

Pressure Propagation in the Discharge Pipe Submerged with Water Pool

19

RELAP5/MOD3

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ABSTRACT

Thermal-hydraulic response in the discharge piping at the upstream of water pool following the opening of the safety relief valve is analyzed. To predict the basic pressure wave propagation and interaction with reflection wave, the RELAP5/MOD3 code is used. Pressure wave propagation behavior in a simple geometry is calculated and the effect of the important parameters including the loss factor, the pipe configuration, the water slug inflow, the valve opening time, and subdivision of sparger are investigated. And the affecting factors influencing the pressure wave propagation and their mechanisms are discussed.

1.

(Safety Relief Valve)

가

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가

[1].

(APR1400)

(In-containment Refueling Water

Storage Tank, IRWST)가

가

[2].

Torus,

Sparger

가

IRWST

가

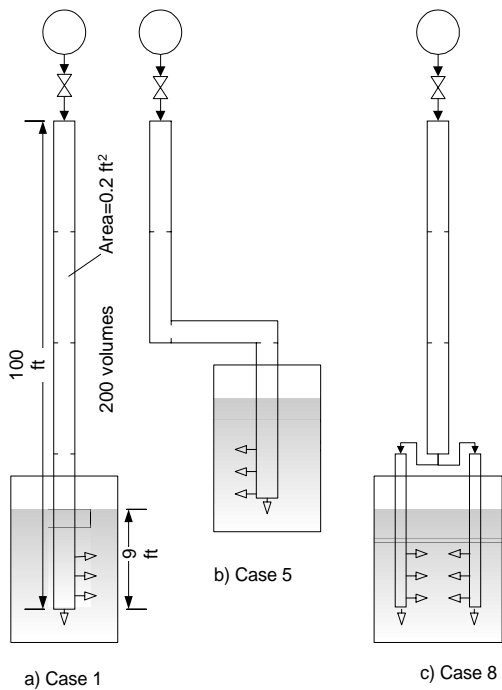
가

가

가 .
 , 가
 , (slug) , 가 (Sparger)
 (Branching)
 RELAP5/MOD3
 [3] 2
 가 [4].

2.

가 , Torus
 U
 6 14
 가
 가



1. 가 RELAP5

RELAP5/MOD3.3bata [3]

[4], EPRI

가 1
 100 ft
 200
 가
 ft가
 가
 가
 가

Case	Description
1	Base case : $dt_{max}=1 \cdot 10^{-4}$, $K_{for/rev}=0.0$, Steam-air mixture inflow, All vertical pipe, SRV quick open, Single sparger
2	Time step size ($dt_{max}=2 \cdot 10^{-4}$), Others same as Case 1
3	$K_{for/rev}=1.0$, Others same as Case 1
4	Water slug inflow (0.3 sec), Others same as Case 1
5	Horizontal pipe segment, Others same as Case 1
6	Pure steam inflow, Others same as Case 1
7	SRV linear opening (1.0 sec) , Others same as Case 1
8	Two branches of sparger, Others same as Case 1
9	All parameters combined ($dt_{max}=1 \cdot 10^{-4}$, $K_{for/rev}=1.0$, Water slug inflow, SRV liner opening, Horizontal pipe segment, Two branches of sparger

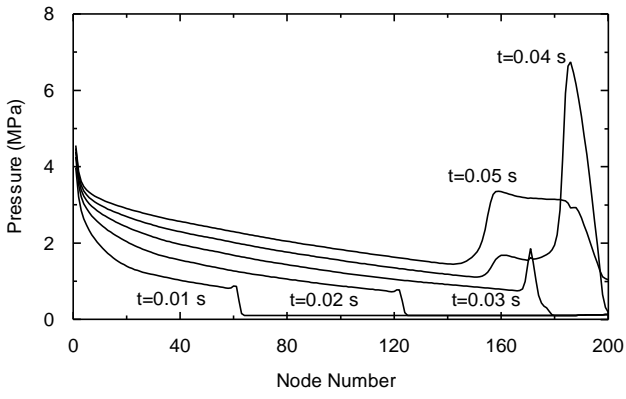
junction . 4 junction (Case 8).
 5). 1 b) 1/4 Sparger 2 (Case 8).
 가 18.7 MPa 가 ,
 1 . Case 1 가
 Case 2 . Case 3 3 $2 \cdot 10^{-4}$ sec junction 1.0 ,
 . Case 4 0.3
 . Case 5
 . Case 6 634 K 가 . Case 7
 1.0 . Case 8 가
 . Case 9 가
 ..

3.

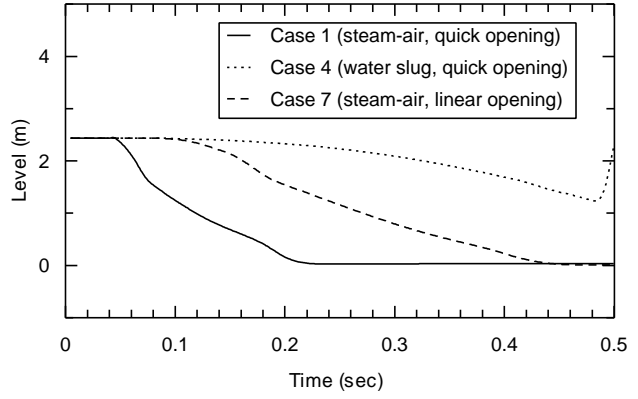
RELAP5 2.0 .

3.1

2 Case 1 .
 가
 0,04 가 가
 (reflection wave) 190 6
 MPa . 0.05
 3 .
 0.05 가 .



2 Case 1



3.

3.2

4 Case 1 2

2

3.3

5 Case 1 Case 3

1.0

가

가

3.4

6 Case 4

, Case 1

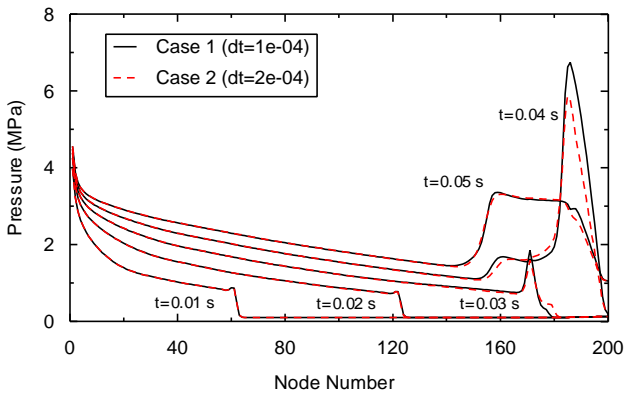
kPa

slug 가 0.3

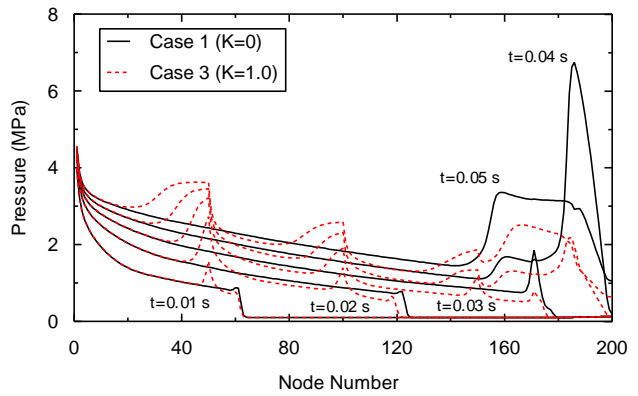
0.3

가

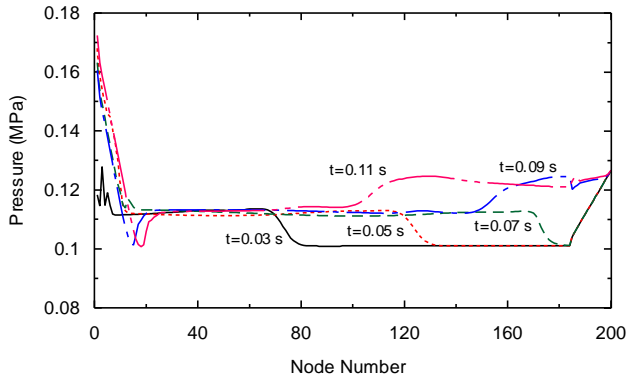
7 Case 4



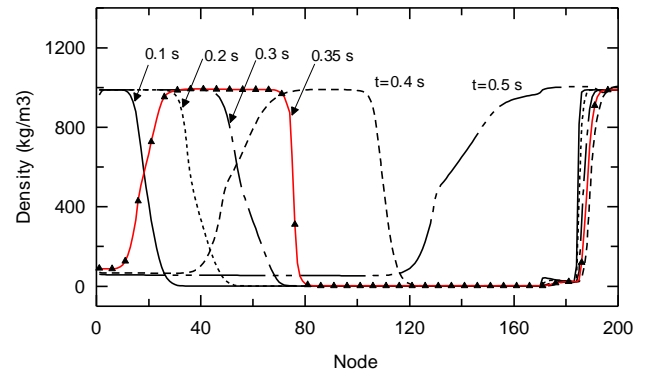
4. Case 1 2



5. Case 1 3



6 Case 4



7. Case 4

0.4 가
20

40 (6 m),

가

3.5

8 Case 1 Case 5

Case 5

junction

RELAP5 1

3.6 가

9 Case 7 ()

Case 1 가 ,

3.7

10 Case 7

가

0.1

3

가

3.8

11 Case1 Case 8

가 0.04

2 Case 8

4 MPa

Case 1

가

3.9

(Case 9)



4.

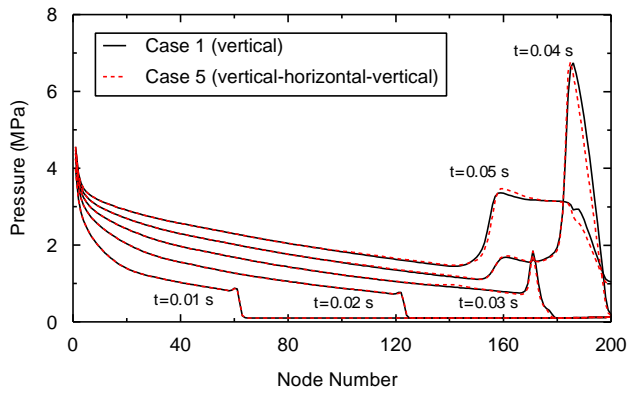
RELAP5/MOD3 가 1

1)

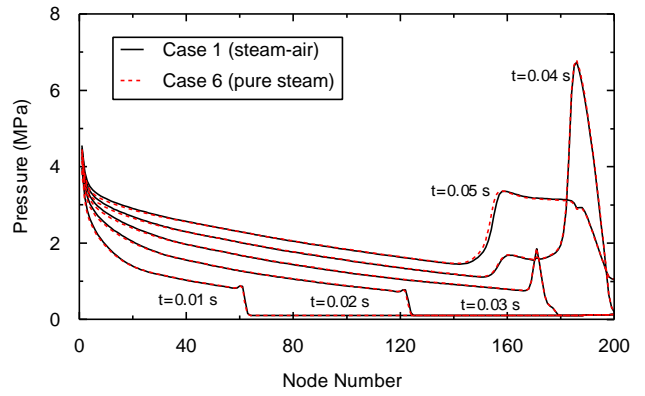
2)

3) , 가 ,
RELAP5/MOD3

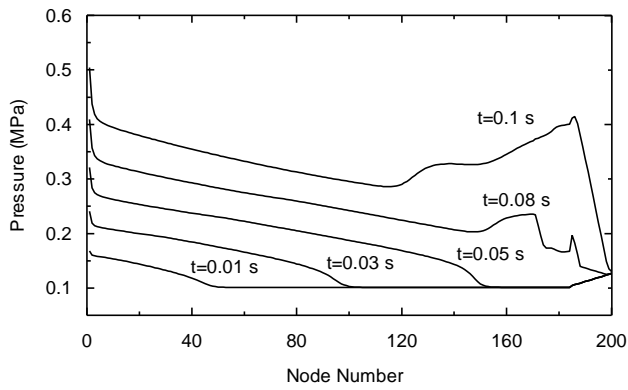
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3. Information System Laboratory Inc., , RELAP5/ MOD3.3Beta Code Manual, Rockville, MD, NUREG.CR-5535/Rev.1 (2001)
4. Stubbe, E.J., Vanhoenacker L., and Otero, R., RELAP5/MOD3 Assessment for Calculation of Safety and Relief Valve Discharge Piping Hydrodynamic Loads, USNRC, NUREG/IA-0094 (1990)



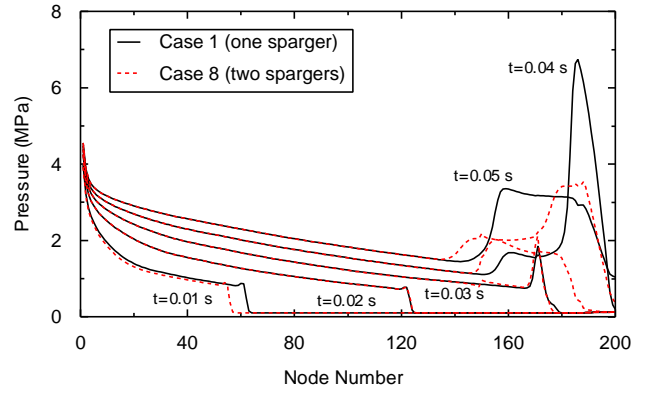
8. Case 1 5



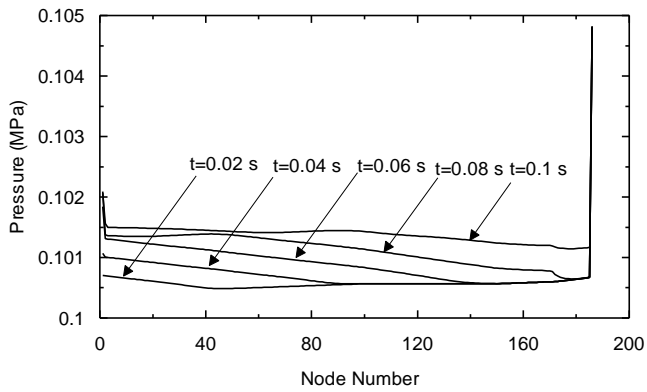
9. Case 1 6



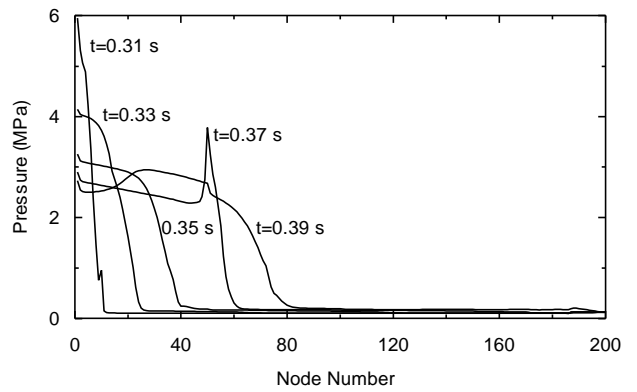
10. Case 7



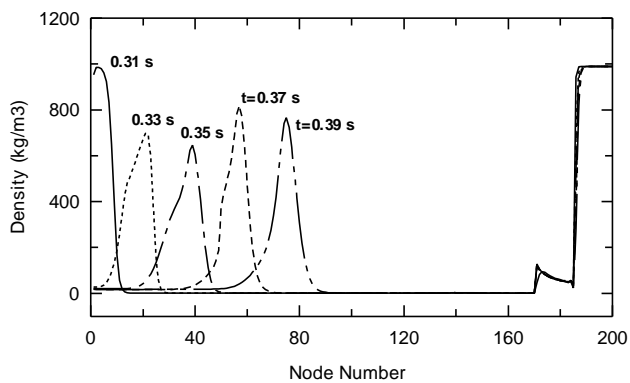
11. Case 1 8



12. Case 9



13. Case 9



14. Case 9