

NSSS

Test Results of the New NSSS Thermal-Hydraulics Program of the KNPEC-2 Simulator

, , a , , , ,
 , () a
 2
 RETRAN NSSS (Nuclear steam supply system)
 RETRAN " "
 " " "
 "Robustness" RETRAN
 (Correlations) (Flow regime)
 Robustness 가 .
 NSSS 가 .

Abstract

As a part of the KNPEC-2 Simulator Upgrade Project, KEPRI and KAERI have developed a new NSSS thermal-hydraulics program, which is based on the best-estimate system code, RETRAN. The RETRAN code was originally developed for realistic simulation of thermal-hydraulic transients in power plant systems. The capability of "real-time simulation" and "robustness" should be first developed before being implemented in full-scope simulators. For this purpose, we have modified the RETRAN code by (i) eliminating the correlations' discontinuities between flow regime maps, (ii) simplifying physical correlations, (iii) correcting errors in the original program, and (iv) others. This paper briefly presents the test results of the new NSSS thermal-hydraulics program.

1.

2 (1)

[1].

RETRAN [2] NSSS (Nuclear steam supply system)
 (ARTS) / . RETRAN
 " (Realistic or best-estimate simulation)"
 " (Real-time simulation)"
 "Robustness" [3]. RETRAN
 (Correlations) (Flow regime)
 Robustness 가 [1, 4]. ,
 RETRAN 가
 가
 가 [3]
 가
 ATRS 가
 1/2 ,
 ARTS 가 가
 (,) /
 가 가 , 가
 (Acceptance test procedure) [5]
 ARTS /
 ARTS 가 가 . Non-Integrated
 Standalone Test (NIST) . ARTS 가
 , ARTS
 가 / ARTS
 . NIST ARTS , ARTS
 (Synchronized state)
 가 . ()
)
 . NIST .

2. Non-Integrated Standalone Test (NIST)

ARTS Windows , Windows NT
 . ARTS NIST ARTS 가
 . 1 NSSS
 . ARTS NIST 1
 NIST [6] .

1.

NSSS

()

		(%)	
	100%, , ,	100	BOL/
	75%, , ,	75	BOL/
	50%, , ,	50	BOL/
	25%, , ,	25	BOL/
	, , ,		BOL/
	, , ,		BOL/
	100%	100	BOL/
	75%	75	BOL/
	50 %	50	BOL/
	25 %	25	BOL/
	100% 75%	100	BOL/
	75% 50%		
	50% 2%		
	2%		
	2%		
	2% 100%		
			100
		100	BOL/
		100	BOL/
		100	BOL/
		100	BOL/
		100	BOL/
		100	BOL/
	(100% 100%)	100	BOL/
	LOOP LBLOCA	100	BOL/
		100	BOL/
		100	BOL/
		100	BOL/
	가 (PORV)	100	BOL/
		-	

1.

NSSS

()

		(%)	
		15	BOL
		7.5	BOL
		100	
	가	100	
		100	
		100	
		100	
	()	100	
	(MSIV)	100	
		100	
			1
		30	
		50	
		100	
	가	100	
	가	100	
	가	0	
	가	100	
	가	100	
	가	100	
		100	
	RCS (C/L)	25	
		25	
		100	
		100	
		100	
		100	
			BOL/가
		100	
		100	
			BOL/

2.1. ARTS NIST

ARTS , 가 , 가 , 1/2

. ARTS 가

, , , , ARTS NIST가 가

[6].

ARTS Malfunction 가

, 가 . ,

가 가 .

, QuickWin

가 ()

, 가 가 .

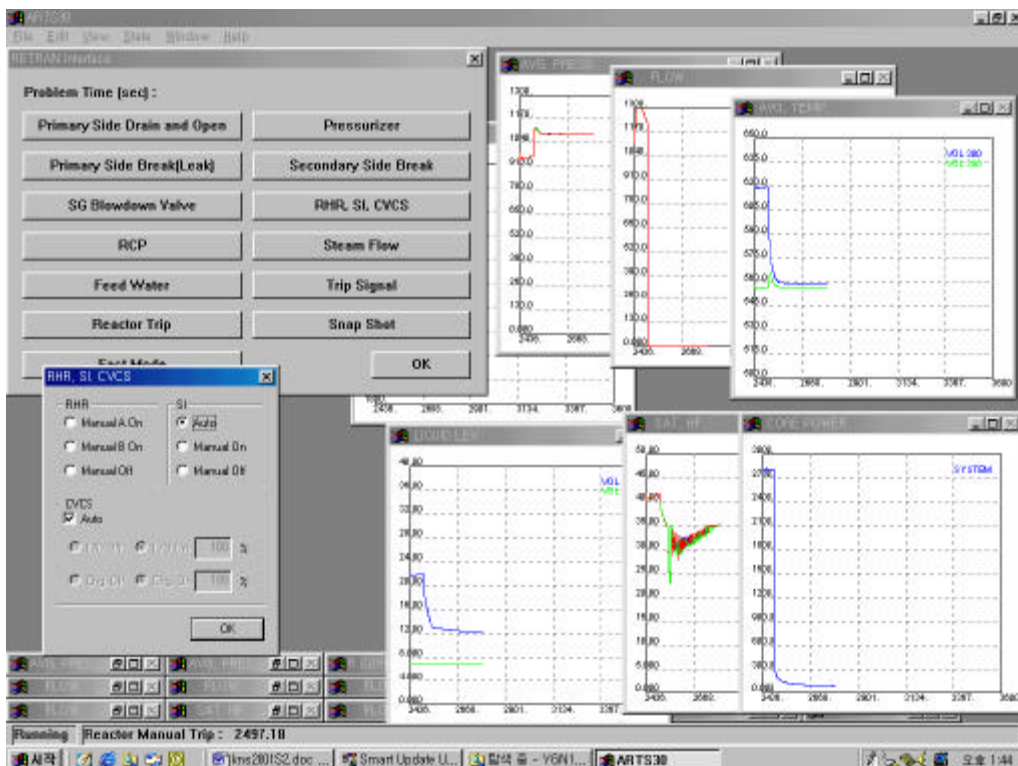
Debugger ARTS

가 가 . ARTS Text File

NIST

On-line X-Y plot . 1 NIST

ARTS



1. NIST ARTS (Windows 98)

2.1. NIST

NIST, 1/2, [7], 1/2, PLS[8]

ARTS 3600 Null-transient, 2, ± 1%

ARTS " #1, SAT(Site Acceptance Test) [5], SAT, 1, ()

ARTS 가, SAT [6].

2. ARTS NIST :

			(%)
(MWt)	2775.0	2760.5	-0.52
가 (psia)	2250.0	2253.2	0.14
가 (ft)	22.4	22.5	0.44
(lb/sec)	30305.6	30263.1	0.14
()	619.9	620.4	0.08
()	557.9	558.0	0.14
()	588.9	589.6	0.12
(psia)	961.0	962.7	0.17
(ft)	41.5	41.6	0.24
(lb/sec)	1138.05 (× 3)	1145.3 (× 3)	0.64
(lb/sec)	1138.05 (× 3)	1145.3 (× 3)	0.64

2.2. NIST

ARTS Robustness 가 2 SAT

(1)

:

_____ -

- -

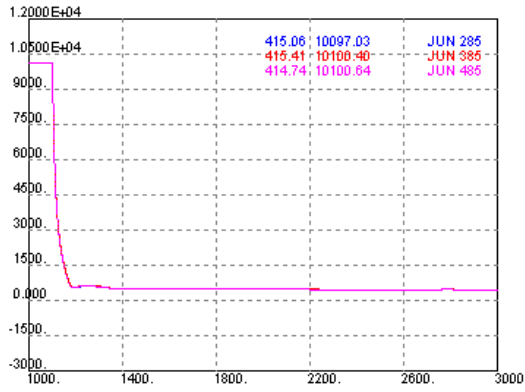
- - (100% 75% 100%)

- -

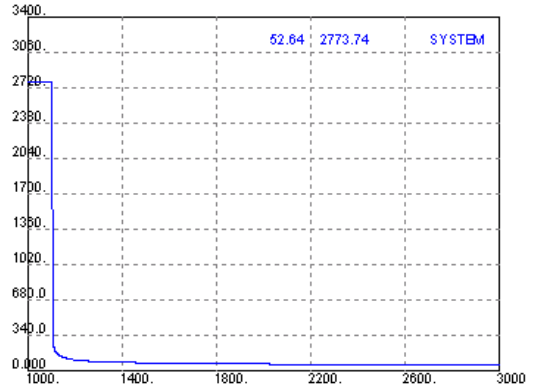
- (RCP) -

Swelling

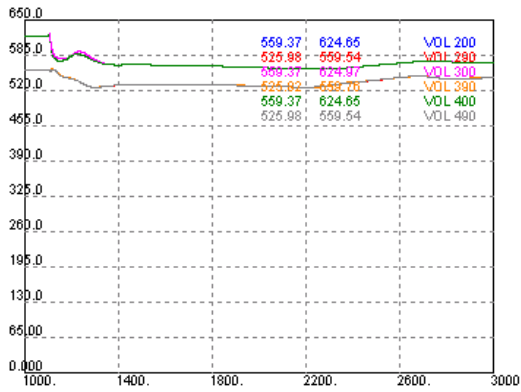
1



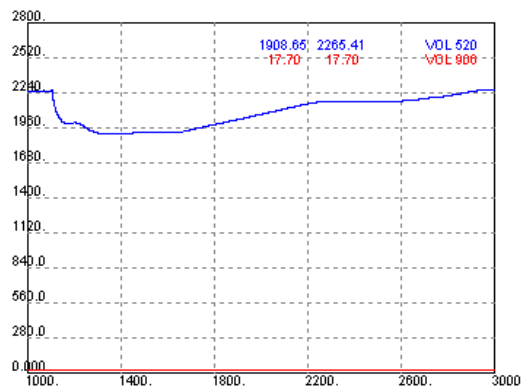
2. RCP :



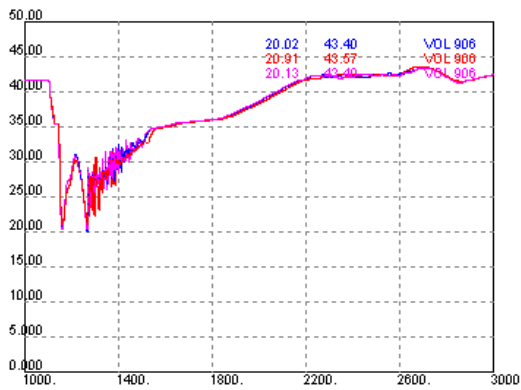
3. RCP :



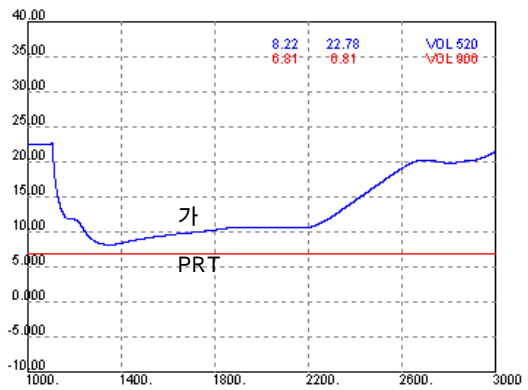
4. RCP :



5. RCP : 가



6. RCP : SG



7. RCP : 가

(2)

(Steam Generator Tube Rupture; SGTR)

3 가

3

8 15 . 1100 3 가

1 가 2 , 1 가 가 (8, 9). 가 가

(10).

가 1455 가

(11). 가 , 가

, OTdT 가 ARTS OTdT, OPdT Turbine runback

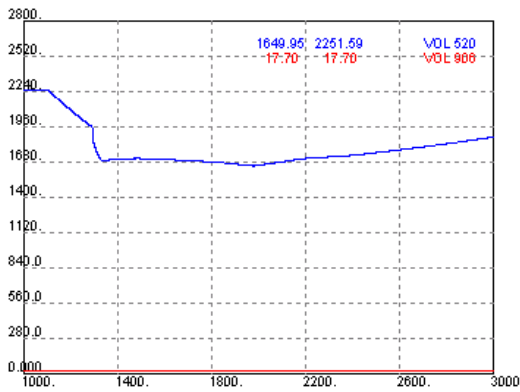
1

가 - 1470 (12)가

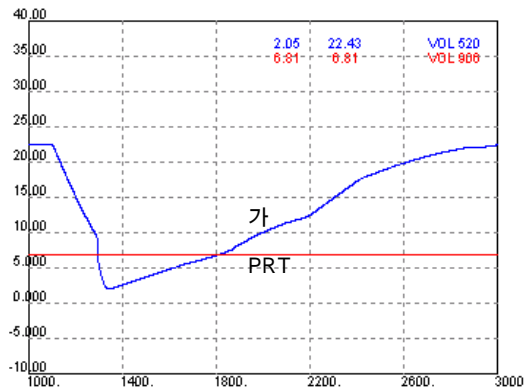
(13). 1

가 가 14

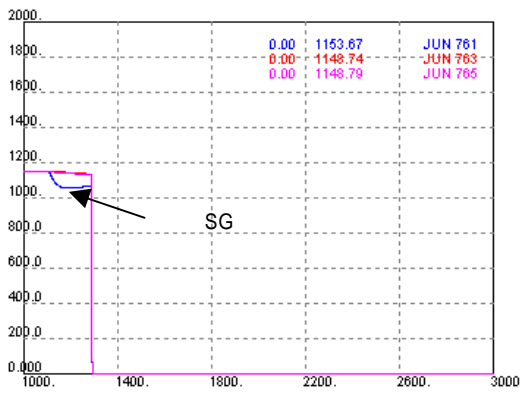
15 가



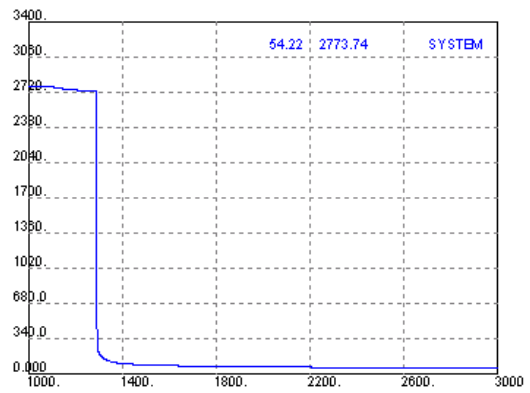
8. SGTR: 가



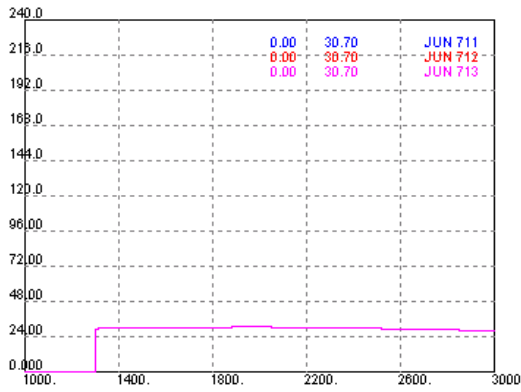
9. SGTR: 가



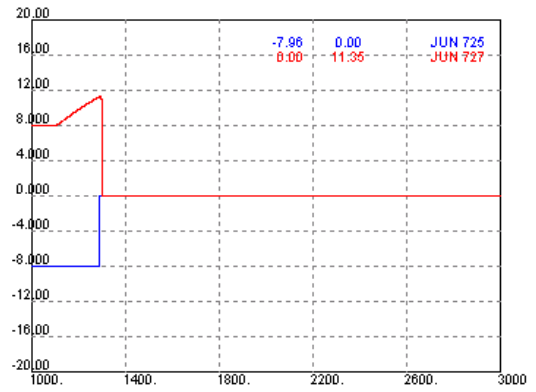
10. SGTR:



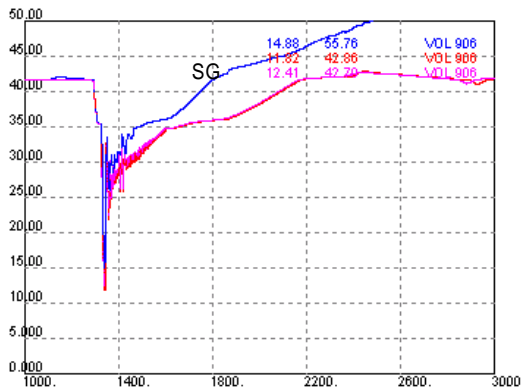
11. SGTR:



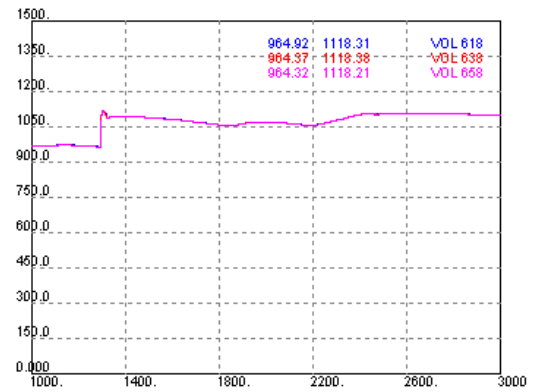
12. SGTR:



13. SGTR:



14. SGTR:



15. SGTR:

, #1 SAT
1

3.

NIST ARTS

SAT (Site Acceptance Test) SAT

1 NSSS

(Discrepancy Report)

Toolkit)

ARTS

“ATTACHE” (

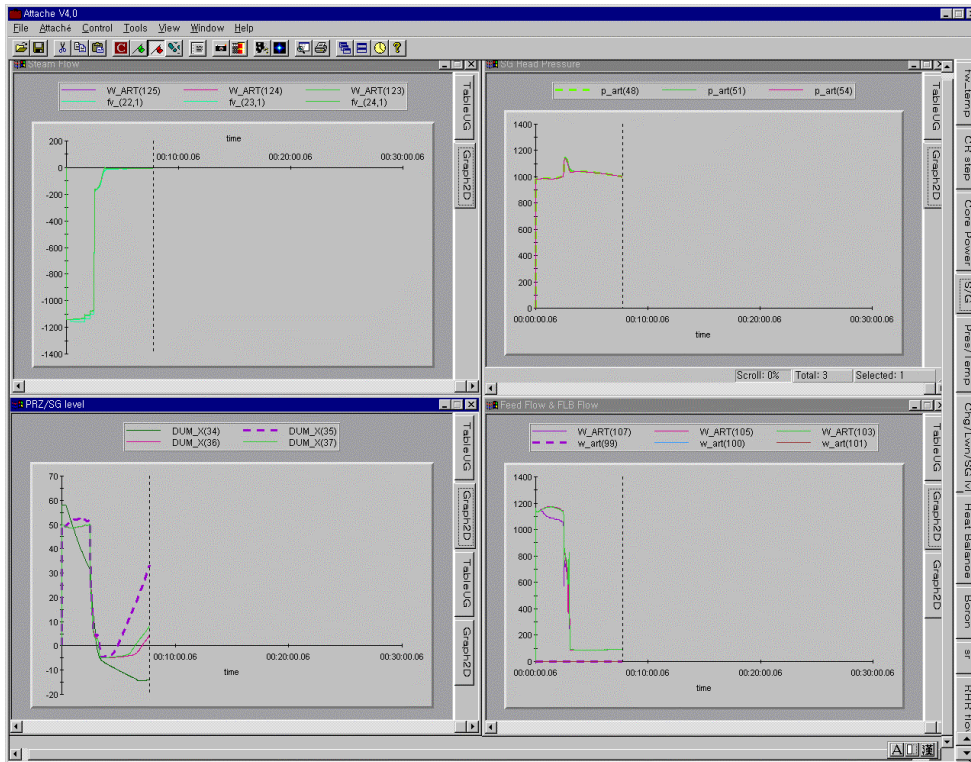
ARTS

, ARTS 가

“Over time”

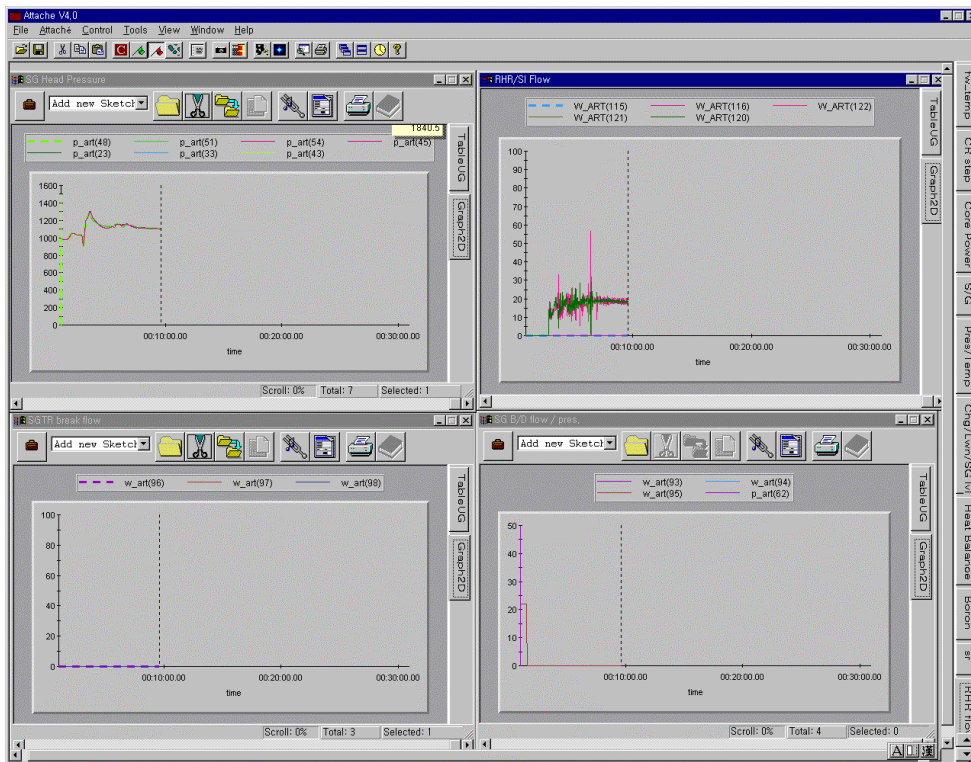
(Calculation failure)가

ARTS가



16. SGTR

ATTACHE



17. "ATWS + LOSS OF FEED WATER"

ATTACHE

(Simulation variables) ARTS가 Freeze
 가 가 . 16 17 “SGTR” “ATWS +
 LOSS OF FEED WATER” ATTACHE . ATTACHE
 Display 가 ,
 1 .

4.

1/2 NSSS ,
 RETRAN NSSS , ARTS
 RETRAN (Correlations)
 Robustness
 가
 ATRS , ,
 Robustness, Realistic Simulation NIST
 RETRAN NSSS

1. , 2 , 00- - 165, , 2000.4.
2. M. P. Paulsen et al., RETRAN 3D code manual, EPRI NP-7450, Electric Power Research Institute (1998).
3. Nuclear Power Plant Simulators for Use in Operator Training and Examination, ANSI/ANS-3.5-1998, American Nuclear Society (1998).
4. , “ 2 NSSS ”, 2001 .
5. , #1 , (1998).
6. 2 NSSS T/H Model NIST , 2000. 9, .
7. 1 (), , 1995. 1.
8. 1, 2 , (PLS; Precautions, Limitations, and Setpoints), , 1993. 12.