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March 3, 1976

Mr. Dennis L. Ziemann, Chief
Operating Reactors - Branch 2
Division of Operating Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Dresden and Quad-Cities Stations
Proposed Change to Eliminate License
Requirements for Jet Pump Flow Indication
from DPR-19, DPR-25, DPR-29, and DPR-30.
NRC Docket Nos. 50-237, 50-249, 50-254,
and 50-265

Dear Mr. Ziemann:

Attached are responses to your January 19, 1976 request for additional information concerning the subject change.

The delay in responding is regretted but this office and the stations were involved in more pressing matters of the Mark I containment.

Please contact this office if you have additional questions.

One (1) original and 59 copies are provided for your use.

Very truly yours,

G. A. Abrell
Nuclear Licensing Administrator
Boiling Water Reactors

Attachment

2322

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

PROPOSED CHANGE TO TECHNICAL SPECIFICATIONS TO DELETE REQUIREMENTS FOR JET PUMP FLOW INDICATION

ITEM 1: Provide estimates of time, expense, and personnel exposure involved in any methods investigated for the repair of jet pump #7 indication at Quad-Cities 1. Discuss your plans with respect to this repair.

RESPONSE: The jet pump #7 instrument sensing line on Quad-Cities Unit 1 failed on October 31, 1972. Since that time, Commonwealth Edison and the General Electric Company have expended considerable effort to develop a conceptual method of repairing the failed instrument line. These efforts have been unsuccessful due mainly to the very limited access to the area involved, and to the high risk of damaging other lines in the immediate vicinity of the severed line.

During the period of June 7, 1974, through December 31, 1974, a full scale mock up of Jet Pump #7 was constructed at San Jose by General Electric. Numerous conceptual tooling designs were prepared, one tool was fabricated, and various fix alternatives were evaluated. The mock up was viewed by Commonwealth Edison representatives in March, 1975. It was concluded from this work that repairing the existing line in place was not practical.

Another proposed fix recommended by General Electric was to provide a new jet pump upper section with a new instrument tap location. The tap and fittings, along with the instrument line would be shop attached. This new instrument line would be routed from the jet pump vertically up the interior side of the reactor vessel wall, run circumferentially around the vessel wall for approximately 90°, and then be routed out of the vessel via the existing control rod drive hydraulic system return line.

Because of flow induced vibration, the vertical portion of the instrument line would have to be supported at intermediate points. However, because of limited access and undeveloped underwater welding techniques, it is not presently felt to be possible to attach the line directly to the vessel wall. Therefore, a vertical support, with the instrument line attached, would have to be developed.

The horizontal section of the instrument line would likewise have to be supported by the installation of brackets on the vessel wall. It has been proposed to accomplish this through the use of a lead lined gondola which has a circular window which could be sealed against the vessel wall for radiation exposure control. A welder could be lowered into the gondola to weld pads and brackets on the vessel clad to support the proposed instrument line. This method has been completely speculative to date.

This replacement method of repair as described above may represent a possible solution, but it is not felt to be a viable method for several reasons:

(A) It is undesirable to make the postulated modifications to the vessel internal clad and to the control rod drive return line.

(B) It is undesirable to have one instrument sensing line routed as described above because of its vulnerability to future damage during vessel maintenance work.

(C) The postulated gondola and other repair methods have never been tried and appear to have many drawbacks.

(D) The personnel radiation exposure related to this repair would be very large.

(E) The costs associated with this repair appear to be far greater than the benefits to be gained.

Because the proposed replacement of the line involves conceptualized methods not tried before, it is very difficult to estimate the time, expense, and personnel exposure involved. However, it would probably cost on the order of one million dollars, not including replacement power costs; the outage time required would probably be in excess of five weeks; and the personnel exposure would probably be several times greater than the 350 Man-Rem associated with the recent feedwater sparger repair job on Quad-Cities Unit 2.

To date, Commonwealth Edison has been billed for over $32,000 from the General Electric Company for the initial investigations. General Electric's cost estimate for engineering and hardware was in excess of $122,000 and indications are that their actual costs would be much greater. Their estimate does not include any on-site engineering or consultation services.

Therefore, as discussed above, no plans are being made to proceed with the conceptualized replacement or repair fix. It is our feeling that the radiation exposure, the costs, and the uncertainties involved cannot be justified for repairing an instrument line that is not needed to accurately measure total core flow or to determine jet pump operability.

ITEM 2: The present Quad-Cities Technical Specification 3.6.G.3 states: "The indicated core flow is the sum of the flow indication from each of the twenty jet pumps." Because the proposed Technical Specification 4.6.G.1.b still requires indicated total core flow, explain in detail how this indicated value is obtained with one jet pump instrument inoperable.

RESPONSE: Total core flow can be determined in a number of different ways as described below. At the present time, jet pump #7 on Quad-Cities Unit 1 has an inoperable instrument sensing line, but the jet pump itself is completely operable. Jet Pump #7 receives its drive flow from the same riser that supplies drive flow to jet pump #8. Thus, jet pumps 7 and 8 should have nearly equal flows. Based on data taken on jet pump #7 before its instrument line failed, the ratio of jet pump #7 flow to jet pump #8 flow was determined to be 1.0057. This ratio shows that the two pumps have flows that can be considered equal within the accuracy of the instrumentation. Therefore, the milliamp flow signal of jet pump #8 is supplied to the core flow summer to represent jet pump #7 flow, to give total core flow based on twenty inputs.

It is possible to employ this same method of supplying substitute jet pump flow signals to the core flow summer to have a valid indication of total core flow even in the event of multiple jet pump flow sensing line failures. This method could validly be used to the extreme of having only one intact sensing line in a recirculation loop and still indicate a total core flow signal and confidently be able to detect jet pump failures. By utilizing data as shown in Figure 5-1 below, either companion jet pump flow signals or similar characteristic jet pump flow signals could be substituted to the summer for failed flow signals. At the extreme limit of having only one intact sensing line, a ratio method, based on the flow distribution data, could be used to provide the total core flow indication.

In the event of other types of failures involving the normal core flow indication system, methods could be employed utilizing other existing indications that are proportional to total core flow. These methods include utilizing the double-tapped jet pump flow indications to approximate the total core flow.

Utilizing data from the actual jet pump failure at Quad-Cities Station, various multiples of sensing line failures were postulated to test the sensitivity of the Figure 4-1 curve in identifying jet pump failures. It was found that the most obvious indication of a jet pump failure occurred when it was postulated that only one sensing line remained intact, and that it was on the jet pump that failed. The indicated core flow for this case becomes greatly increased for the same core plate ΔP because the failed jet pump experiences the largest flow signal change (actually in the reverse direction), and because this signal is added through the core flow summer ten times.

The least obvious indication of a jet pump failure occurred when it was postulated that only one sensing line remained intact, and that it was on the companion jet pump to the one that failed. The indicated core flow for this case showed an increase of 10% above that normally expected for the same core plate ΔP. All other postulated cases fell between these limits and served to verify the ability to detect jet pump failures using the prescribed surveillance tests, even with degenerated conditions of jet pump flow indications.

In the even more remote, unlikely event of a total loss of all core flow indication, a method exists to determine the core flow by a heat balance calculation. This calculation is completely independent of jet pump or other core related flow signals. Continued reactor operation in a degenerated condition such as this would be undesirable and highly unlikely. However, it would be technically feasible to operate in this manner and still have methods to detect jet pump failures.

It is unlikely that any additional jet pump sensing lines will fail; it is almost incredible that all jet pump sensing lines will be failed simultaneously. However, the discussion above demonstrates that since the proposed Technical Specifications are adequate to detect jet pump failures in the extreme cases, they therefore are completely adequate to detect jet pump failures in the present condition.

ITEM 3: Describe the differences, if any, which exist between flow measuring instrumentation systems at Dresden 2, Dresden 3, Quad-Cities 1, and Quad-Cities 2. This should include jet pump, loop, and core flow systems.

RESPONSE: Dresden 2, Dresden 3, Quad-Cities 1, and Quad-Cities 2 were all constructed by the General Electric Company based on identical specifications for core recirculation systems, including instrumentation. At the present time, Quad-Cities Unit 1 is different that the others in that is has a failed instrument sensing line on jet pump #7. The flow signal from companion jet pump #8 is supplied to the total core flow summer to give total core flow based on twenty inputs (Also see Response to Item 2 above).

It is possible that there may be slight component variations in these flow instrumentation systems due to manufacturers' model variations. However, functionally the units have exactly the same systems and equipment for measuring the subject flows, with the exception of the jet pump #7 signal for Quad-Cities Unit 1 as described above.

ITEM 4: Provide data concerning initial and recurrent calibration of the differential pressure instrument(s) which measure(s) across the core plate at Quad-Cities Unit 1. Numerical data related to instrument drift as a function of time is desirable.

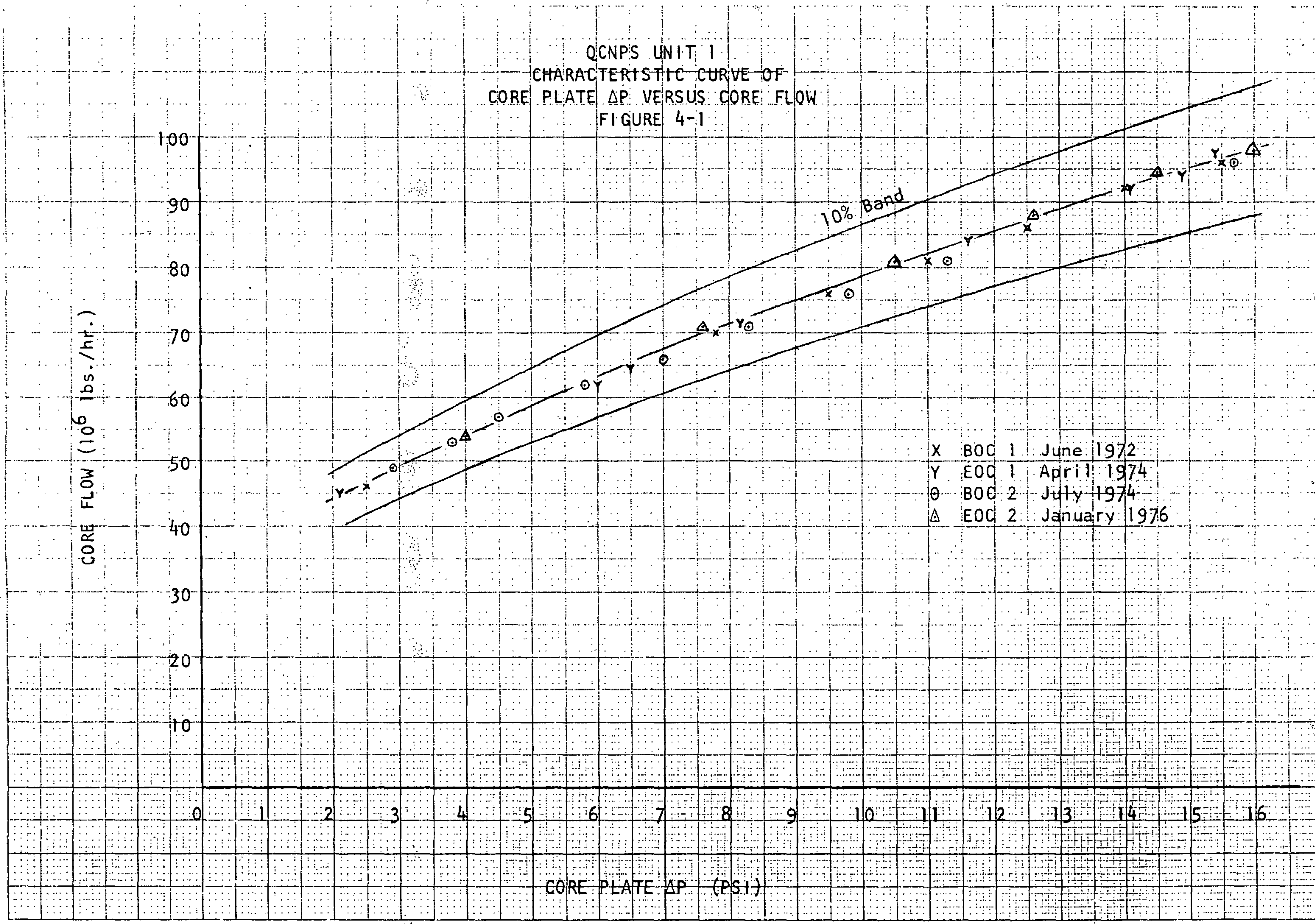
RESPONSE: The instrument which measures the differential pressure across the core plate at Quad-Cities Unit 1 is a General Electric Diaphram Type DP transmitter with the following specifications:

General Electric Model 50-553122CAAV2	
ACCURACY	±0.5% of span
SENSITIVITY	0.05% of span
REPEATABILITY	±0.1% of span

From the calibration data that is available, this instrument and others of the same model type have experienced only minimal drift on the order of less than 1% since their initial calibration. Data is available from June, 1972 through January, 1976 that illustrates the total core flow as a function of core plate ΔP. This data is graphically shown in Figure 4-1. It can be seen that the core plate ΔP has been within approximately 3% of the characteristic curve with the variations primarily due to minor inconsistencies in data-taking. Instrument drifts of 1% or less are probably masked by the accuracy of the data takers.

The characteristic curve in Figure 4-1 is typical of the curve that would be used to verify the total core flow indication according to proposed Technical Specification 4.6.B.1.b. The actual characteristic curve to be used for the required surveillance would be re-evaluated each operating cycle in accordance with Technical Specification 4.6.G.3.

As shown on Figure 6.1, a jet pump failure would be easily determined by use of this curve. It is felt that a calibration frequency of once per operating cycle will adequately insure the accuracy necessary for operational use of this instrument.


QCNPS UNIT 1
CHARACTERISTIC CURVE OF
CORE PLATE ΔP VERSUS CORE FLOW
FIGURE 4-1
10% Band
CORE FLOW (10^6 lbs./hr.)
CORE PLATE ΔP (PSI)
X BOC 1 June 1972
Y EOC 1 April 1974
⊙ BOC 2 July 1974
Δ EOC 2 January 1976

ITEM 5: Provide the latest flow readings (at ≈ 100% power) of all jet pumps for all stations. Provide data in same format as figure C.10-4 on C-93/C-94 of NEDC-10692 (Startup Test Results, Dresden Nuclear Power Station Unit 3, January 1, 1971-November 16, 1971) and include actual value recorded. A copy of figure C.10-4 is enclosed. This data will be utilized in the analysis of jet pump performance at other stations.

RESPONSE: The subject jet pump flow readings are shown in Figure 5-1 in the format requested. The actual flow values plotted on the graphs are shown in Table 5-1. The values shown are from the last set of calibration data obtained in accordance with Technical Specification 4.6.G.3.

ITEM 6: Discuss the conservatism of the 10% value of Technical Specifications 4.6.G.1.a and b, especially with reference to instrument calibration and error and changes in pump speed-flow characteristics with age.

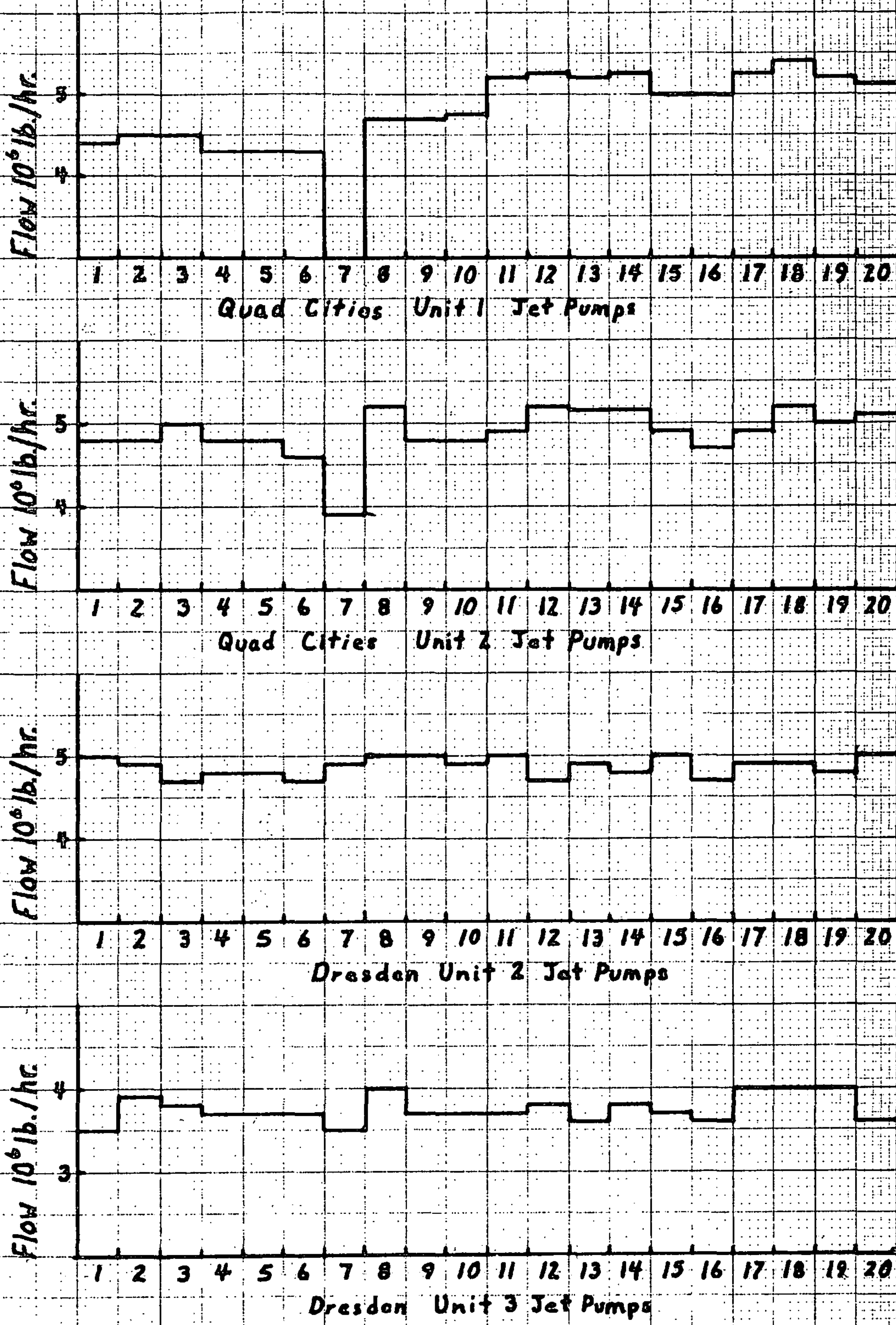
RESPONSE: Characteristic curves are utilized in several ways to determine whether or not a particular set of reactor flow parameters demonstrates the operability of the jet pumps. Figures 6-1, 6-2, and 6-3 show characteristic curves of core flow vs core plate ΔP, and recirculation pump speed vs flow. Shown on these characteristic curves are data points from an actual jet pump failure that occurred on August 20, 1972 at Quad-Cities Unit 2. The data points show that an actual jet pump nozzle failure would yield indications approximately 15% off normal.

Figure 6-2 shows that the recirculation flow characteristic remains unchanged in the loop that remains intact. Figure 6-3 shows that the recirculation flow characteristic for the affected loop increases by greater than 10% for the same pump speed signal. These curves are utilized to perform surveillance according to Technical Specification 4.6.G.1.a and thus give a positive indication of a change in reactor flow system performance.

A further confirmation of this change in flow system performance could be obtained by observing the relationship of recirculation pump ΔP vs recirculation loop flow for the same speed setting. The actual failure data showed that the loop flow in the failed loop increased, while the pump ΔP for the failed loop decreased at the time of the failure. These same conditions remained unchanged for the unaffected loop.

Further confirmation of an actual jet pump failure, rather than a recirculation pump disturbance, is obtained by performing surveillance according to Technical Specification 4.6.G.1.b utilizing the curve shown in Figure 6-1. It can be seen that the core plate ΔP had decreased for the same pump speed setting, which is a positive indication that the core flow has decreased. Furthermore, for the new core plate ΔP, it can be seen that the indicated core flow is off normal by 15%; this serves as confirmation of an actual jet pump failure. Also plotted on Figure 6-1 is a data point representing what the indicated total core flow would have been if jet pump #17 had had a failed sensing line (See also Response to Item 2 above).

The instrumentation that would be used in performing the above described surveillance has demonstrated negligible drift (<1%) as observed from its calibration records. (See also Response to Item 4 above).



Jet Pump Flow Distribution
Figure 5-1

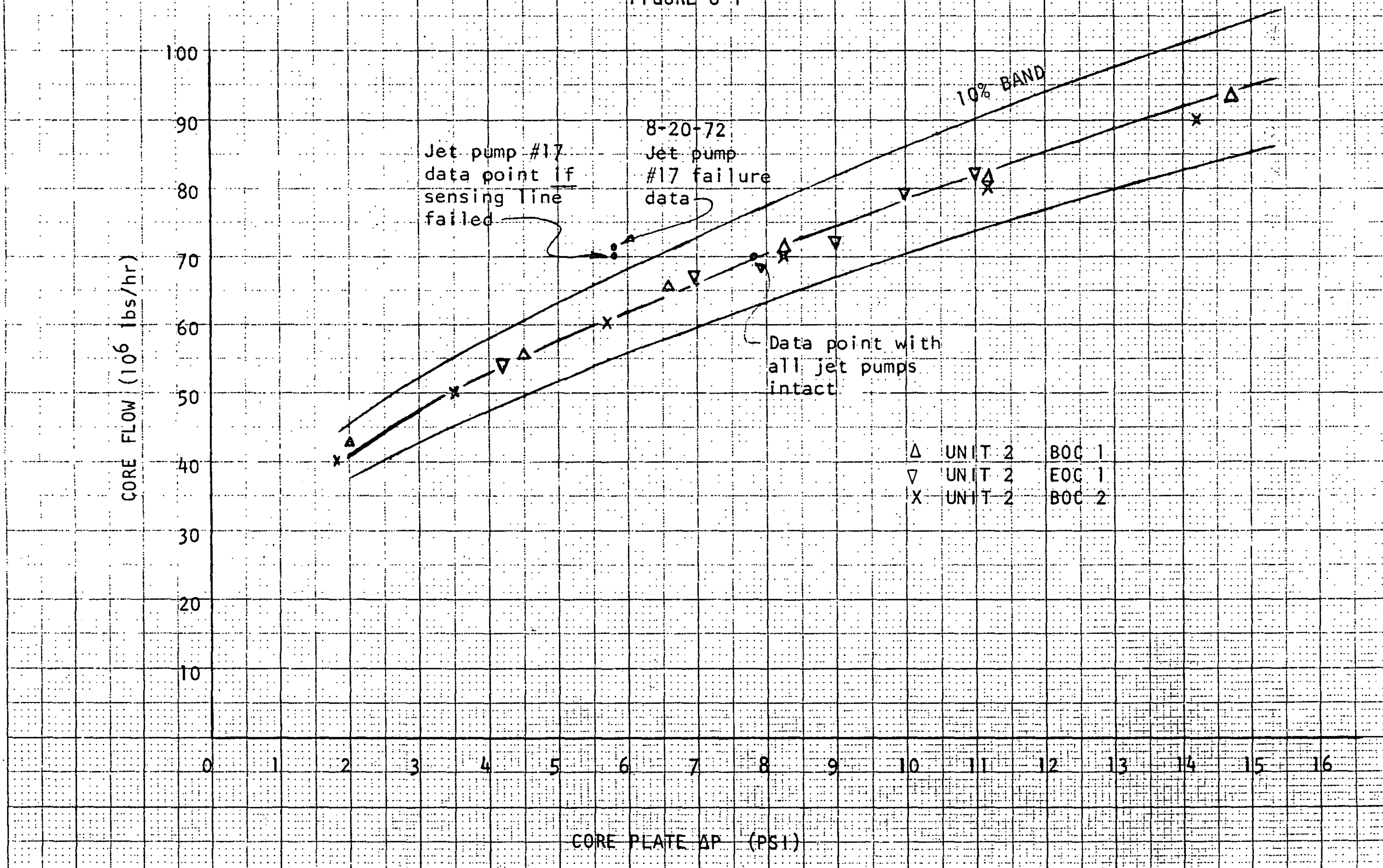
TABLE 5-1

JET PUMP FLOW READINGS

DATE	8/7/74	5/24/75	6/26/75	9/26/75
UNIT	QUAD CITIES 1	QUAD CITIES 2	DRESDEN 2	DRESDEN 3*
CORE FLOW	97 Mlb/hr	98 Mlb/hr	97.1 Mlb/hr	73.0 Mlb/hr
JET PUMP	JET PUMP FLOW Mlb/hr			
1	4.4	4.8	5.0	3.5
2	4.5	4.8	4.9	3.9
3	4.5	5.0	4.7	3.8
4	4.3	4.8	4.8	3.7
5	4.3	4.8	4.8	3.7
6	4.3	4.6	4.7	3.7
7	Failed Line	3.9	4.9	3.5
8	4.7	5.2	5.0	4.0
9	4.7	4.8	5.0	3.7
10	4.75	4.8	4.9	3.7
11	5.2	4.9	5.0	3.7
12	5.25	5.2	4.7	3.8
13	5.2	5.15	4.9	3.6
14	5.25	5.15	4.8	3.8
15	5.0	4.9	5.0	3.7
16	5.0	4.7	4.7	3.6
17	5.25	4.9	4.9	4.0
18	5.4	5.2	4.9	4.0
19	5.2	5.0	4.8	4.0
20	5.15	5.1	5.0	3.6

*Full flow reading not available due to Dresden Unit 3 derating

QCNPS UNIT 2
CHARACTERISTIC CURVE OF
CORE PLATE ΔP VERSUS CORE FLOW
FIGURE 6-1



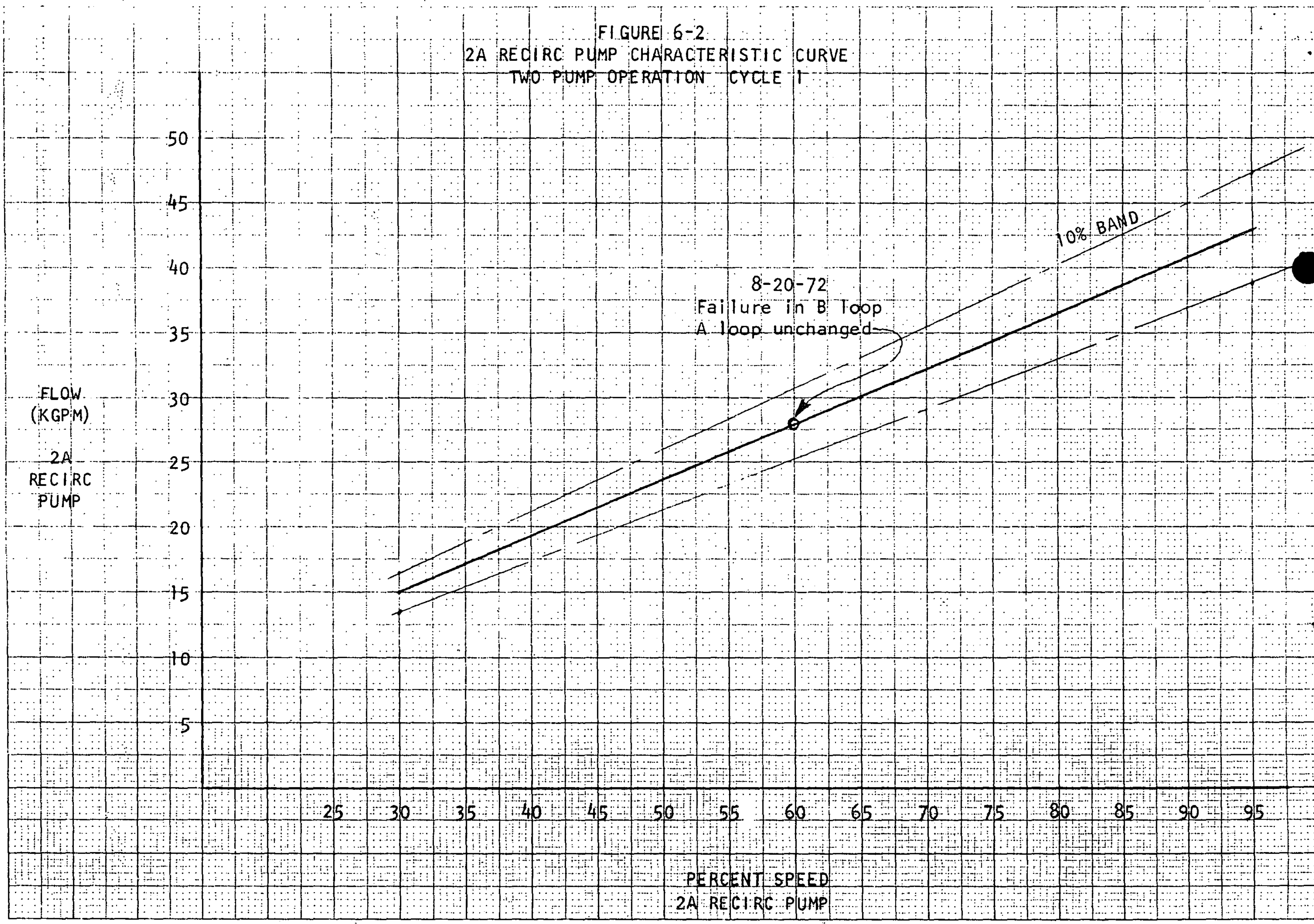


FIGURE 6-2
2A RECIRC PUMP CHARACTERISTIC CURVE
TWO PUMP OPERATION CYCLE 1
FLOW (KGPM)
2A RECIRC PUMP
50
45
40
35
30
25
20
15
10
5
10% BAND
8-20-72
Failure in B loop
A loop unchanged
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
PERCENT SPEED
2A RECIRC PUMP

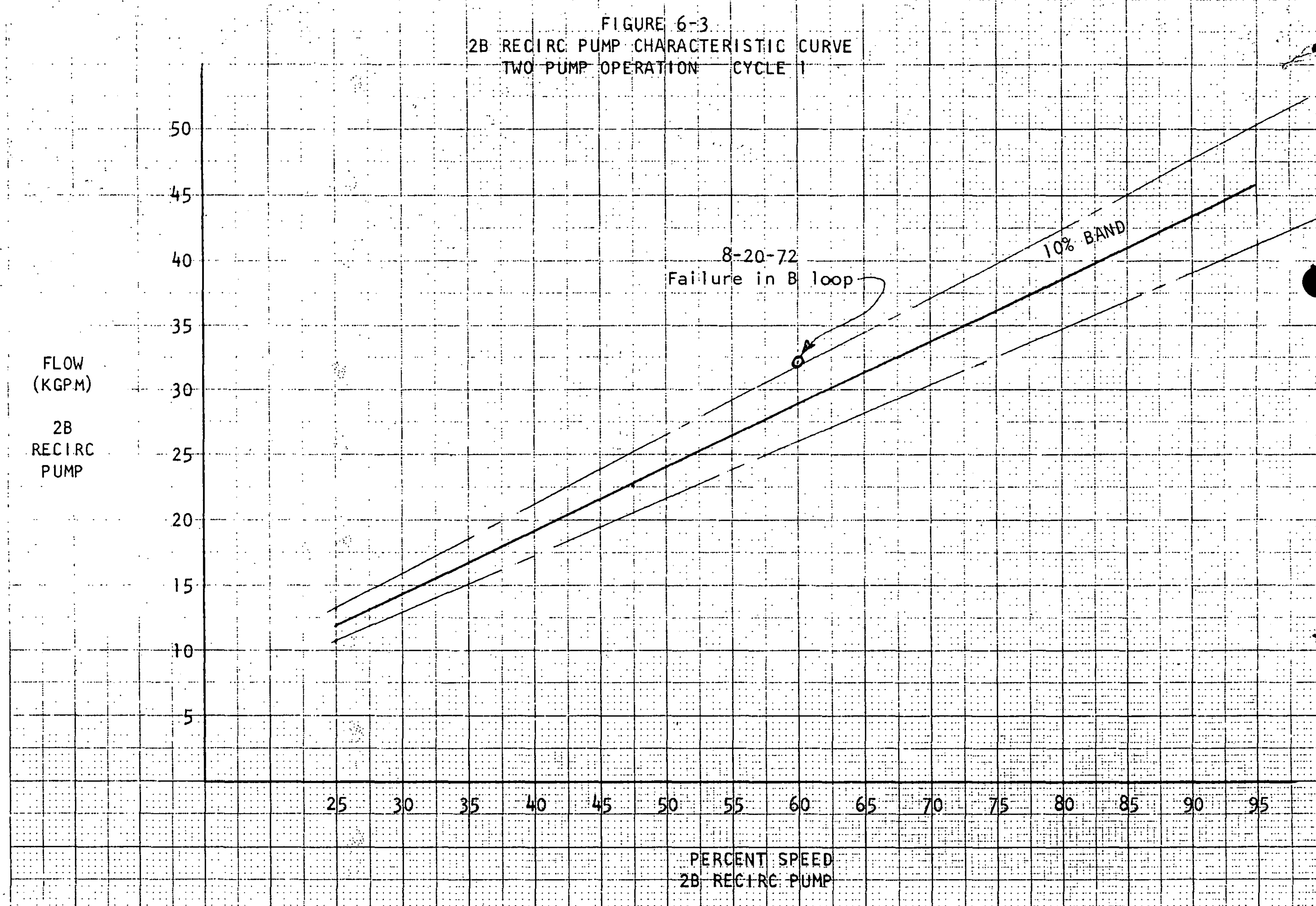


FIGURE 6-3
2B RECIRC PUMP CHARACTERISTIC CURVE
TWO PUMP OPERATION CYCLE 1
FLOW (KGPM)
2B RECIRC PUMP
50
45
40
35
30
25
20
15
10
5
8-20-72
Failure in B loop
10% BAND
25 30 35 40 45 50 55 60 65 70 75 80 85 90 95
PERCENT SPEED
2B RECIRC PUMP

Changes in recirculation pump speed-flow characteristics are expected to occur with age. However, effectively there should be no significant change over the time periods between the gathering of new baseline data. This base line data is required to be collected each operating cycle in accordance with Technical Specification 4.6.G.3.

The large off-normal indications associated with a jet pump failure, combined with the frequency at which baseline data is aquired, and the negligible drift experienced by the subject instrument illustrates that the 10% value of Technical Specification 4.6.G.1.a and b is adequately conservative to detect jet pump failures.

ITEM 7: Explain how proposed Technical Specification 4.6.G.2 will be implemented with regard to the "differential pressure of any jet pump....," especially with one or more jet pump flow indications inoperable.

RESPONSE: Technical Specification 4.6.G.2 is not being revised in the proposed changes to the Technical Specifications. Section 4.6.G.2, as presently written, cannot be implemented on the jet pumps having failed sensing lines. Consequently, single loop operation with the equalizer valve closed will not be permitted with a failed jet pump sensing line in the idle loop.

At some future time, changes to Section 4.6.G.2 may be proposed with procedures for determining failure of a jet pump in the idle loop. There is certainly adequate economic incentive for developing such procedures; however, they are not a part of this proposed change.