

(Maintenance and Plant Shutdown for Steam Generator)

991

가 . 1 2 가
가 가 , 가 가 .
가 , 2 , 1 2 ,
J- , 가 .

Abstract

The steam generator problems in the Korea rank second, behind refueling outages, as the most significant contributor to lost generation. The steam generator is the boundary between the primary and secondary systems, and is the major component in the PWR. The most of steam generator damage is a tube. Tube sleeving can be an effective repair process providing a finite increase in the useful operating life of a degraded steam generator. The other failure of steam generator is invasion of loose parts, moisture separator corrosion, decrease of carbon steel J-nozzle thickness, steam leakage through the gasket sealing. The diversity of steam generator damage mechanisms means that no one solution is likely to resolve all problems. The monitoring and maintenance of steam generator internals are important tasks in the operation and care of steam generators. Steam generator maintenance guideline as a way to develop a maintenance plant provides invaluable information on how to minimize repair costs, increase and maintain efficiency, and minimize unplanned shutdowns.

1.

2

가 가

가

가

1

2.

10

가 가

'76

23

'75

'95

9

20%

5 가

1

[14].

(Tube)

5

가 4

, 2

(Hand Hole)

1

[2].

2.1

1

1986. 2. 19

2

가

, 1990. 3. 16

(IGSCC)

(IGA)

1

가

1994. 11. 8

가

1

3

[1].

2.2

2

가

1989. 1. 2

[1].

2.3

2

(N-16)

1996. 8. 7

8

2

< 1 >

'86. 2. 19	1	707 24	○	○ (1)
'89. 1. 2	2	49 34	○ 2	○
'90. 3. 16	1	344 05	○ IGSCC IGA	○ (3)
'94. 11. 8	1	1321 09	○ 가	○ ○
'96. 8. 7	2	594 44	○	○ (8) ○ SG 2

< 2 >

PWR

(EPRI)

(/ %)			SG	SG	
1980- 1984	57.20	12.80	4.20	1.50	24.30
1992	73.91	10.24	2.66	0.65	12.54
1995	77	11	2	0	10

< 3 >

(/ %)			SG	
1978- 1993	79.3 (67.9)	14.2 (20.8)	0.006 (0.8)	6.5 (10.5)
1994	87.4 (66.5)	12.8 (16.7)	1.0 (14.8)	6.0 (2.0)
1978- 1994	80.2 (67.8)	14.1 (20.6)	0.01 (1.67)	5.7 (9.93)
1. () :	1	(O/H)	
2. SG :				

3.

3.1

가 () (Wastage) 가 (Denting) , 1970 / (ODSCC/IGA; Outside Diameter Stress Corrosion Cracking/Intergranular Attack), 1 (PWSCC; Primary Water(Side) Stress Corrosion Cracking) . 1979 . 1983 (Wear) 가 , 1996 2 / , 1 (Fretting Wear) 70% . '97 '98 IDSCC (Inside Diameter Stress Corrosion Cracking) 15% , ODSCC 60% 50% 10% , Fretting 가 '98 10% [14]. 가 가 Alloy-600 MA , Alloy-600 TT 가 (TSP; Tube Support Plate), (AVB; Anti-Vibration Bar) Denting (Pitting) . Alloy-600 TT 1 2 . Monel 400 . Alloy-800 MA 690 TT Simens/KWU (Wastage) Fretting . (N-16,), , ()가 , 가 (SGTR; Steam Generator Tube Rupture) , 11 , 1 1 . 11 5 ODSCC, , PWSCC, Wastage 2000 2 Indian Point 2 , U-Bend , McGuire . . 7 가 32 250mm , " (4 ") . 360° 2 , 가 20mm 2 Bulge 가 1 . 11 425 /min 2,900 /min .

3.2

가 (Removable plug) , 가 (Weld plug) , 가 (Plugging) 가

가 (Sleeving) .

600 TT, 690 690 TT, 800

1 1988 1998

('99) 가 (Weldless sleeve; PLUSS sleeve) 가 1998 Slovenia Krsko 6m [14]. 1

573mm (1.2mm) Sleeving rate 41sleeve/plug 가 41 (Nickel Plating) 1

가 가 [10].

1 (PWSCC) 12mm (Permeability)

(ECT; Eddy Current Test) , (UT; Ultrasonic Test) 가 ,

Shot peening 가 가 ,

가

'85 65 '94 Shot peening 10

1, 2

3.3

가 1 '96. 8. 7 20 2

1
[10].

"EPRI SG Program Report"

'93 235 77
[13]. 2

100%

“ ”

가

가

4.

4.1

1 2 J- J- J-
가 가 J-
3

[2].

4.2

1 2 0.25%
2
('89).
100% 0.1119% [2].

4.3 1

(Swirl Vane) 1 가 가

2 '96 1
 , '98 13 Blade . 1999
 가 (16") 1 (19.5") 2
 1 32 26
 Swirl Vane (A 285
 Gr. C) 가 (FAC; Flow Accelerated
 Corrosion) 가 가
 (SA 517 Gr. B)
 A 285 Gr. C 가 6.5mm/20 SA 517 Gr. B 0.7mm
 /20 (1 1 SA 517 Gr. B).
 (pH) FAC 가
 pH ETA(Ethylene Tetra Armine)
 FAC . 1 '98 9 ETA
 [10].

4.4 (Man way) 2
 가 가 2 가
 , 가 가
 . 1 2 가 가
 (Mock up) , 1 ('95. 7,
 '95. 8, '97. 10) 2 ('94. 10) 가 , 3
 ('94. 9) 4 '94. 9 Furmanite
 [10]. Salam 1 Furmanite
 . Prairie Island 1 '83. 3 , diablo Canyon 2
 '99. 8 2
 가 .
 , 1, 2 2
 가 2 가
 가 . 1, 2
 2 가 ,

4.5
 , (TS; Tube Sheet)

1, 2 , '95 59 [14].
(Broached Hole)
가 .

5.

가 ,
'80
('97 10 47)
가
(EFPY; Effective Full Power
Years) 3.6 19.6EFPY . 1996 11.3EFPY .
38 365 60
2,141man-rems . 3,700 2 3,000
Surry 2
45%, 6% [14].

5.1

Acceptance) , , PA (Public
가(,), 가
가
가, 가
가
가
가
가 (PA) .
PA

5.2

1 1 가 , 1999
60
가
690TT ,

2 U-bend U-bend 가 .
가 (Sludge collector) , 2
Wet Lay-up 가 . [5].

5.3 / 가 가
2 가 ,

가 가 (Thermal sleeve) ,
Elevated Pocket
2 가 ,
가 (pH)
2 1
1
가 [9].

6.
가 가 가 , J-
가 , 가
(1) 가 2 가
가 가
(2)

(3)

2

(4)

< >

- [1] , 1999, " "
- [2] , , 1998, " "
- [3] , 1997. 3, " "
- [4] , 1996. 12, " "
- [5] 1 , 1999. 4. 6. " 1 "
- [6] / , 1997. 8, " "
- [7] , 1997 , 31 , " ", p133 ' ODSCC ' "
- [8] , 1997. 9, " 10 "
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