

가

가

A Study on the Development of On-Line Source Term Estimation System for PWRs

1, 2, 1, 3, 3

16

가

(CARE)

CARE

12 가

가

FADAS

가

(STES)

가

SBO

MAAP

ABSTRACT

Currently, the CARE system (Computerized Technical Advisory System for the Radiological Emergency) is established in Korea Institute of Nuclear Safety (KINS) for the purpose of monitoring the 16 units of nuclear power plants in Korea. In this study, the Source Term Estimation System (STES) has been developed for 12 units of Pressurized Water Reactor: STES estimates source terms using safety parameters transmitted from PWR plants and transfers the results to FADAS which can estimate the radiological doses on real-time basis. As a result, it is now possible for CARE system to estimate on real-time the source term for PWRs and its radiological consequences in the event of nuclear accidents. It is also shown that STES gives results similar to those of MAAP (Modular Accident Analysis Program) for the calculation of Station Black-Out accident.

1. (62-1)
2. (KAIST)
3. (KINS)

1.

1979 TMI-2

가

(DBA)

TID-

14844

가

(KINS) 1991

(ERF)

가

가

KINS

CARE

CARE

가

1991

[1,2,3].

CARE

(SIDS)

가

(STES, Source Term Estimation System),

가

가

(FADAS)

가

[1].

CARE

SIDS

FADAS

가

STES

2.

가

2.1

(WASH-740) [3]

가

BNL (Brookhaven National

Lab.)

1957 3

(AEC) "

가

" (WASH-740)

가

(Hazard State)

가 . WASH-740 TID-14844 10CFR100 ()
, 2 TID-14844 .

2.2 가 (Maximum Credible Accident; TID-14844) [4]
1962 2 10CFR100 , 가
3 TID-14844 가 가 . 가
(Large Break LOCA)가 , WASH-740 2
LB-LOCA 가
. 10CFR100 가 TID-14844

TID-14844 가 (Xe, Kr)
100%, 50%, 1%가
(0.1% /) 가 .

2.3 (WASH-1400) [5]
1975 10 (Reactor Safety Study; WASH-1400)
가 가
, 가 (PWR) Surry , (BWR)
Beach Bottom (Initiating
Event) (Fault Tree Analysis) , (Event Tree
Analysis) ,
, 가 . 가
. 가 가 40
9가 .

2.4 가 (NUREG-0956) [6]
가 TMI
,
(Source Term Code Package; STCP), STCP
. NUREG-0956 가

(WASH-1400)

NRC

2.5 가 (NUREG-1150) [7]
1975 NRC

2.6 가 (NUREG-1465) [8]

5 가 , NUREG-1465 가 .
(Coolant Activity Release)
(Gap Activity Release)
(Early In-Vessel Release)
(Ex-Vessel Release)
(Late In-Vessel Release)

3. 가 (STES)

3.1

가
(CARE)
(FADAS)

NRC RTM (Response Technical Manual)

[9].

가
(FPI)
(Gap Release),
(Core Release Fraction, CRF)

가 () , () , (SGTR) 가 (Reduction Fraction, RDF) 가 가 가 가 (Escape Fraction, EF) , , , [9].

$$SourceTerm = \sum (FPI_i \times CRF_i \times RDF_i \times EF_i)$$

3.2

FADAS

85 [10]

(FSAR)

[11]

WASH-1400

3.3.

(CRF)

4가

[9].

가

[4].

가

가

10

(CET)가

가

980

2

(

CET

)

가

가

가

가 980
가
10
가 980 1300
10 1000 , 1,000
1,000 RTM
가 980 가
980 1300
RTM I-131, I-132, I-135, Cs-134, Cs-137, Sr-90
RCS 10000 가 , TMI
10,000 - 100,000 가 [9]. , RCS Sample
, RCS
1,000 . RCS
가 1300 , 1,000
, 100,000
가
, 1300 , CET
, RCS 가
가
100
가 가

5 %

가

3.4.

(RDF)

(EF)

(RDF) SGTR

SGTR

2

가

Scrubbing

가

RDF

, SGTR

가

가

RDF

(EF) SGTR

SGTR

가 가

가

. SGTR

(1%/day)

가

가

가

가

(Isolation Failure)

24

가

가

1

가

(RDF)

(EF)

5

6

[9].

RDF

RDF

0.001

0.001

RDF=0.001

1/1000

가

가

(EF)

1)

(0.1%/day):

4E-5

(100%/day):

0.04 (

)

1.0

2)

(500gpm):

0.35

1

0.03

(500gpm)

4. STES

STES 가
STES ,
가 가 , TMI-2
,
PSA MAAP
MAAP
STES STES
MAAP STES 가
1 3&4 SBO
가 9 10 MAAP 가
가
, STES
MAAP 가 , FADAS 가
가
, MAAP () [9,
10] () STES MAAP
, STES MAAP

5.

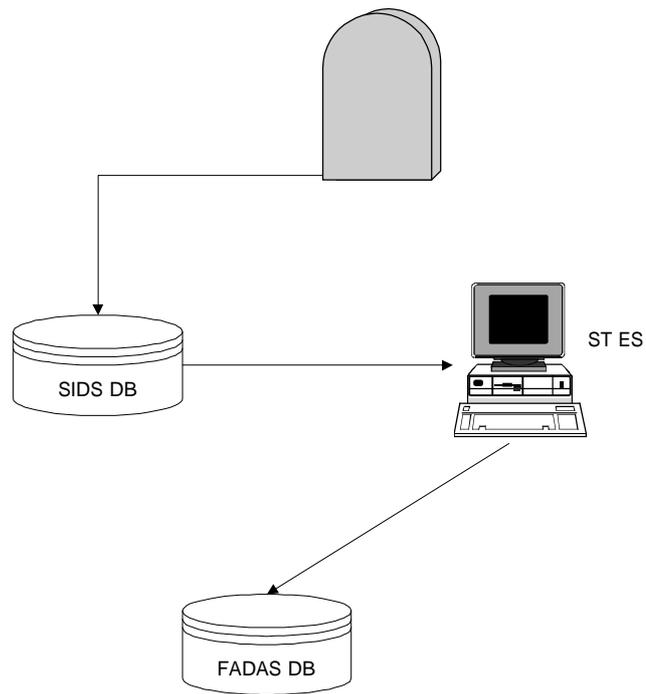
✓ STES SIDS
FADAS
SIDS, FADAS CARE
✓ STES 300 SIDS
30 가
가
✓ STES SIDS, FADAS
가 ,

✓ STES 가 , MAAP

✓ 가 STES

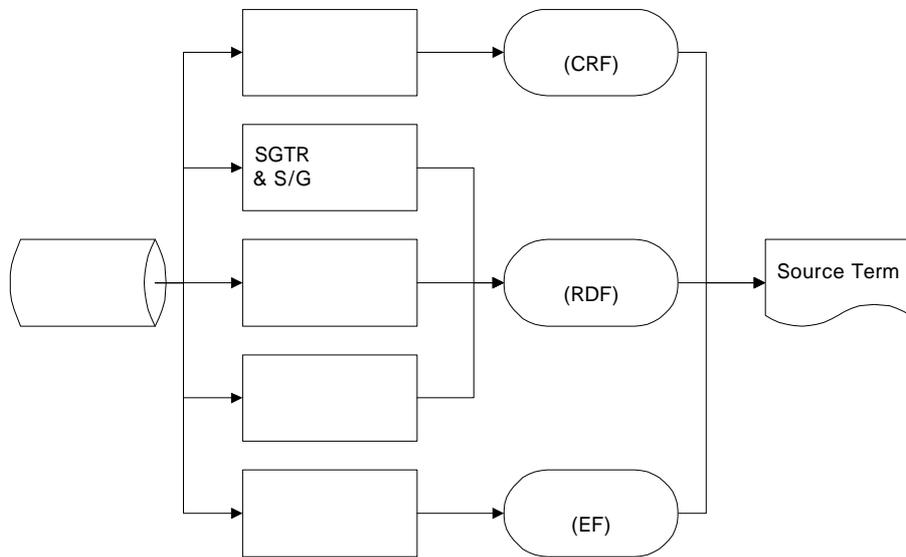
6.

1. 가; (), KRC-93N-J08, , 1995.
2. ; (1), KINS/AR-438, , 1996.
3. , KINS/AR-626, , 1998.
4. Calculation of distance factors for power and test reactor sites, Technical Information Document (TID)-14844, U.S. Atomic Energy Commission, 1962.
5. Reactor safety study: an assessment of accident risks in U.S. commercial nuclear power plants, WASH-1400 (NUREG-75/014), NRC, 1975.
6. Reassessment of the technical bases for estimating source terms, NUREG-0956, NRC, 1986.
7. Severe accident risks: an assessment for five U.S. nuclear power plants, NUREG-1150, NRC, 1990.
8. Accident source terms for light water nuclear power plants, NUREG-1465, NRC, 1992.
9. RTM-96: Response Technical Manual, NUREG/BR-0150, Vol. 1, Rev. 4, 1996.
10. (FADAS) , KINS/HR-282, 1999.
11. PWR CANDU , KAERI/CM-151/94, , 1995.



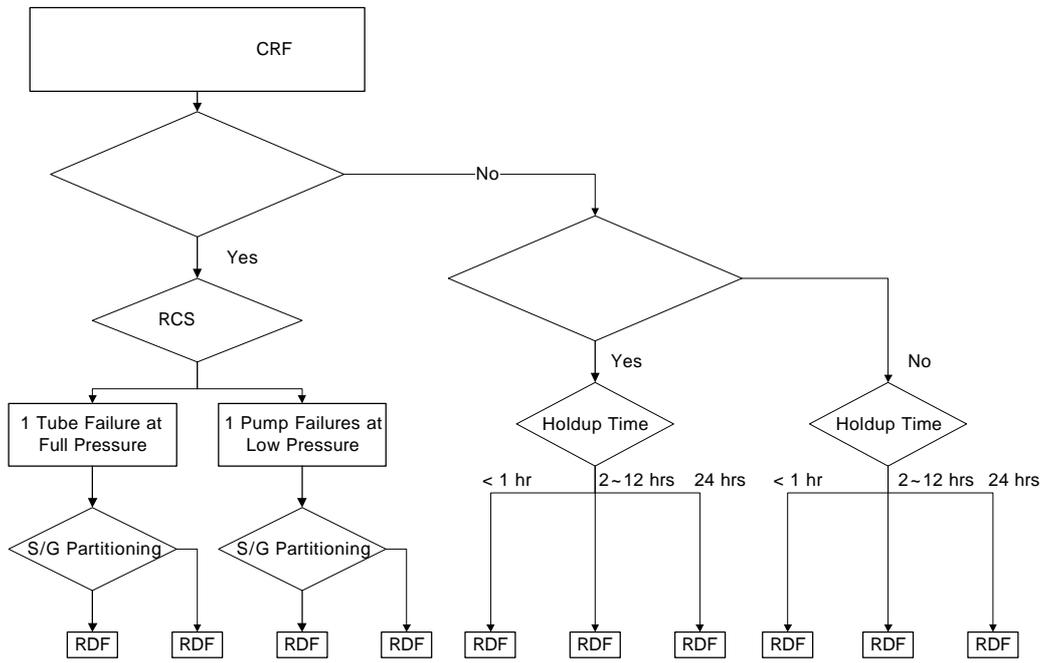
1. CARE

(SIDS-STES-FADAS)



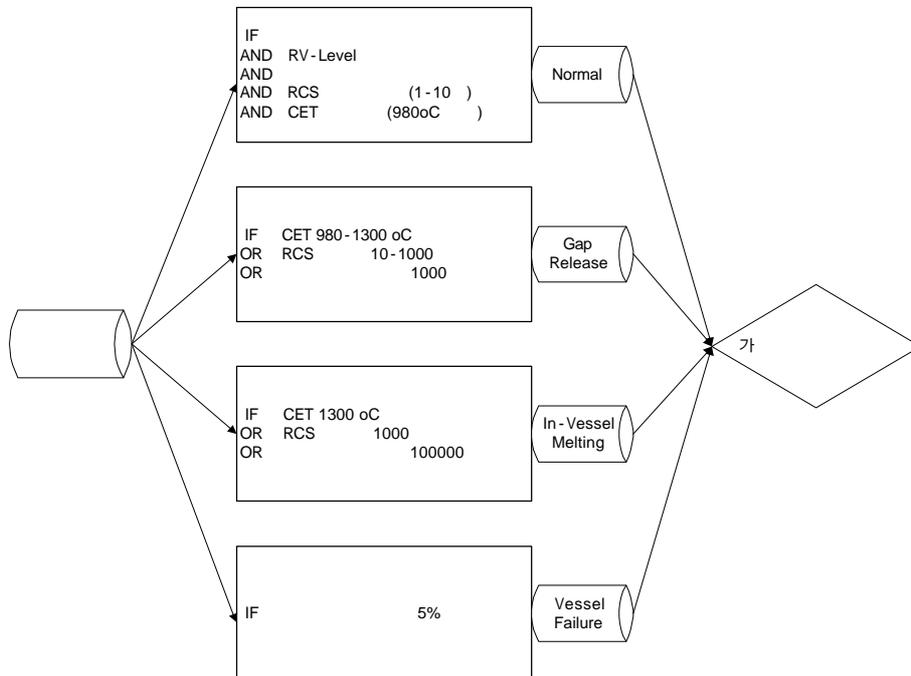
2.

(1/2)

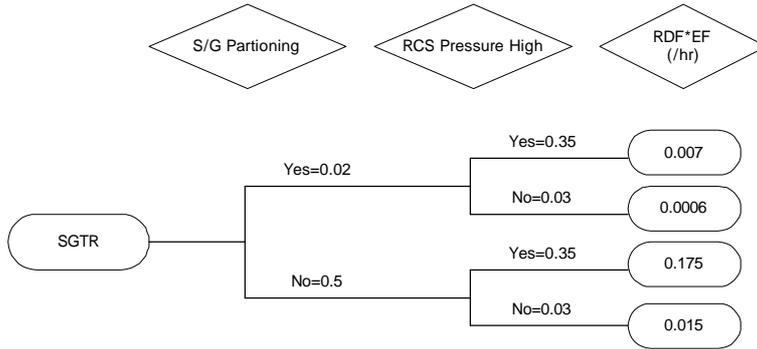


3.

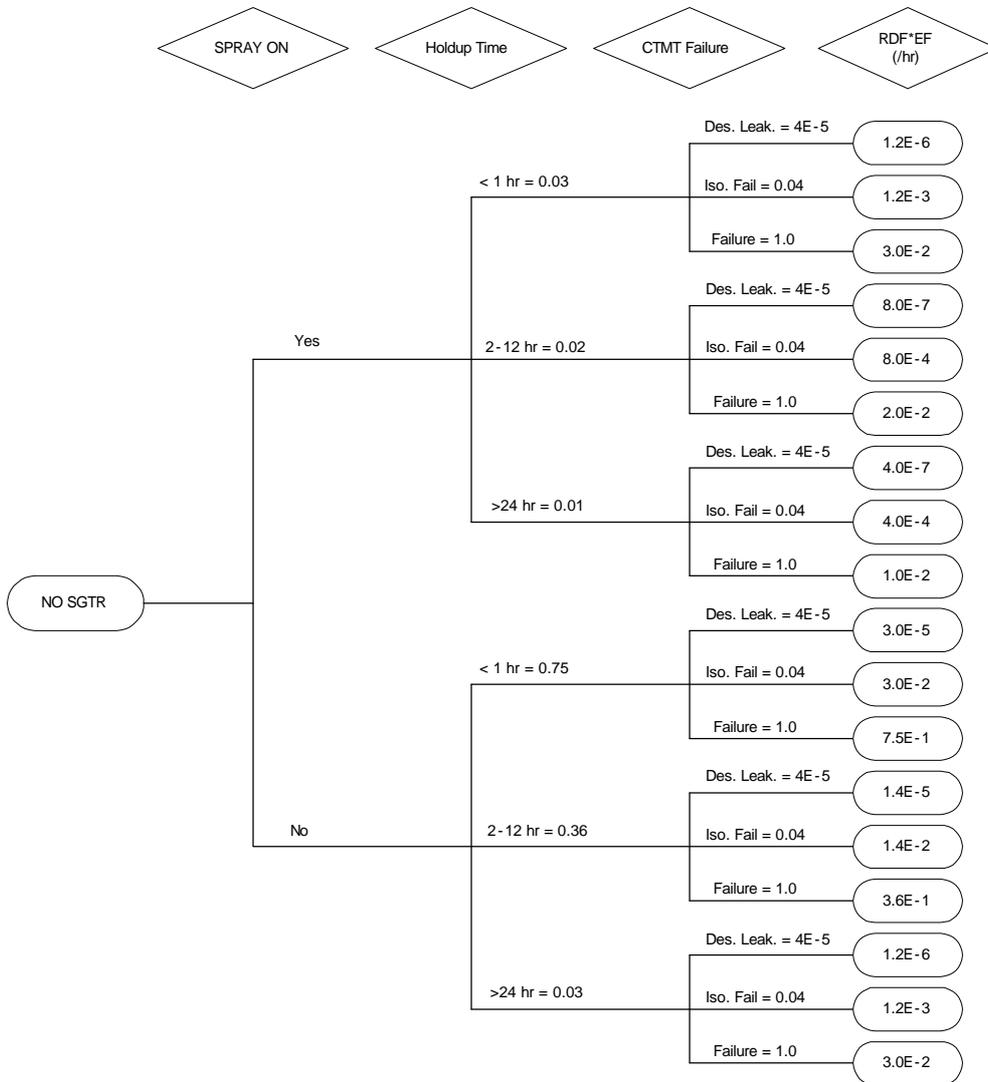
(2/2)



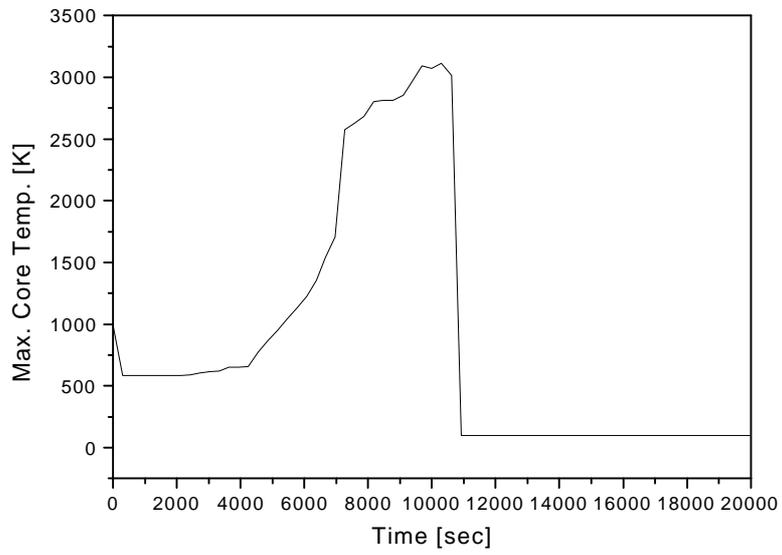
4.



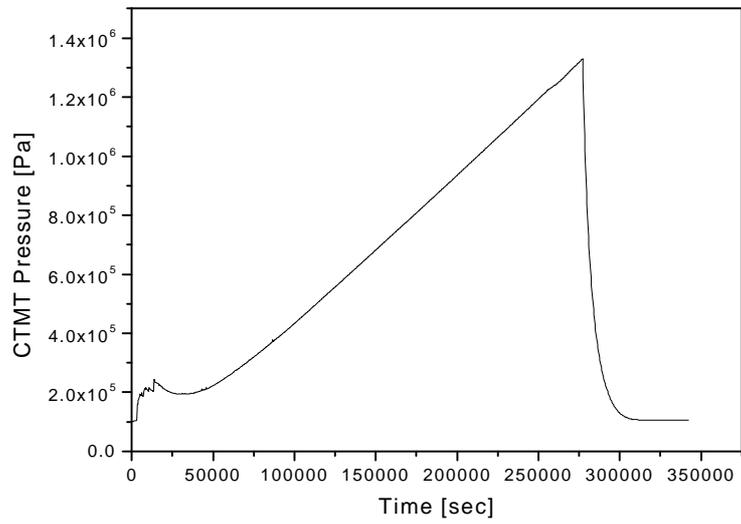
5. SGTR RDF EF



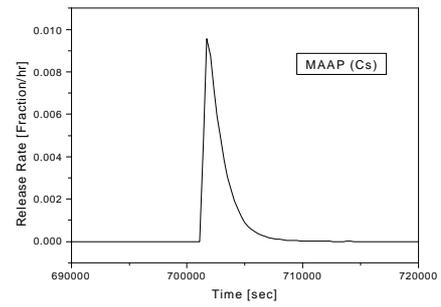
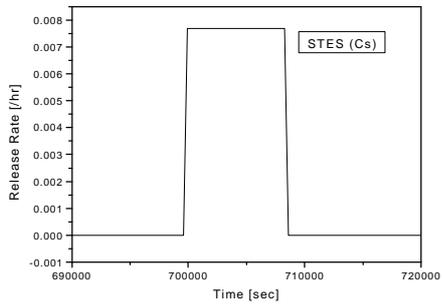
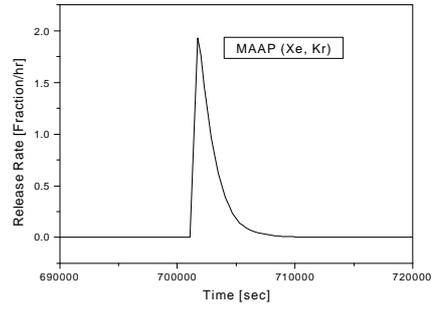
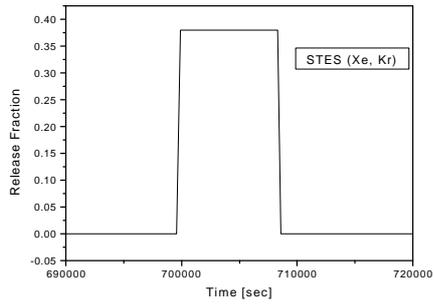
6. SGTR RDF EF



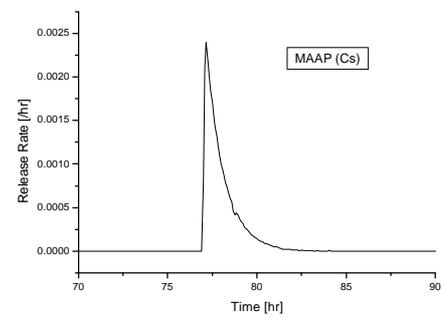
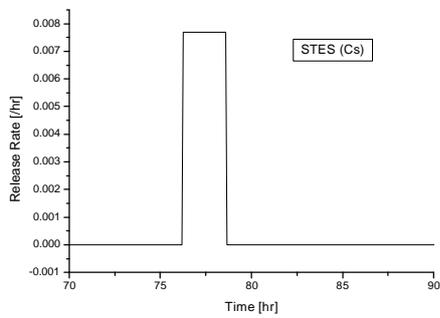
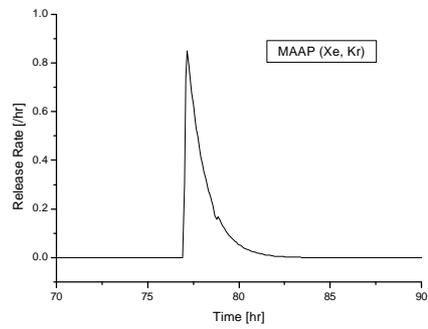
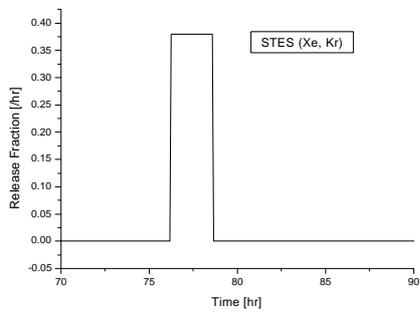
7. (3&4 SBO)



8. (3&4 SBO)



9. 1 SBO MAAP STES



10. 3&4 SBO MAAP STES