

**MARS 1.3.1**

**1/2**

**Realistic Analysis of YGN 1/2 Single SGTR Transient Using MARS 1.3.1**

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150

\*

103-16

1/2

가

MARS 1.3.1

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가

**Abstract**

Realistic transient response of YGN 1/2 during single SGTR (Steam Generator Tube Rupture) accident with operator actions has been analyzed focusing on the symptoms measurable in reactor system. For the realistic thermal-hydraulic system analysis, MARS 1.3.1 was used as the analysis tool, and the system initial operating conditions were generated based on the plant operation data at full power. For the realistic simulation of system transients, reactor control/protection systems and safety systems were modeled based on their realistic performance data and the operator emergency actions were modeled based on YGN 1/2 EOP (Emergency Operation Procedure). Through the analysis, the effectiveness of the current EOP has been investigated and several improvement items of the current EOP have been derived. The realistic transient symptoms of the system generated can be used as a reference in enhancing the emergency preparedness of plant operators.

**1.**

( 1 )

overflow

가

overflow

<sup>1)</sup> E-3

E-0

, E-3

. E-3

overflow

1 -2

1

1 -2

1 -2

1/2

가

L/D

1

-2

1

가

MARS 1.3.1

<sup>2)</sup>

nodding scheme

1

가

, E-3

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1 -2

가

2.

2.1

1,2

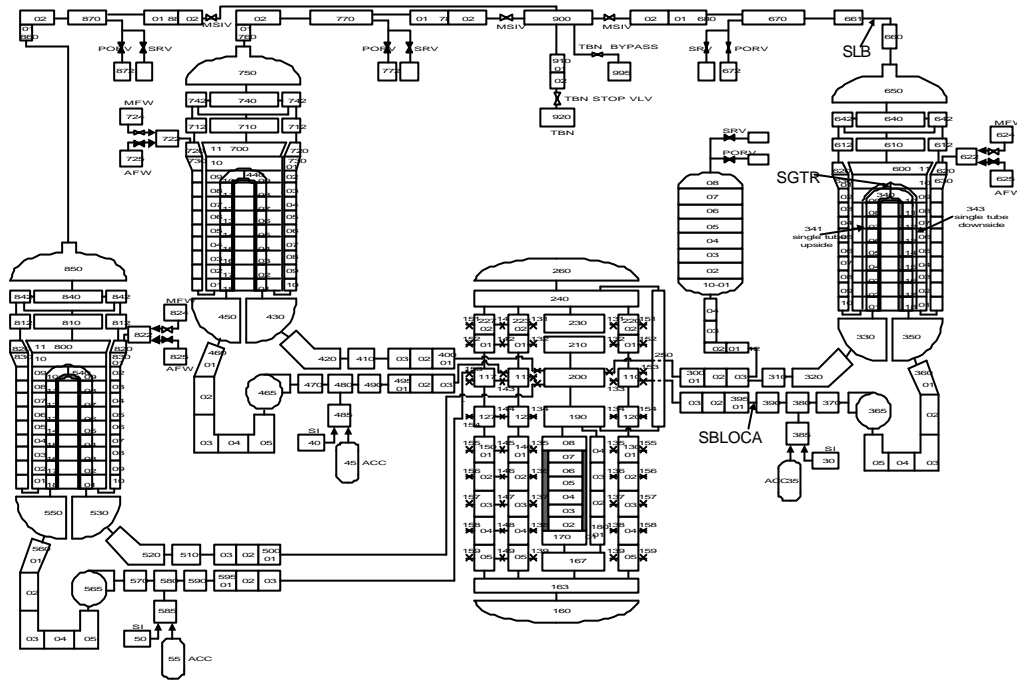
3-

Westinghouse

MARS

1

nodalization 1  
 noding scheme , 300 volume  
 , 가 가  
 noding scheme ,  
 3)



1. 1,2 Nodalization

Trip Valve

Vantage-5H 가 가 2775 MWt

97.4%

3,4 3,4 1,2

4), 5), 1,2 PL&S (Precautions Limitations and Setpoints)<sup>6)</sup>

Westinghouse PIP (Plant Information Package)<sup>7)</sup> , 1

1.

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Plant Parameters	Initial Conditions	Simulated Conditions
Core Thermal Power (MWt)	2775.	2775.
Pressurizer Pressure (bar)*	155.13	155.13
Pressurizer Level (%)**	58.	58.0
RCS Flowrate (kg/sec)***	4808.	4808.
Hot Leg Temperature (K)*	598.15	598.4
Cold Leg Temperature (K)*	565.15	565.0
RCS Average Temperature (K)*	581.65	581.75
Steam Line Pressure (bar)*	66.3	66.4
Steam Generator Level (%)**	50.	49.9
Feedwater Flow (kg/sec)+*	516.+ (536.1*)	513.6
Feedwater Temperature (K)*	498.15	498.15
Steam Flow (kg/sec)+*	516.+ (536.1*)	513.2
SG Recirculation Ratio <sup>+</sup>	3.7	3.7
Core Bypass Fraction***	0.033	0.032
SG Heat Transfer Area (m <sup>2</sup> )***	5109.67	5109.9
Gamma Heating Factor***	0.026	0.026

\* Obtained from YGN 1,2 Plant Operation Log

\*\* Nominal values for reactor control in PL&S

\*\*\* Best-estimate values in FSAR

+ Best-estimate values in Westinghouse PIP

## 2.2

가

1/2 PL&S

Westinghouse

8)

가

가

, 가

1/2 PL&S

2 Vantage-5H RTSR<sup>9)</sup>

3.3 가

ANS '79

## 2.3

1/2

가 E-0

E-0 25

E-3

E-3

2

1 -2

1

1

1

1

1

1

2

EOP

E-0	- Diagnosis of SGTR	
Start E-3	- E-0 Step 25	5 min
Check RCP Trip Criteria	- RCP Trip against SBLOCA - RCS P < 115.72 bar	30 sec
Broken SG Identification and Isolation	- Isolation of Broken SG MSIV - SGTR Symptoms	3 min
Broken SG Level Check and AFW Cutoff	- Prevention of Broken SG Overfill - Maintenance of Broken SG Inventory - NR Level > 6%	10 sec
Intact SG Level Control	- Maintenance of Intact SG Inventory - 6% < NR Level < 50%	1 min
RCS Cooldown using Steam Dump Valve	- Acquirement of RCS Subcooling - Textit < Desired Textit vs. B-SG P	3 min 1 min for termination
RCS Subcooling Check	- Maintenance of Textit Subcooling - Textit < Subcooling Table (50 F)	1 min
RCS Depressurization using PZR Spray	- Control of Break Flow - RCS P < Broken SG P and LpZR > 6% or Textit > Subcooling Table (30 F)	1 min for termination
SI Termination	- Prevention of Re-pressurization	10 sec
Calculation Termination		

2. E-3

가 2

가

, Westinghouse

10)

1

3.

가

50

2

가

2.

Events	Time (sec)
Break Opening	50.
Backup Heater On	50.9
Reactor Trip Signal by Low PZR P	257.8
Shutdown CEA Drop	259.8
Turbine Trip/Steam Dump On	260.0
SI Signal by Low PZR P	272.9
AFW Signal	272.9
Control System Isolation by SI	274.9
MFW Isolation	277.9
Motor Driven AFW Delivery	282.9
SI Delivery to RCS	284.9
Turbine Driven AFW Delivery	286.0
Entry into E-3 Procedures	557.8
RCP Trip Check Passed	587.8
Broken SG Identification and Isolation	737.8
Broken SG Level above 6%	737.8
Broken SG AFW Cutoff	747.9
Intact SG Level Check OK	807.9
RCS Cooldown Start using Steam Dump Valve	987.9
Intact SG AFW Off	992.4
Intact SG AFW On	1158.3
RCS Cooldown Termination	1202.3
RCS Subcooling Check OK	1262.3
RCS Depressurization Start using PZR Spray	1262.3
RCS Depressurization Termination	1660.4
SI Termination	1670.4
Calculation Termination	2000.0

1

( 3) 가

( 4)

가

가

, 1 -2

(~ 30 kg/s)

1

가 ( 5) 1

가 , 1

50% 1

2 ( 3) ( 6) 2

( 6) 1

1 가

( 3), 가 ( 4),

( 6) 2 가

( 5)

2

(78.6 bar) ( 3)

가 ,

(~40 kg/sec) (~30 kg/sec) 가 (

3) ( 4) 가 .

( 5).

E-0 , E-0 25

E-3

1 -2

2

E-3 1 , 1

( 3) (115.72 bar)

가 6% overfill ( 3)

가 ,

6 ~ 50% ( 5).

2 ( 7). 1 1  
 가 ( 6). 1 가  
 ( 4) 가 . 1  
 가(~50 kg/sec) 가  
 가 ( 3)  
 2 swelling ( 5) 50% 가 ,  
 1 , 가  
 1 (41.35 bar)  
 1  
 , 1  
 ,  $\Delta T$  가  
 $\Delta T$  가 ( 8)  
 1 (27.8°K)  
 ( 3). , 1 가  
 1 가 1 -2 , 1  
 1 가 가  
 1 가 1 2  
 . 가 가 ( 4) 가 , 가 1  
 , 1  
 가 1 -2  
 가 가 6%  
 1 1 -2 overfill  
 ( 5) ,  
 ( 3) ,  
 1 ( 6) 16.7°K



1 가  
300  
1 가  
( 3) , 1 가

4.

가

가. 1 -2

가 overflow

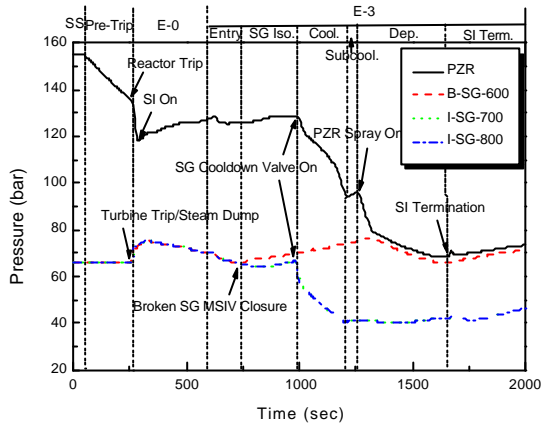
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2) 1

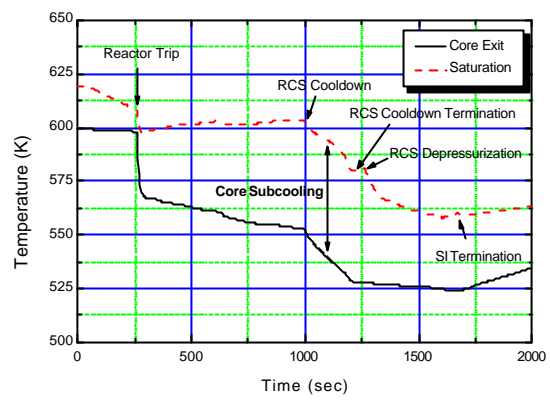
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5.

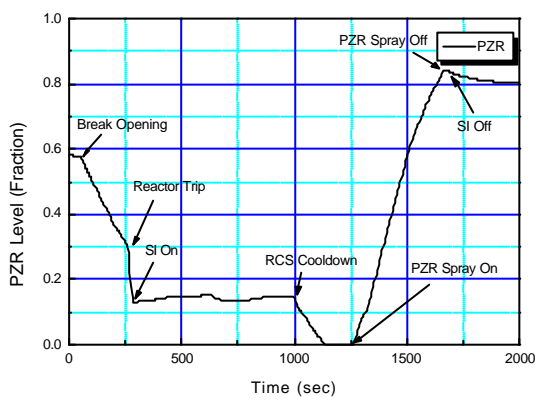
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3. 7,8 - , 1986
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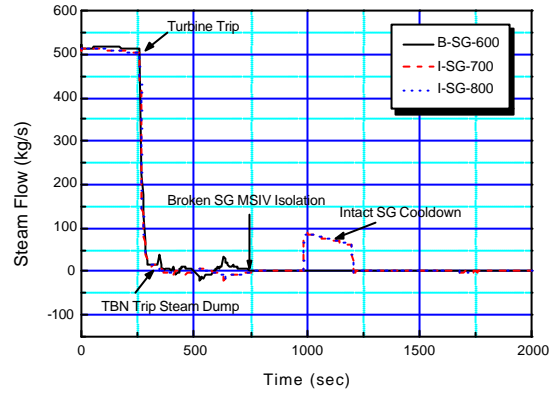
3. 가



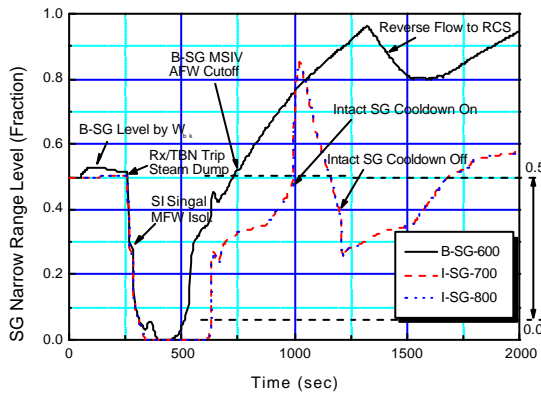
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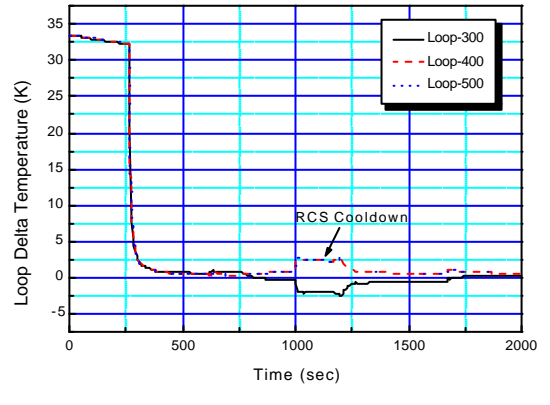
4. 가



7.



5.



8. 가