guidelines should be based on additional operating experience. Further considerations must be given to such phenomena as Xe transients over extended periods of time and EGC operation near flow control line limits. Thus, the EGC trip points and ramp rates can be set to optimize EGC, but also provide adequate safety margins and protection for the reactor fuel.

SUMMARY - This testing has demonstrated proper operation of EGC at the Quad-Cities Nuclear Power Station Unit 2.

3.3 LIMITING CONDITION FOR OPERATION	4.3 SURVEILLANCE REQUIREMENT

E. Reactivity Anomalies

The reactivity equivalent of the difference between the actual critical rod configuration and the expected configuration during power operation shall not exceed 1% ΔK. If this limit is exceeded, the reactor will be shutdown until the cause has been determined and corrective actions have been taken if such actions are appropriate. In accordance with Specification 6.6, the NRC shall be notified of this reportable occurrence within 24 hours.

F. If Specifications 3.3.A through D above are not met, an orderly shutdown shall be initiated and the reactor shall be in the Cold Shutdown condition within 24 hours.

G. Economic Generation Control System

Operation of the unit with the Economic Generation Control system with automatic flow control shall be permissible only in the range of 65-100% of rated core flow, with reactor power above 20%.

E. Reactivity Anomalies

During the startup test program and startups following refueling outages, the critical rod configurations will be compared to the expected configurations at selected operating conditions. These comparisons will be used as base data for reactivity monitoring during subsequent power operation throughout the fuel cycle. At specific power operating conditions, the critical rod configuration will be compared to the configuration expected based upon appropriately corrected past data. This comparison will be made at least every equivalent full power month.

G. Automatic Generation Control System

Weekly, the range set into the Economic Generation Control System shall be recorded.

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scram performance will detect local variations and also provide assurance that local scram time limits are not exceeded. Continued monitoring of other drives exceeding the expected range of scram times provides surveillance of possible anomalous performance.

The numerical values assigned to the predicted scram performance are based on the analysis of the Dresden 2 startup data and data from other BWR's with control rod drives the same as those on Dresden 2.

The occurrence of scram times within the limits, but significantly longer the average, should be viewed as an indication of systematic problem with control rod drives especially if the number of drives exhibiting such scram times exceeds eight, the allowable number of inoperable rods.

D. Control Rod Accumulators

The basis for this specification was not described in the SAR and, therefore, is presented in its entirety. Requiring no more than one inoperable accumulator in any nine-rod square array is based on a series of XY PDQ-4 quarter core calculations of a cold, clean core. The worst case in a nine-rod withdrawal sequence resulted in a $k_{eff} < 1.0$ -- other repeating rod sequences with more rods withdrawn resulted in $k_{eff} > 1.0$. At reactor pressures in excess of 800 psig, even those control rods with inoperable accumulators will be able to meet required scram insertion times due to the action of reactor pressure. In addition, they may be normally inserted using the control-rod-drive hydraulic system. Procedural control will assure that control rods with inoperable accumulators will be spaced in a one-in-nine array rather than grouped together.

E. Reactivity Anomalies

During each fuel cycle excess operating reactivity varies as fuel depletes and as any burnable poison in supplementary control is burned. The magnitude of this excess reactivity may be inferred from the critical rod configuration. As fuel burnup progresses, anomalous behavior in the excess reactivity may be detected by comparison of the critical rod pattern selected base states to the predicted rod inventory at that state. Power operating base conditions provide the most sensitive and directly interpretable data relative to core reactivity. Furthermore, using power operating base conditions permits frequent reactivity comparisons. Requiring a reactivity comparison at the specified frequency assures that a comparison will be made before the core reactivity change exceeds 1% ΔK. Deviations in core reactivity greater than 1% ΔK are not expected and require thorough evaluation. One percent reactivity limit is considered safe since an insertion of the reactivity into the core would not lead to transients exceeding design conditions of the reactor system.

G. Economic Generation Control System

Operation of the facility with the Economic Generation Control System with automatic flow control is limited to the range of 65-100% of rated core flow. In this flow range and with reactor power above 20% the reactor can safely tolerate a rate of change of load of 8 MW(e)/sec. (Reference FSAR Amendment 9-Unit 2, 10-Unit 3). Limits within the Economic Generation Control System and Reactor Flo Control System preclude rates of change greater than approximately 4 MWe/sec.

When the Economic Generation Control System is in operation, this fact will be indicated on the main control room console. The results of initial testing will be provided to the AEC at the onset of routine operation with the Economic Generation Control System.