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April 28, 1985

NUCLEAR LICENSING & SAFETY DEPARTMENT

U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Attention: Mr. Harold R. Denton, Director

Dear Mr. Denton:

SUBJECT: Grand Gulf Nuclear Station
Unit 1
Docket No. 50-416
License No. NPF-29
File: 0260/0650
Evaluation of GGNS Startup Test Results Regarding Recirculation Pump Coastdown
AECM-85/0138

This letter documents discussions with NRC Staff held April 26, 1985 regarding recent Test Condition 3 testing of the recirculation pumps at Grand Gulf Nuclear Station (GGNS). The testing pertained to the measurement of pump coastdown in Startup Test No. 27 (Turbine Trip and Generator Load Rejection) and No. 30B (Recirculation Pump Trip). In the subject testing, which was completed on April 25, 1985, the pump coastdown was observed to deviate slightly from the FSAR specified Level 1 acceptance criteria (derived from FSAR Figure 14.2-6).

Delays in data reduction were experienced due to problems encountered on April 19, 1985 with special flow monitoring instrumentation intended for this testing. These problems necessitated the use of installed plant instrumentation for data collection and resulted in delays associated with the acquisition of instrumentation characteristics and final data analysis.

As discussed with the NRC Staff, the test data deviates slightly from the acceptance criteria derived from FSAR Figure 14.2-6. However, the test data has been analyzed by General Electric, as described in Attachment 1. Attachments 2 and 3 present actual test data. Conservative design basis analyses have been used to evaluate the impact of the deviation. General Electric and MP&L have concluded that the actual pump coastdown performance has negligible impact on the plant's accident and transient analyses, as presented in FSAR Chapters 6 and 15. MP&L, based on its review and the General Electric analyses, concludes that the slight deviation from the specified acceptance criteria is acceptable and that the test results should be considered acceptable. MP&L has determined that the plant is safe to operate and to continue the testing program. The Plant Safety Review Committee has reviewed and concurs in this conclusion.






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Your approval is requested on April 29, 1985 in that ascension into the next test condition is expected on that date. We recognize that special demands on your resources are requested in this matter, given the above schedule . However, we believe the events leading to this situation were for the most part unavoidable, and we appreciate the prompt attention you are giving this matter.

The processing fee of $150 required by 10CFR170 will be provided by separate cover.

Yours truly,

L. F. Dale
Director

SAB/JGC:vog
Attachments

cc: Mr. J. B. Richard (w/a)
Mr. O. D. Kingsley, Jr. (w/a)
Mr. R. B. McGehee (w/a)
Mr. N. S. Reynolds (w/a)
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# DEVIATION FROM LEVEL 1 ACCEPTANCE CRITERIA FOR RECIRCULATION PUMP COASTDOWN

Test: Test No. 17-Turbine Trip and Generator Load Rejection
Test No. 30B-Recirculation Pump Trip (RPT) Trip of Two Pumps

FSAR Section: 14.2.12.3.24
14.2.12.3.27.2

Test Deviation: A deviation to a Level 1 acceptance criteria in Test Condition 3 occurred during testing being conducted for GGNS FSAR Startup Test No. 27 - Turbine Trip and Generator Load Rejection (FSAR Section 14.2.12.3.24) and Test No. 30B-Recirculation Pump Trip (RPT) of Two Pumps (FSAR Section 14.2.12.3.27.2). The subject Level 1 acceptance criteria pertains to the two pump (recirculation pumps A & B) drive flow coastdown, which is represented by the curves shown in FSAR Figure 14.2-6 as adjusted for instrumentation time delay and time constants.

As a measure to avoid problems experienced by other BWR plants in conducting this test, MP&L elected to utilize special flow monitoring instrumentation with particularly rapid response characteristics. In preparation for the RPT testing, however, it was determined on April 19, 1985 that the special instrumentation exhibited excessive sensitivity to flow noise. This precluded the use of the special instrumentation and required use of installed inplant recirculation flow monitoring instrumentation. The use of the inplant instrumentation resulted in some delay in the final analysis of test data because the instrumentation time response characteristics are required to adjust the acceptance criteria in FSAR Figure 14.2-6. This time response data was obtained on April 25 and 26, 1985 and permitted the final evaluation of test data.

After the TC3 testing for Test No. 30B on April 19, 1985, test data acquired for RPT drive flow was reviewed in a preliminary fashion (without consideration of instrumentation time response). At that time, the data appeared to be slightly outside of the expected RPT coastdown limits.

On April 25, Test No. 27 was completed and test results obtained. This test placed the plant in a shutdown condition which allowed the collection of instrument time response characteristics. Adjusted curves were subsequently plotted for both A and B recirculation loops from both the turbine trip and recirculation pump trip (RPT) data on April 26, 1985. The GGNS test data is provided on Tables 1 and 2 in Attachment 2 and the adjusted GGNS specific curves with test results plotted are provided on Figures 1 through 4 for NRC review (Attachment 3). Since FSAR Figure 14.2-6 is based on an instrumentation time constant of 0.0 seconds, GGNS specific curves were developed to

reflect the plant measured instrumentation time constants. The GGNS time constants were measured to be 0.264 seconds for recirculation loop A and 0.288 seconds for recirculation loop B from time response tests. The sensed flows were then plotted on the adjusted curves, and the acceptance criteria deviation was documented. This was completed late on April 26, 1985.

The limits on the curves represented in FSAR Figure 14.2-6 are established based on the ECCS/LOCA response (lower curve) and the transient response from a generator load rejection without bypass (upper curve). For ECCS, a four second inertia time constant coastdown limit is given for consideration of LOCA evaluations. During the ECCS Design Basis Accident (DBA), one of the recirculation loops is assumed to break. The remaining loop supplies the forced flow through the core for about the first second. Should the core flow drop off too rapidly, it is possible for the high power portion of the fuel to go into an early boiling transition which could result in a subsequent increase in calculated Peak Clad Temperature (PCT). If the coastdown has a large enough inertia time constant, no early boiling transition occurs on the high power node and results in very little impact on PCT. After about 1.5 seconds into the Design Basis Accident, natural circulation becomes dominant and the pump coastdown has a negligible effect.

For the generator load rejection without bypass, a five second inertia time constant coastdown limit is given for MCPR consideration. From a transient standpoint, the faster recirculation coastdown, produces more favorable transient results because of the subsequent reduction in power. In the transient evaluation, the first 0.4-0.5 seconds of the transient were considered, since it was only during this period that the coastdown was slower than the five second inertia time constant coastdown limit.

The GGNS specific test data was provided to GE for their evaluation to determine if the pump coastdown flow results could adversely impact the safe operation of GGNS. As shown on the attached figures, slight deviations were experienced for both the upper curve (MCPR limit) and the lower curve (peak clad temperature limit); and therefore, both the ECCS analyses (FSAR Chapter 6) and transient analyses (FSAR Chapter 15) were evaluated for impact on the GGNS design basis.

Evaluation: An ECCS evaluation was performed for GGNS with an inertia time constant of 3 seconds, which bounds the actual test data. The results show that early boiling transition does not occur in the high power portion of the fuel for a 3 second pump coastdown time. Thus the effect on calculated PCT will be small and is estimated by General Electric to be less than 10°F. The addition of a 10°F delta to the current GGNS PCT of 2098°F results in a PCT well below the 10CFR50.46 acceptance criteria of 2200°F.

An evaluation for transient response was performed for load rejection with bypass failure. An additional RPT time delay was used to bound the measured coastdown and evaluate the load rejection from 100% full power with bypass failure. The results indicated a negligible increase in heat flux; consequently, the difference in delta CPR between considering the slower initial part of the RPT coastdown and the criteria in Figure 14.2-6 of the FSAR is negligible.

Conclusion: Based on the above evaluations conducted for GGNS from the test data obtained from the recirculation pump coastdown, neither the GGNS FSAR Chapter 6 ECCS analyses or the FSAR Chapter 15 transient response analyses are significantly impacted by the observed deviation from the Level 1 acceptance criteria for Startup Tests No. 27 and 30B in TC3. In fact, upon analysis of the actual test data, it has been demonstrated that the recirculation pump coastdown performance is within the bounding events which form the basis for the FSAR acceptance criteria.

MP&L has concluded that even with the slight deviation from the previously specified coastdown curve limitations, analysis of the test results indicate that the recirculation pump coastdown characteristics are acceptable. It is also concluded that no modification to the FSAR acceptance criteria is necessary and that the test results should be accepted. Based on the evaluation conducted and General Electric's analyses, MP&L has concluded that the plant is safe to operate and continue the power ascension program.

Table 1

TURBINE TRIP: SU-27-3

| | RECIRC LOOP 'A' INSTR. TC = 264 MSEC | | | RECIRC LOOP 'B' INSTR. TC = 288 MSEC | | |
|---|---|---|---|---|---|---|
| TIME (SEC) | % SENSED DRIVE FLOW | 4.0 SEC PUMP INER. T.C. | 5.0 SEC PUMP INER. T.C. | % SENSED DRIVE FLOW | 4.0 SEC PUMP INER. T.C. | 5.0 SEC PUMP INER. T.C. |
| 0(RPT Brkr) Open | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| .20 | .998 | 0.993 | 0.995 | .997 | 0.993 | 0.995 |
| .24 | .995 | 0.989 | 0.992 | .996 | 0.990 | 0.992 |
| .28 | .993 | 0.985 | 0.989 | .995 | 0.986 | 0.989 |
| .32 | .989 | 0.981 | 0.986 | .990 | 0.982 | 0.986 |
| .36 | .988 | 0.976 | 0.982 | .987 | 0.977 | 0.983 |
| .40 | .981 | 0.970 | 0.978 | .983 | 0.972 | 0.979 |
| .44 | .977 | 0.965 | 0.974 | .977 | 0.966 | 0.975 |
| .48 | .969 | 0.959 | 0.968 | .971 | 0.961 | 0.970 |
| .52 | .962 | 0.954 | 0.964 | .969 | 0.956 | 0.966 |
| .56 | .954 | 0.948 | 0.959 | .956 | 0.950 | 0.961 |
| .60 | .946 | 0.942 | 0.954 | .953 | 0.944 | 0.956 |
| .68 | .931 | 0.930 | 0.944 | .936 | 0.933 | 0.946 |
| .76 | .919 | 0.918 | 0.935 | .920 | 0.921 | 0.937 |
| .84 | .909 | 0.907 | 0.924 | .908 | 0.910 | 0.927 |
| .92 | .899 | 0.894 | 0.914 | .895 | 0.915 | 0.917 |
| 1.00 | .889 | 0.881 | 0.904 | .880 | 0.884 | 0.907 |
| 1.20 | .855 | 0.853 | 0.878 | .849 | 0.856 | 0.881 |
| 1.40 | .823 | 0.828 | 0.855 | .811 | 0.831 | 0.858 |
| 1.60 | .797 | 0.803 | 0.836 | .789 | 0.806 | 0.838 |
| 1.80 | .767 | 0.776 | 0.812 | .761 | 0.779 | 0.815 |
| 2.00 | .737 | 0.747 | 0.787 | .738 | 0.750 | 0.790 |
| 2.20 | .716 | 0.722 | 0.764 | .728 | 0.725 | 0.767 |
| 2.40 | .693 | 0.699 | 0.743 | .699 | 0.702 | 0.746 |
| 2.60 | .675 | 0.676 | 0.723 | .676 | 0.679 | 0.725 |
| 2.80 | .657 | 0.657 | 0.704 | .656 | 0.659 | 0.706 |
| 3.00 | .633 | 0.638 | 0.686 | .622 | 0.640 | 0.688 |
| 3.50 | .592 | 0.598 | 0.648 | .584 | 0.600 | 0.650 |
| 4.00 | .552 | 0.565 | 0.616 | .555 | 0.566 | 0.618 |
| 5.00 | .496 | 0.510 | 0.561 | .484 | 0.511 | 0.562 |

Table 2
RPT: SU-30-3

| | RECIRC LOOP 'A' INSTR. TC = 264 MSEC | | | RECIRC LOOP 'B' INSTR. TC = 288 MSEC | | |
|---|---|---|---|---|---|---|
| TIME (SEC) | % SENSED DRIVE FLOW | 4.0 SEC PUMP INER. T.C. | 5.0 SEC PUMP INER. T.C. | % SENSED DRIVE FLOW | 4.0 SEC PUMP INER. T.C. | 5.0 SEC PUMP INER. T.C. |
| 0(RPT Brkr) Open | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 0.20 | 0.997 | 0.993 | 0.995 | 0.995 | 0.993 | 0.995 |
| 0.30 | 0.995 | 0.983 | 0.988 | 0.989 | 0.984 | 0.988 |
| 0.34 | 0.989 | 0.978 | 0.984 | 0.987 | 0.979 | 0.985 |
| 0.38 | 0.983 | 0.973 | 0.980 | 0.979 | 0.974 | 0.981 |
| 0.42 | 0.974 | 0.967 | 0.976 | 0.973 | 0.969 | 0.977 |
| 0.46 | 0.968 | 0.962 | 0.971 | 0.972 | 0.964 | 0.972 |
| 0.50 | 0.958 | 0.957 | 0.966 | 0.961 | 0.959 | 0.968 |
| 0.54 | 0.953 | 0.951 | 0.961 | 0.958 | 0.953 | 0.963 |
| 0.58 | 0.943 | 0.945 | 0.957 | 0.946 | 0.947 | 0.959 |
| 0.62 | 0.937 | 0.939 | 0.952 | 0.944 | 0.941 | 0.954 |
| 0.66 | 0.928 | 0.933 | 0.947 | 0.933 | 0.936 | 0.949 |
| 0.70 | 0.922 | 0.927 | 0.942 | 0.927 | 0.930 | 0.944 |
| 0.74 | 0.914 | 0.921 | 0.937 | 0.920 | 0.924 | 0.939 |
| 0.78 | 0.908 | 0.916 | 0.932 | 0.914 | 0.919 | 0.935 |
| 0.82 | 0.901 | 0.910 | 0.927 | 0.904 | 0.913 | 0.930 |
| 0.86 | 0.894 | 0.904 | 0.922 | 0.896 | 0.907 | 0.925 |
| 0.90 | 0.888 | 0.897 | 0.917 | 0.889 | 0.900 | 0.920 |
| 1.1 | 0.853 | 0.867 | 0.891 | 0.853 | 0.870 | 0.894 |
| 1.3 | 0.828 | 0.840 | 0.867 | 0.827 | 0.843 | 0.870 |
| 1.5 | 0.799 | 0.815 | 0.847 | 0.799 | 0.818 | 0.849 |
| 1.7 | 0.777 | 0.790 | 0.824 | 0.771 | 0.793 | 0.827 |
| 1.9 | 0.760 | 0.761 | 0.800 | 0.740 | 0.764 | 0.803 |
| 2.1 | 0.733 | 0.734 | 0.775 | 0.710 | 0.737 | 0.778 |
| 2.3 | 0.709 | 0.710 | 0.753 | 0.688 | 0.713 | 0.756 |
| 2.5 | 0.680 | 0.688 | 0.733 | 0.674 | 0.690 | 0.735 |
| 2.7 | 0.657 | 0.666 | 0.713 | 0.663 | 0.668 | 0.715 |
| 2.9 | 0.644 | 0.648 | 0.695 | 0.641 | 0.650 | 0.697 |
| 3.1 | 0.629 | 0.630 | 0.677 | 0.622 | 0.632 | 0.679 |
| 4.1 | 0.548 | 0.559 | 0.610 | 0.536 | 0.560 | 0.611 |
| 5.1 | 0.485 | 0.506 | 0.556 | 0.476 | 0.507 | 0.557 |

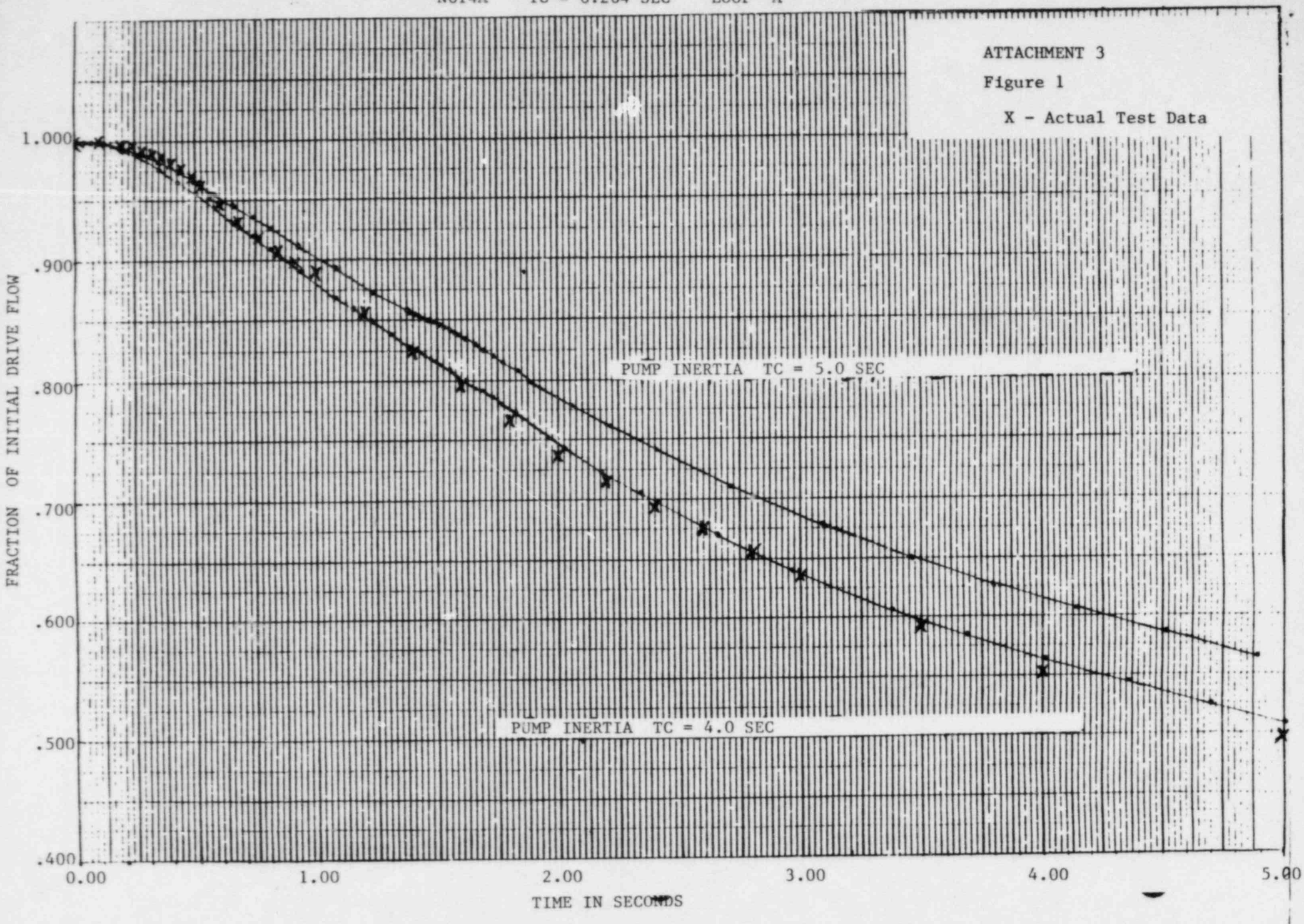
TURBINE TRIP: SU-27-3

N014A TC = 0.264 SEC LOOP 'A'

ATTACHMENT 3

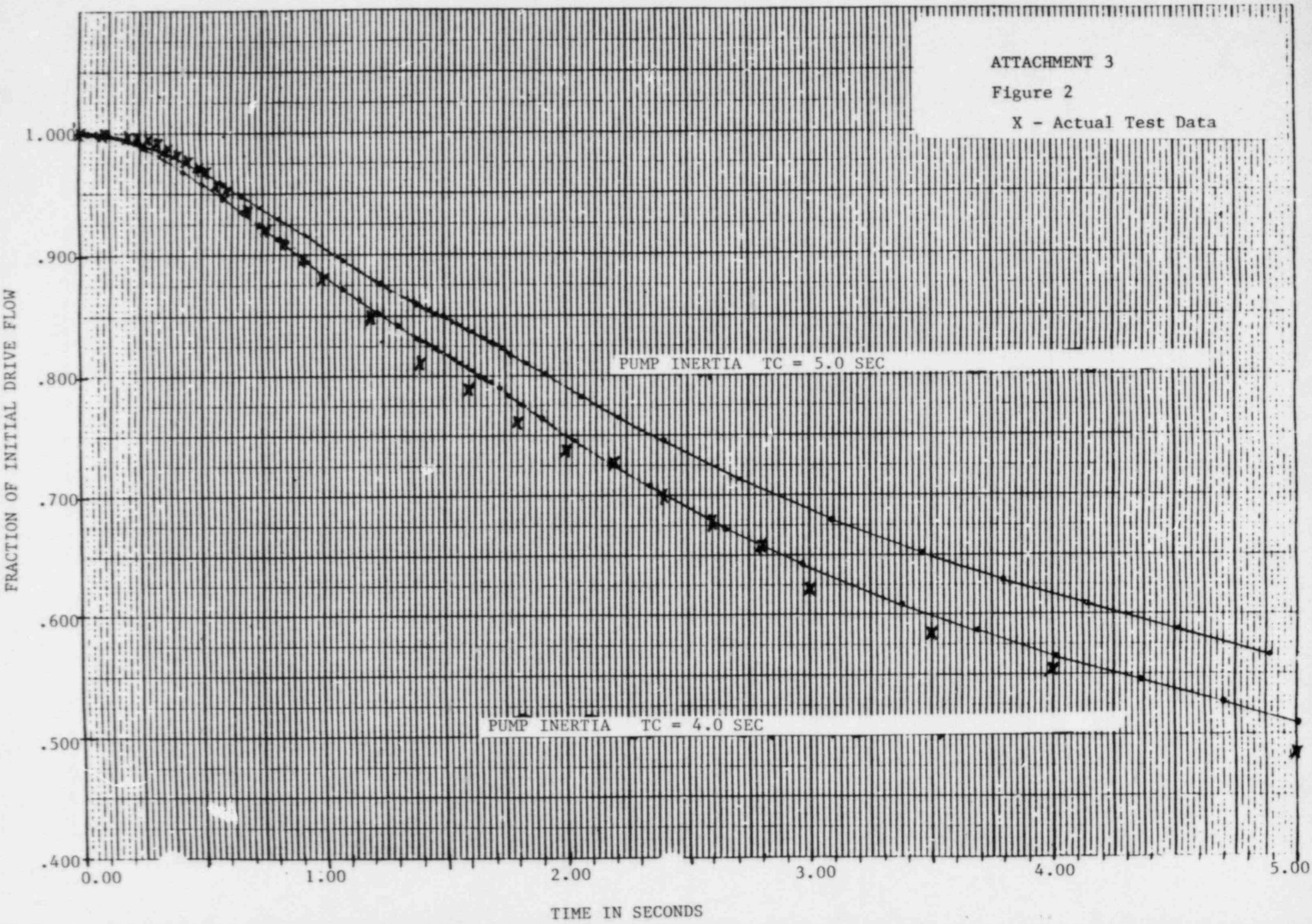
Figure 1

X - Actual Test Data



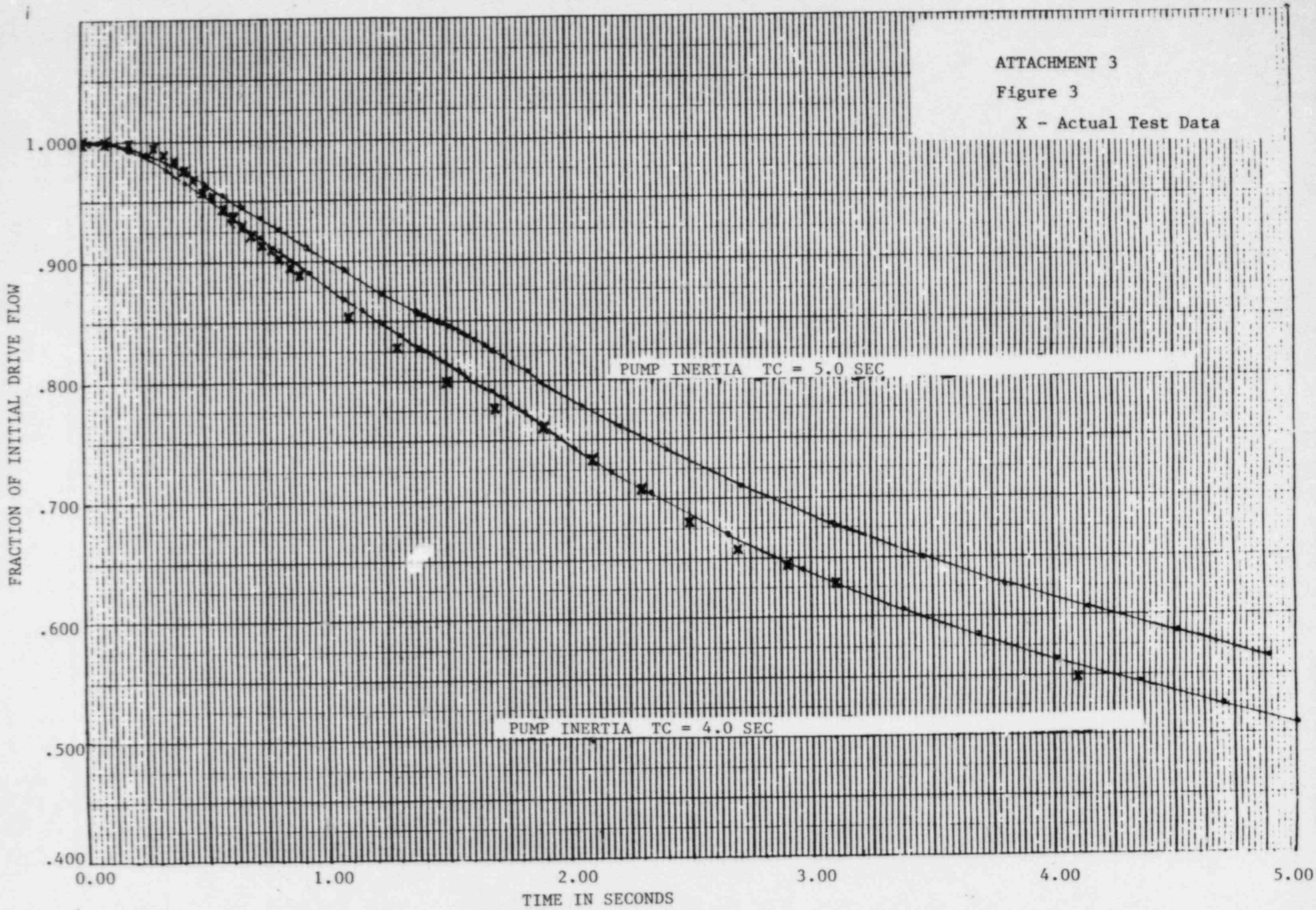
TURBINE TRIP: SU-27-3

N024A TC = 0.288 SEC LOOP 'B'



RPT: SU-30-3

N014A TC = 0.264 SEC LOOP 'A'



N024A TC = 0.288 SEC LOOP 'B'

ATTACHMENT 3

Figure 4

X - Actual Test Data