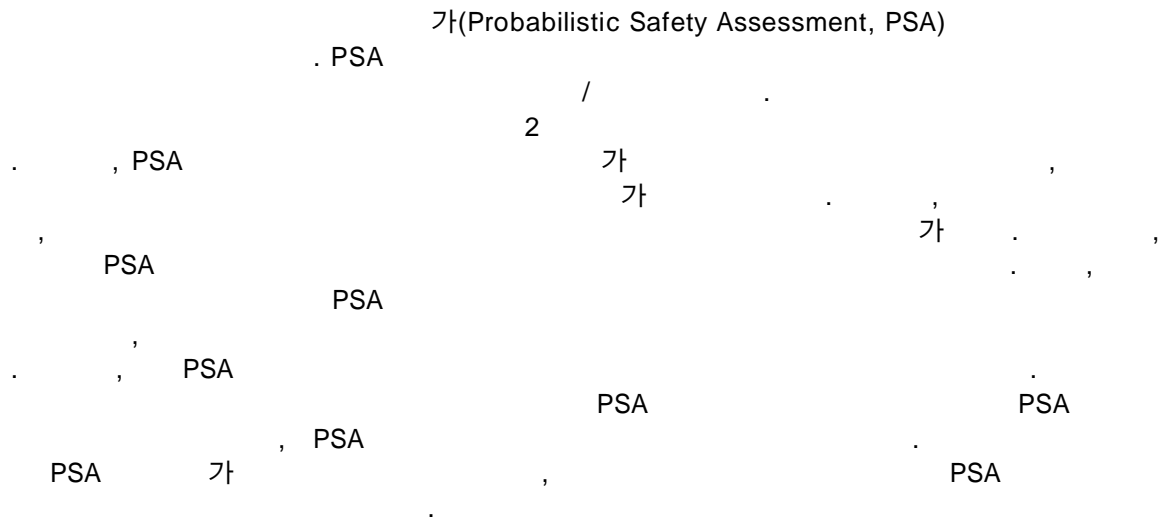


PSA Development of a PSA Standard Model in Korea for Risk-informed Applications

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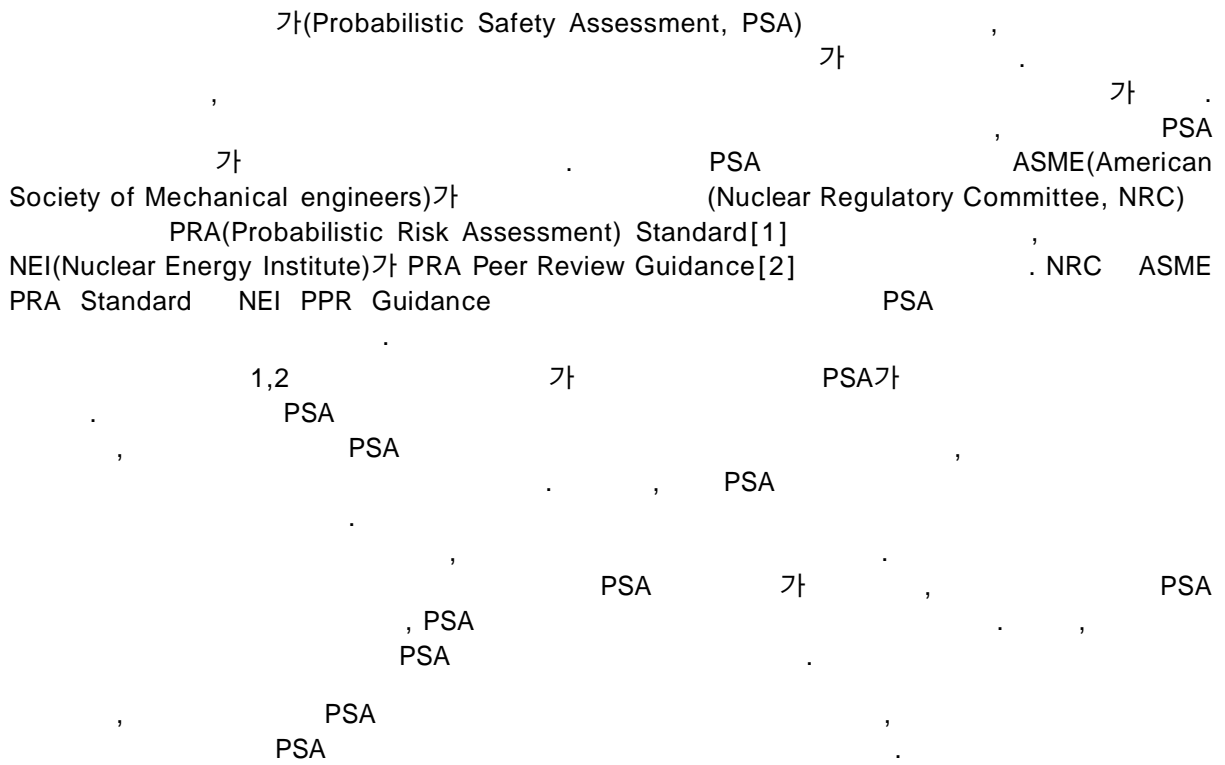


Abstract

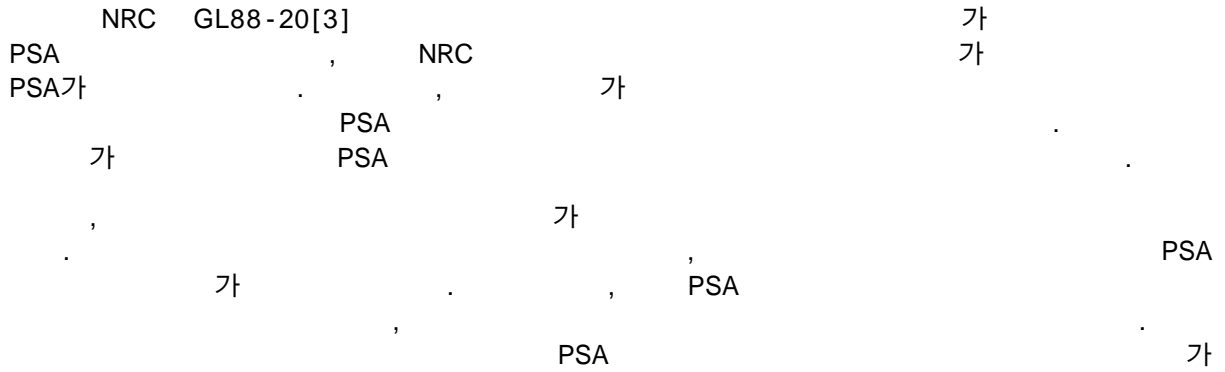
In this paper, we will show the direction for the development of a PSA (Probabilistic Safety Assessment) standard model. The Risk-informed applications have been studying and implementing to improve the safety and economy of the Nuclear Power Plants. In Korea, the government recognized the importance of the Risk-informed applications and addressed to import them in the policy of nuclear safety. PSA is a method to evaluate

the safety of a nuclear power plant as a main element for the Risk-informed applications. However, the uncertainty of the result is dependent on the used method, data and level of analysis. To solve this problem, the USA has been developing the standard guidance to evaluate the quality of PSA. Presently, the PSA for all of the operating NPPs except Ulchin unit 1&2 in Korea was performed or is under performance. But, the first objective of this PSA is to identify the weaknesses on the design. Therefore, there is lack of the detail of an analysis and the independent review to certificate the technical basis. For that reason, we can't use this model as a decision-making tool for Risk-informed applications. To get an appropriate PSA model for the Risk-informed regulation and application, it is required to identify the items needed improvement, to ensure the basis and to establish the requirements for the PSA quality evaluation. Therefore, in this paper, we will review the requirements developed in the USA for a PSA standard model, and will find the method to improve the quality of domestic PSA through the review of Ulchin 3&4 PSA model.

1.



2. PSA



PSA 가 ,
PSA

3. PSA

3.1 PSA

PSA 가 ,
PSA
ASME PRA Standard NEI PPR

ASME PRA Standard NEI PPR
ASME PRA Standard , NEI PPR
(Check List)

NEI PPR Guidance PSA

- NEI PPR :
- (1) PSA ,
 - (2) PSA ,
 - (3) PSA ,

NEI PPR 1 11 가 PSA
1 4 가 , PSA

1. NEI PPR

	PRA
IE	
AS	가
TH	
SY	
DA	
HR	
DE	
ST	
QU	
L2	
MU	

가 , 1 가 ,
 가 ,
 가 ,
 ,
 , PSA 가 :
 (1) ; 가
 (2) ; 가
 (3) 가 ; 가 가
 가 가 가
 PSA
 PSA
 PSA

NEI PPR :

■ 1 (Grade 1)

- NRC GL 88-20

- PSA 1
- ,
- 가
- GL 88-20
- 가
-
- Licensing

■ 2 (Grade 2)

- 1 가 가 가
- GL 89-10 MOV
- NRC
-

■ 3 (Grade 3)

- PSA 가
- 1, 2 가 가 가
- Grades QA
- IST (In-Service Test)
- ISI (In-Service Inspection)
- Backfit Calculations
- Reduce or Eliminate Licensing Commitments
- 가 가
-

■ 4 (Grade 4)

- , , 가 가
- 1,2,3 가 가 가
- 가
-

, 3 4 3,4 PSA PSA

3.2

3,4 PSA

NEI PPR

가

3.2.1

1 11

PSA가 (Backup)
 PSA
 가 PSA
 PSA

11 PSA
 / (Maintenance and Update Process)
 PSA 가가 /

가 PSA

PSA 3,4 가
 NEI NEI Grade 3 PSA
 Grade 2

3.2.2

11 PSA 가 11
 “ (Structural Response) ” “ (Containment Performance) ”

- (Initiating Event):
 - 가 4 4
 - IE-6
 - 4~8
 - PSA
 - IE-8, IE-10
 - 1,2,3, 4
 - 가
 - 가 : 가
 - IE-6:
 - IE-8:
 - IE-10:
 - IE-17: FMEA

- 가(Accident Sequence Evaluation): 가
 - PSA
 - 가
 - AS-5:
 - AS-12: RCP Seal Cooling

- (Thermal Hydraulic Analysis): PSA
 - 가
 - PSA
 - TH-4: 가
 - TH-5: 가

- (System Analysis): SY-7
 - 가
 - PSA
 - 가
 - SY-16
 - 가
 - SY-21
 - 가
 - 가
 - SY-7:
 - SY-11:
 - SY-16:
 - SY-21: 가

- (Data Analysis):
 - DA-4:
 - DA-12/14: 가 NUREG/CR-4780
 - DA-15/16: 가 가

- (Human Reliability Analysis):
 - 가
 - 가 Case A Case B 가
 - 가
 - Case A= HEP1 x Sys1 (HEP1: 1, Sys1: 1)

- Case B= HEP2 x Sys2 (HEP2: 2, Sys2: 2)
- Case A = Case B, HEP1 > HEP2, Sys1 < Sys2

, Case A Case B , Case A
 가 , Case B
 가 , Case A Case B
 / 가
 가

- (Dependencies): DE-5 가
 / DE-9 NUREG/CR-4780
 가 , DE-10 DE-11 가
 /

- DE-5:
- DE-9: NUREG/CR-4780
- DE-10:
- DE-11:

- (Quantification): KIRAP, FORTE PSA
 4
 가 가
 MGL
 -factor 가

- QU-11:
- QU-23:
- QU-27/28: DB 가
- QU-30: 가

3.2.3

가 2 3,4 가 NEI PPR
 가 2 2 , 3 3 , 4 4 가 ,
 가 2 2 54 , 3 81 , 4 108
 가 70 2
 3

2. 3,4 가

	NEI Guide	2	3	4
SY-1	/ FMEA / grade 3 /	O	X	X
SY-2	grade 3	O	X	X
SY-3		O	O	X
SY-4		O	O	O
SY-5	AOP grade 3	X	X	X
SY-6	grade 3	O	X	X
SY-7	CCF strainer	O	O	X
SY-8	, AOP	O	O	X
SY-9	가	O	O	O
SY-10	room cooling	O	X	X
SY-11	steam binding	O	O	X
SY-12		O	X	X
SY-13	AFWS , CST	O	X	X
SY-14		O	O	O
SY-15		O	O	X
SY-16	, FMEA	X	X	X
SY-17	grade 3	O	X	X
SY-18		N/A	N/A	O
SY-19		O	O	O
SY-20		X	O	O
SY-21		N/A	O	O
SY-22	가	O	O	X
SY-23	가 / -> grade 3	O	X	X
SY-24	grade 3	O	X	X
SY-25	grade 3	O	X	X
SY-26	grade 3	O	X	X
SY-27	grade 3	O	X	X

2 NEI PPR 3,4 PSA
 PSA 4 , 4
 . 3
 3 PSA

3.3 PSA

NEI PPR 11

3,4

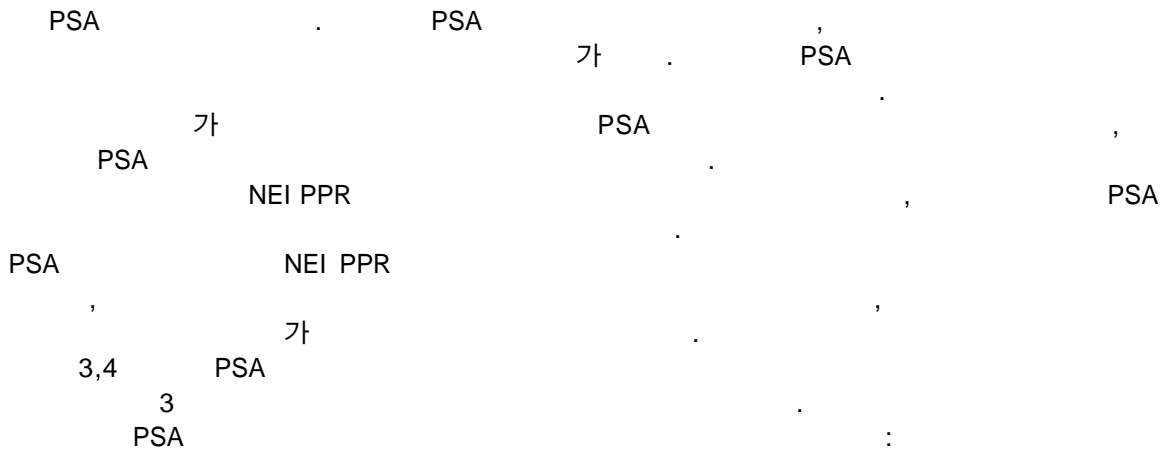
PSA

3

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-
-
-
- FMEA
- CCF(Common Cause Failure) 가 (Grouping) CCF
- 가 ,
- CST(Condensate Storage Tank)
- T&M(Test and Maintenance), I&C(Instrumentation and Control) ;
- ; FMEA
- CCF: CCF
- ; , ,
- 가
- T&M, I&C :
-
-
- (AOP,)

4.



- PSA 가 ,
 - PSA 가 ,
 - / 가 ,
- , PSA

Acknowledgment

5.

1. Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications Rev. 13A, May 11, 2001, ASME
2. Industry PRA Peer Review Process Guidelines Rev. A3, 2000, NEI
3. NRC Generic Letter 88-20, " Individual Plant Examination of External Events for Severe Accident Vulnerabilities "
4. 3,4 PSA Report