

# Performance Characteristics of Flow Circulation System in HANARO Flow Simulation Facility

150

30 MW<sub>th</sub>

1995 2

가

1/2

가

가

1/2

## Abstract

The HANARO, multi-purpose research reactor, 30 MW<sub>th</sub> open-tank-in-pool type, has been under normal operation since its initial criticality in February, 1995. Many experiments should be safely performed to activate the utilization of the HANARO. For this purpose, a HANARO flow simulation facility with similar flow characteristics to the HANARO has been installed to verify the structural integrities and to predict the performances for those experimental facilities prior to loading in the HANARO. This facility is composed of a half-core structure assembly, a flow circulation system and a support system. The flow circulation system should supply the core flow and the core bypass flow to the half-core structure assembly loaded flow orifices instead of nuclear fuels to simulate a similar flow characteristic to the HANARO. In this paper, we describe the performance characteristics for the circulation system. As results, it was confirmed through the field performance test that the flow circulation system supply the core flow and the core bypass flow to be satisfied the design requirements.

1.

30MW<sub>th</sub>

(1) 1995 2

가

가

1/2

(2), (3) 1/2

13

3

7

(shroud tube)

2.

2.1

1 2

13

3

7

46

1/2

( , IEDVTF, Irradiation Equipment Design Verification Test

Facility) 1

(4)

1

10%

369 kg/s 41 kg/s가

2.2

1/2

3



가

14

#### 4.0

#### 4.1

25% 가

5

mWg  
mWg)

가

, 410 kg/s  
420 kg/s

36 mWg

,

35

(410 kg/s @ 35

1, 2, 3 4

(H),

(V)

(A)

(3)

6

1

2

1

(4 - 8 mm/s)

가

가

가

2

가

가

가

가

(75

°C)가

가

가 가

2

30

7

가

50

가

가

5 °C

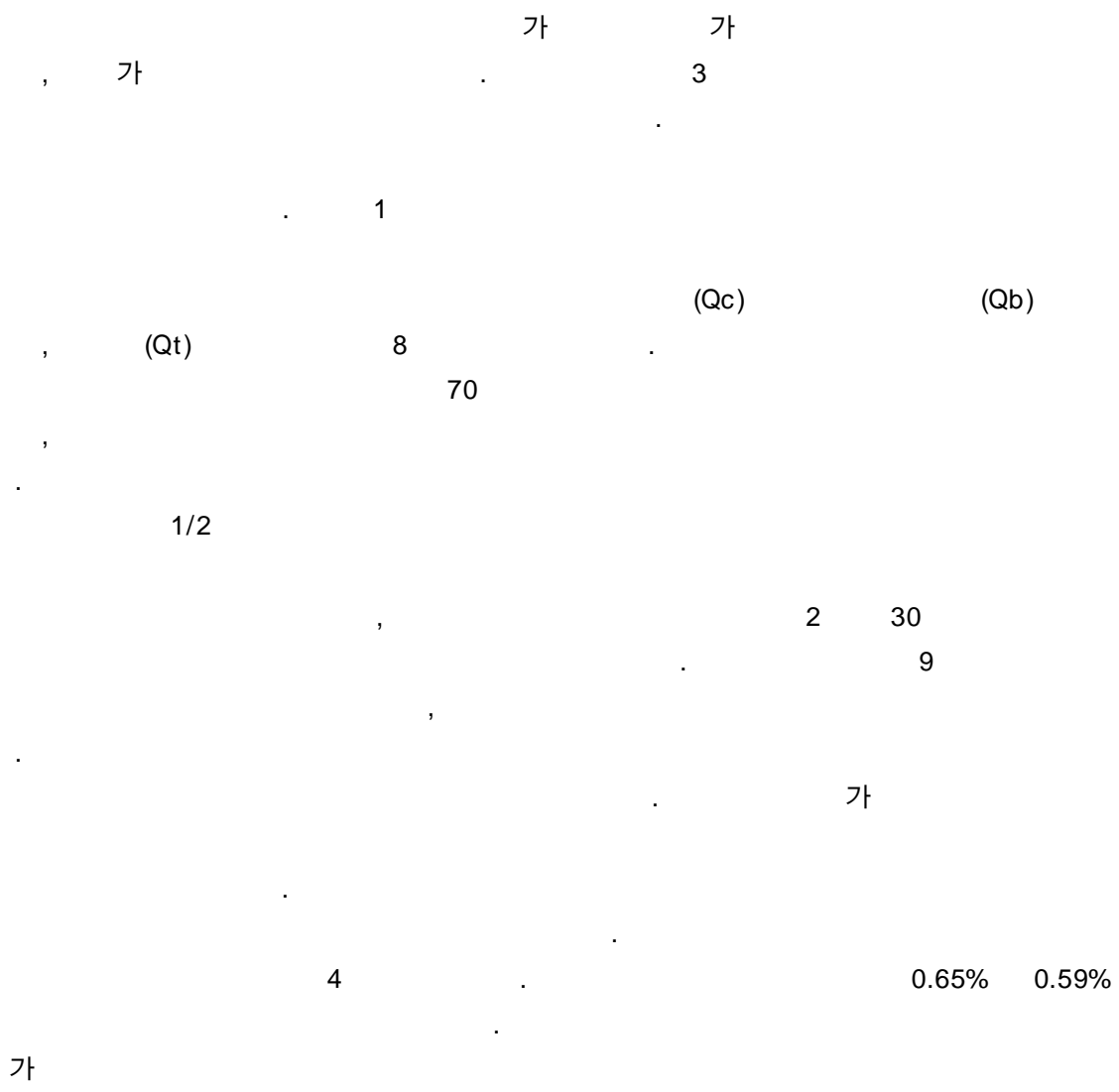
4 °C

#### 4.2

가

가

가



5.0

가

1) mWg 420 kg/s (410 kg/s @ 35 mWg) 가 35

2)

(4 -8 mm/s)

가

3)  
가 50

4) 가

5) ,  
70

6) 1/2

가 가

- [1] Chul Gyo Seo, et., al., "Pin Power Reconstruction of HANARO Fuel Assembly via Gamma Scanning and Tomography Method", Reactor", J. of KNS, Vol. 33, No. 1, p. 25, (2001).
- [2] Y.C.Park, et., al., "Technical Specification for Fabrication of Flow Circulation System in HANARO Flow Simulation Facility", KAERI/TR-2290/2002 (2002).
- [3] Y.C.Park, et., al., "Technical Specification for Fabrication of Support System in HANARO Flow Simulation Facility", KAERI/TR-2299/2002 (2002).
- [4] Cho, M. S., et., al., "Fabrication & Installation of Irradiation Equipment Design Verification Test Facility", KAERI/TR-1633/2000 (2000).
- [5] Kim, H. I., et., al., "Flow Characteristics of Korea Multi -Purpose Research Reactor", Proceedings of the 7<sup>th</sup> International Meeting on Nuclear Reactor Thermal-Hydraulics (1995).
- [6] Y.C.Park, et., al., "Flow Analysis of HANARO Flow Simulated Test Facility", Proceedings of the fifth JSME-KSME Fluid Engineering Conference, Nagoya, Japan, (2002).

**Table 1 Flow rate of HANARO flow simulation facility**

Description		HANARO	HANARO Flow Simulation Facility	IEDVT	
Core flow	Hexagonal tube	Quantity	23	13	1-2
		Design flow	19.6		
		Sub total	450	255	39.2
	Circular tube	Quantity	16	7	-
		Design flow	12.7		
		Sub total	203	89	-
	Gab flow		50	25	12
Total		703	369	51.2	
Core bypass flow		77	41	5.8	
Grand total		780	410	57	

**Table 2 Abnormal conditions under circulation pump automatic operation`**

Abnormal conditions	Alarm
Over current	Pump fail
Water level LL and core flow low or high	Piping fail
Water level LLL	Water level LLL

**Table 3 Results of circulation pump automatic operation test**

Cause	Simulation	Results	
		Alarm	Pump
Over current	Set value change	Pump fail	Stop
Water level LL and core flow low or high	Set value change	Piping fail	Stop
Water level LLL	Set value change	Water level LLL	Stop

**Table 4 Absolut torrences of core and core bypass flow variations**

Description	Average flow (kg/s)	Absolute Torr, (kg/s)	Torr. rate (%)
Core flow	374.1	2.4	0.7
Core bypass flow	41.8	0.2	0.6

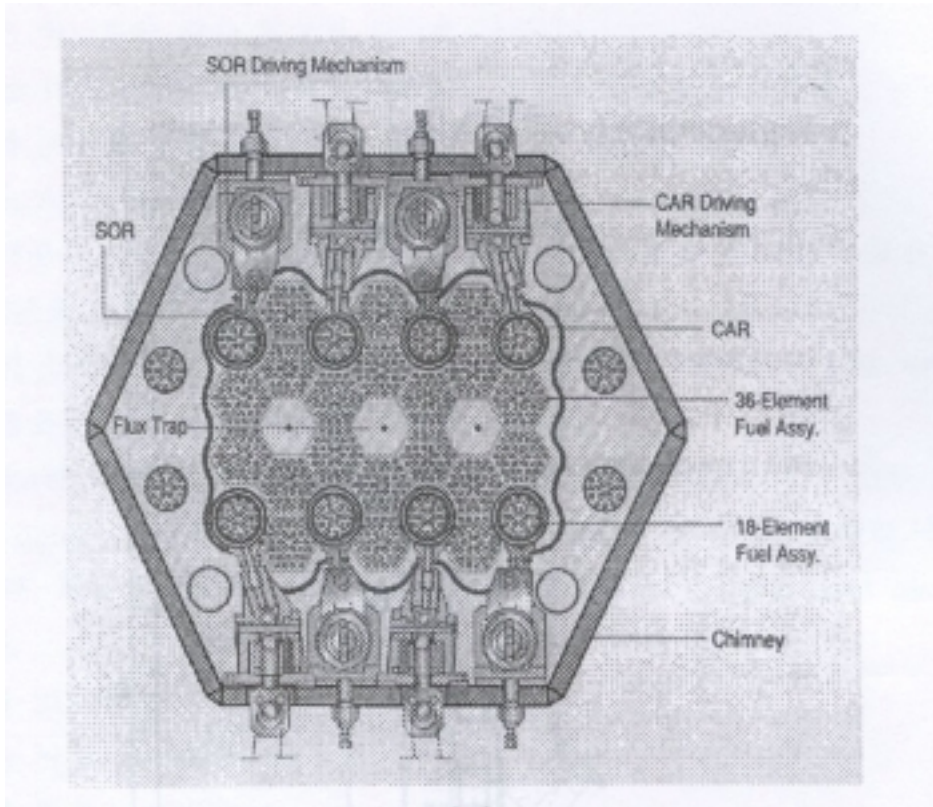


Figure 1 Configuration of HANARO core

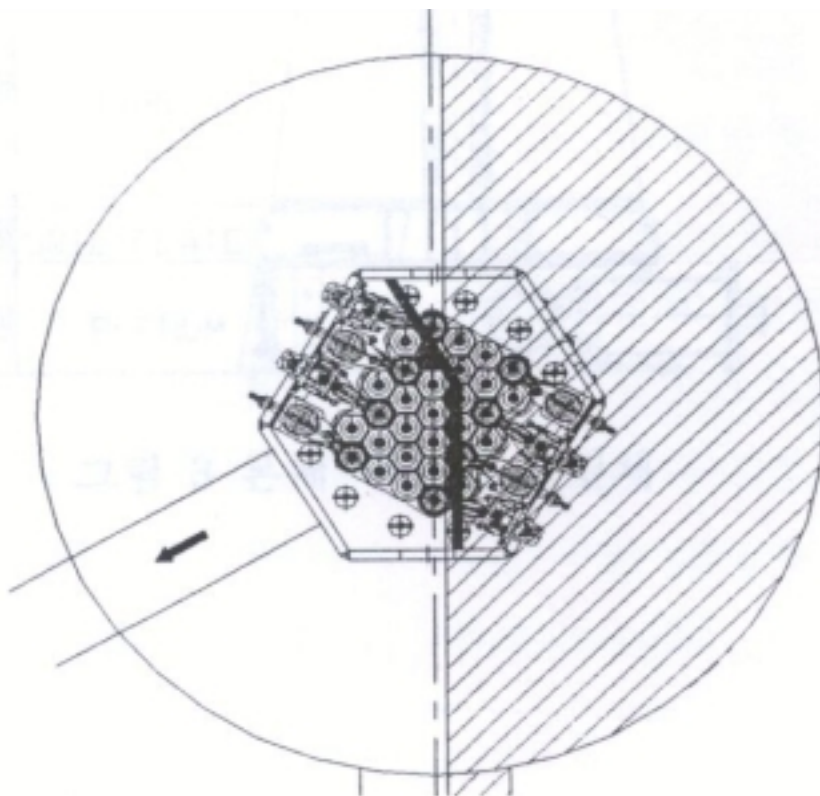


Figure 2 Configuration of 1/2 Core



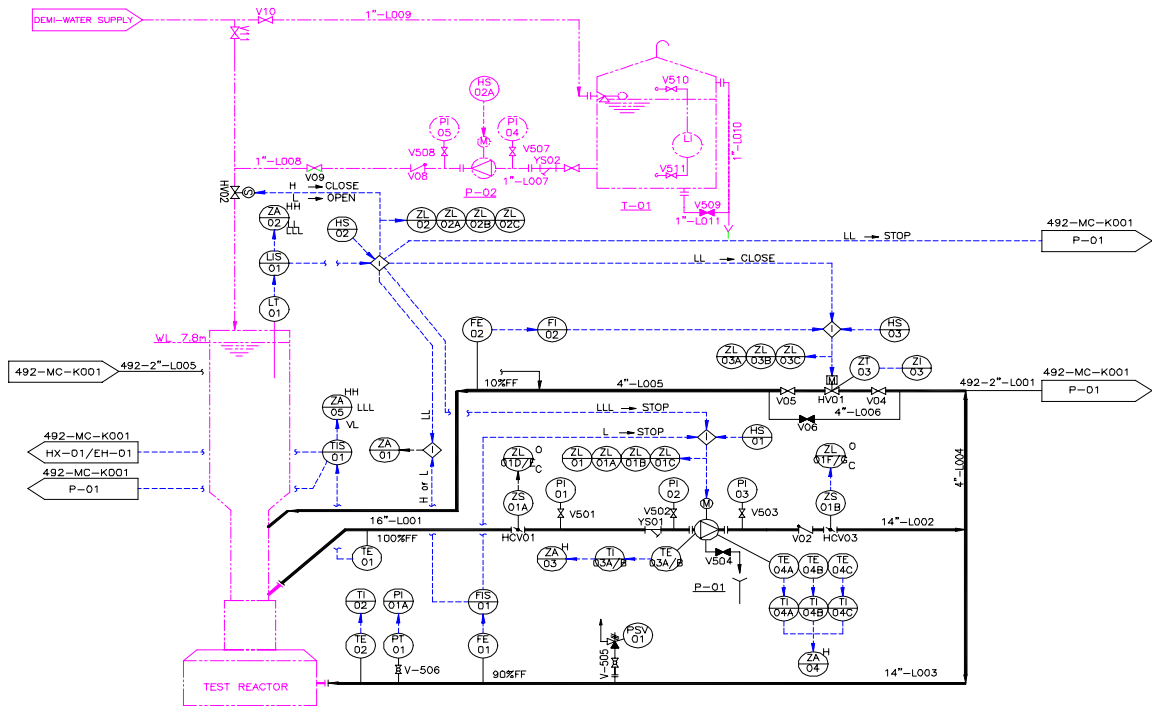


Figure 3 P&ID of flow circulation system

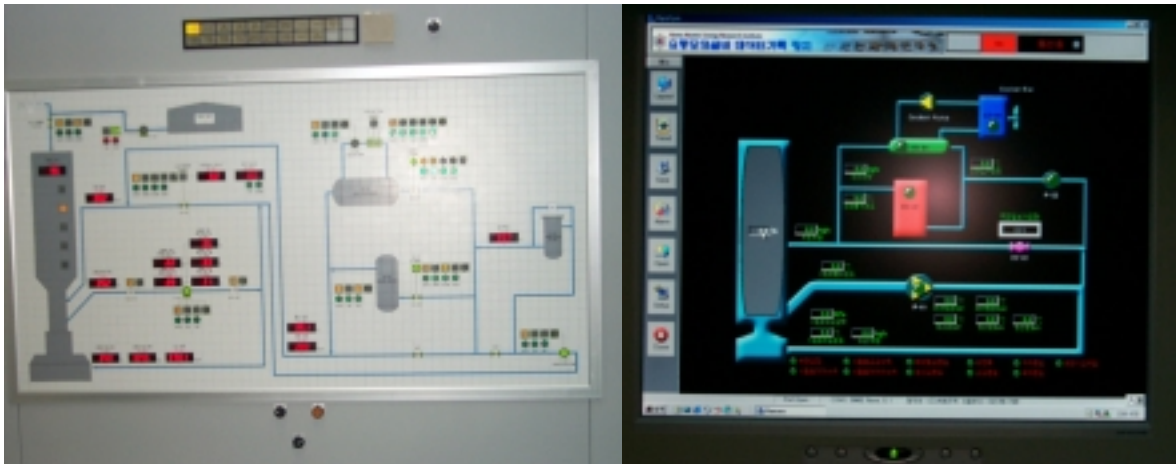


Figure 4 Field control panel

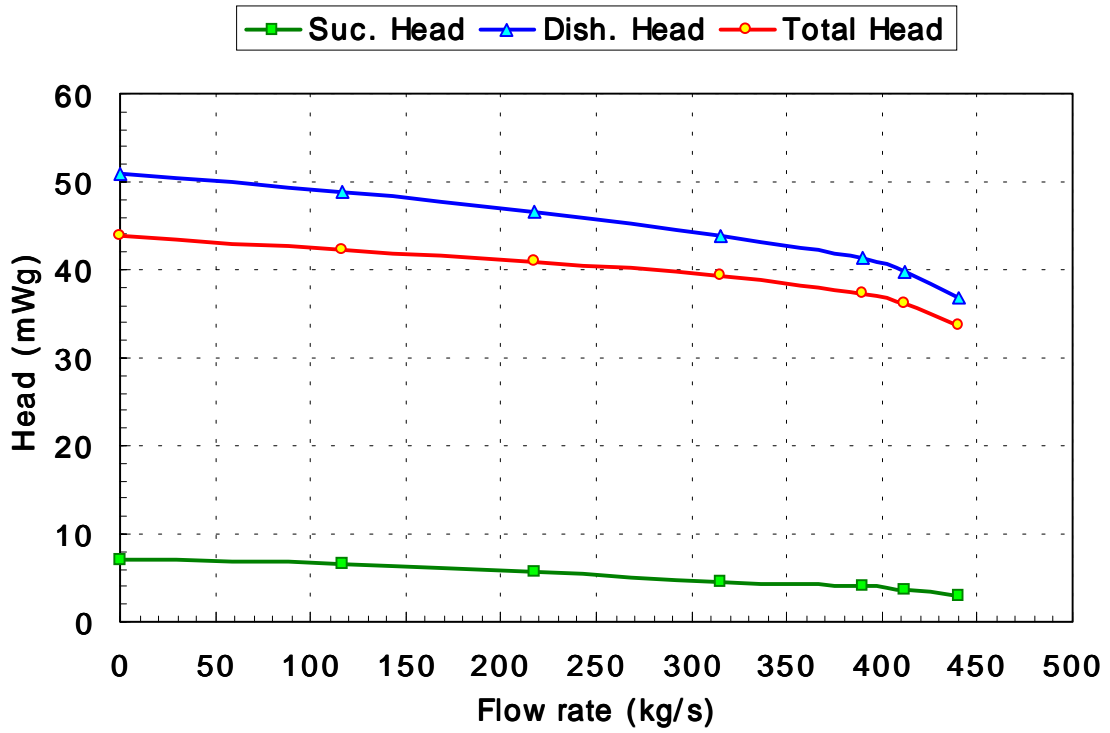


Figure 5 Flow-head characteristics curve of flow circulation pump

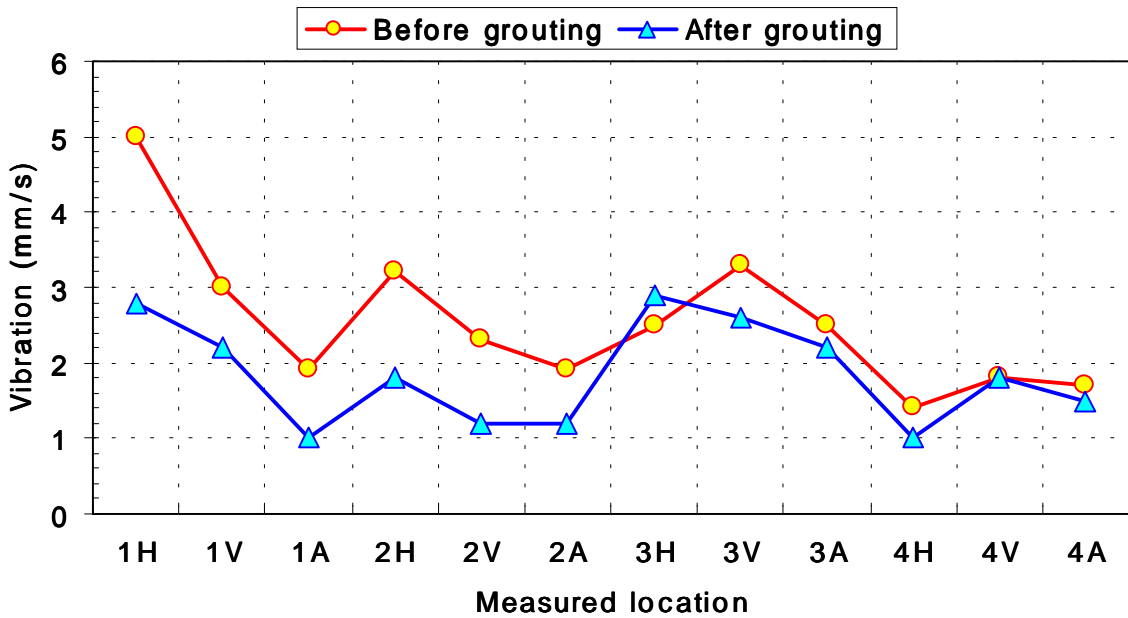


Figure 6 Vibration of flow circulation pump

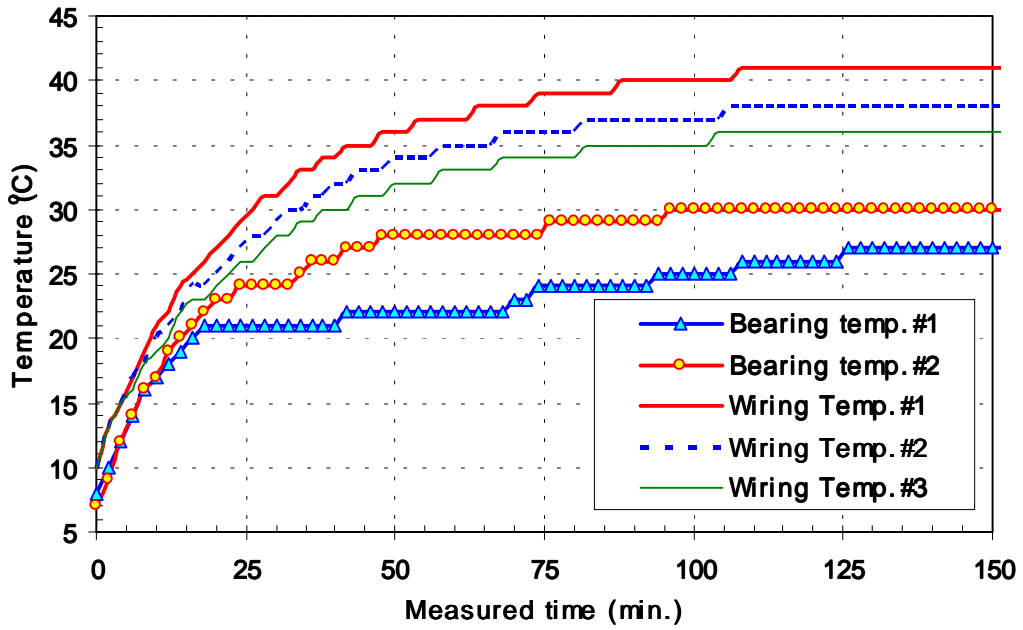


Figure 7 Variations of motor bearing temperatures and winding temperature

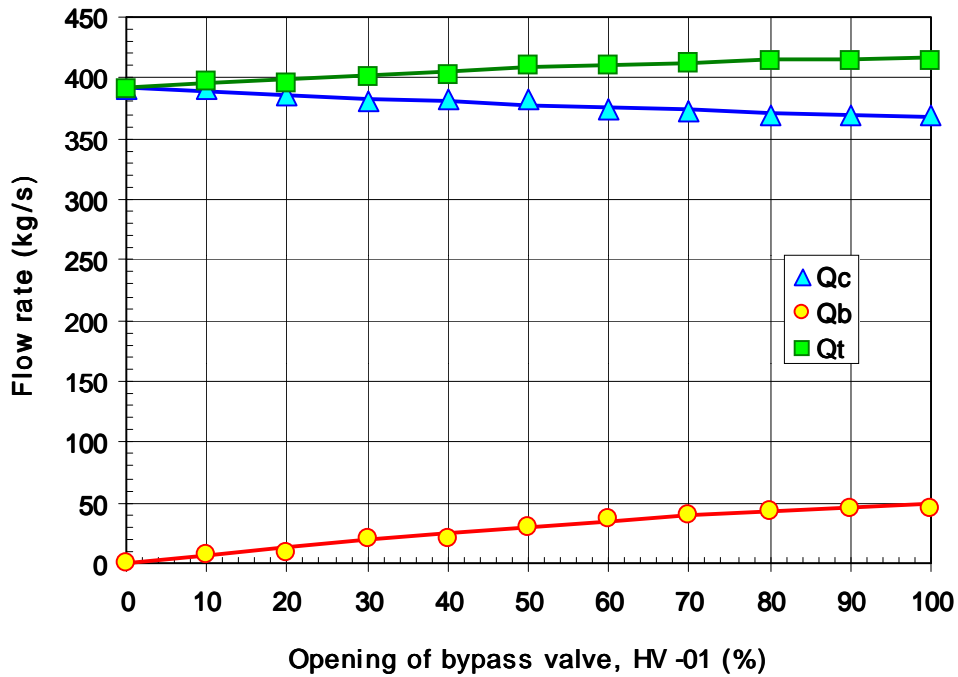


Figure 8 Variations of core and core bypass flow as per opening of bypass valve

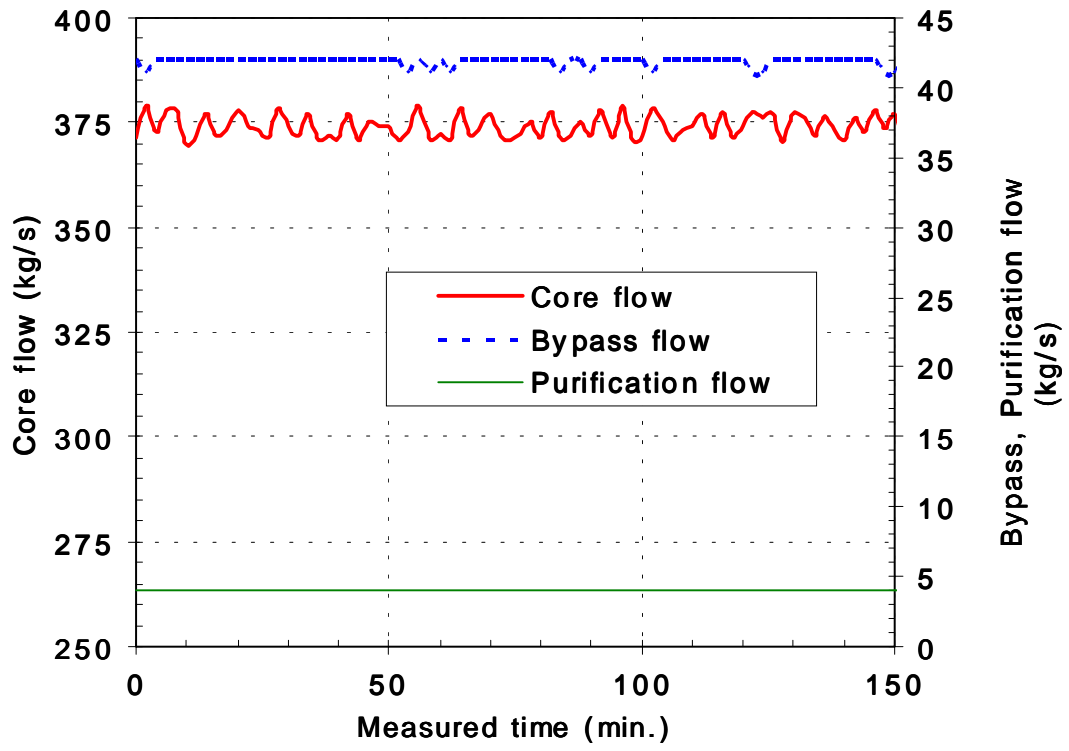


Figure 9 Results of continuity test for flow circulation system