ERRATA

American National Standard
Radioactive Source Term for Normal
Operation of Light Water Reactors,
ANSI/ANS-18.1-1999

Page 1, Section 3.2
The second sentence of the paragraph that currently reads:

> *"Recalculated fluid stream concentrations shall be based on the adjustment factors provided in Tables 5, 6, and 7, which are given to only one or two significant figures."*

should be changed to read:

> *"Recalculated fluid stream concentrations shall be based on the numerical values provided in Tables 5, 6, and 7, which are given to only one or two significant figures."*

Page 3, Table 2
The value for the "Reactor coolant letdown flow rate (yearly average for boron control) should be changed from 5.0 E+3 lb/hr to 5.0 E+2 lb/hr. The revised Table 2 should read as indicated in the attached.

Page 4, Table 3
The values for the "Weight of secondary side water in all steam generators" should be changed from 4.5 E+5 lbs and 2.0 E+5 kg to 1.0 E+5 lbs and 4.5 E+4 kg, respectively. The value for the "Reactor coolant letdown flow rate (yearly average for boron control)" should be changed from 5.0 E+3 lb/hr to 5.0 E+2 lb/hr. The revised Table 3 should read as indicated in the attached.

Page 6, Table 6
The Xe-137 value for the "Secondary Coolant" steam activity should be changed from 7.1 E-8 to 7.1 E-9. The Y-93 value for the "Secondary Coolant" water activity should be changed from 1.2 E-8 to 1.2 E-7. The revised Table 6 should read as indicated in the attached.

Page 11, Table 10
The variable "W" should be replaced by "WP" in the equations defining the adjustment factors. The revised Table 10 should read as indicated in the attached.

Pages 12 & 13, Table 11
The variable "W" should be replaced by "WP" in the equations defining the adjustment factors. The definition of the variable r_i should refer to Note ^{f} of Table 9 rather than Note ^{e}. The revised Table 11 should read as indicated in the attached.

Page 14, Table 12
The definition of the variable r_i should refer to Note (f) of Table 9 rather than Note (e).

Table 2
Parameters Used to Describe the Reference Pressurized Water Reactor with U-Tube Steam Generators

Parameter	Symbol	Units	Nominal Value
Thermal power	P	MWt	3.4 E+3[a]
Steam flow rate	FS	lb/hr	1.5 E+7
		kg/s	1.9 E+3
Weight of water in reactor coolant system	WP	lb	5.5 E+5
		kg	2.5 E+5
Weight of secondary side water in all steam generators	WS	lb	4.5 E+5
		kg	2.0 E+5
Reactor coolant letdown flow rate (purification)	FD	lb/hr	3.7 E+4
		kg/s	4.7
Reactor coolant letdown flow rate (yearly average for boron control)	FB	lb/hr	5.0 E+2
		kg/s	6.3 E-2
Steam generator blowdown flow rate (total)	FBD	lb/hr	7.5 E+4
		kg/s	9.5
Fraction of radioactivity in blowdown stream which is not returned to the secondary coolant system	NBD	-	1.0
Flow through the purification system cation demineralizer	FA	lb/hr	3.7 E+3
		kg/s	4.7 E-1
Ratio of condensate demineralizer flow rate to the total steam flow rate	NC	-	0.0
Fraction of the noble gas activity in the letdown stream which is not returned to the reactor coolant system (not including the boron recovery system).	Y	-	0.0

[a] 3.4 E+3 = 3.4×10^3. This nomenclature is used in subsequent tables in this standard.

Table 3
Parameters Used to Describe the Reference Pressurized Water Reactor with Once-Through Steam Generators

Parameter	Symbol	Units	Nominal Value
Thermal power	P	MWt	3.4 E+3[a]
Steam flow rate	FS	lb/hr	1.5 E+7
		kg/s	1.9 E+3
Weight of water in reactor coolant system	WP	lb	5.5 E+5
		kg	2.5 E+5
Weight of secondary side water in all steam generators	WS	lb	1.0 E+5
		kg	4.5 E+4
Reactor coolant letdown flow rate (purification)	FD	lb/hr	3.7 E+4
		kg/s	4.7
Reactor coolant letdown flow rate (yearly average for boron control)	FB	lb/hr	5.0 E+2
		kg/s	6.3 E-2
Flow through the purification system cation demineralizer	FA	lb/hr	3.7 E+3
		kg/s	4.7 E-1
Ratio of condensate demineralizer flow rate to the total steam flow rate	NC	-	6.5 E-1
Fraction of the noble gas activity in the letdown stream which is not returned to the reactor coolant system (not including the boron recovery system)	Y	-	0.0

[a] 3.4 E+3 = 3.4 x 10^3. This nomenclature is used in subsequent tables in this standard.

Table 6
Numerical Values - Concentrations in Principal Fluid Streams of the Reference PWR with U-Tube Steam Generators
(μCi/g)

Nuclide	Reactor Coolant[a]	Secondary Coolant[b]	
		Water[c]	Steam[d]
Class 1			
Kr-85m	1.6 E-2	nil	3.4 E-9
Kr-85	4.3 E-1	nil	8.9 E-8
Kr-87	1.7 E-2	nil	1.0 E-8
Kr-88	1.8 E-2	nil	3.8 E-9
Xe-131m	7.3 E-1	nil	1.5 E-7
Xe-133m	7.0 E-2	nil	1.5 E-8
Xe-133	2.9 E-2	nil	6.0 E-9
Xe-135m	1.3 E-1	nil	2.7 E-8
Xe-135	6.7 E-2	nil	1.4 E-8
Xe-137	3.4 E-2	nil	7.1 E-9
Xe-138	6.1 E-2	nil	1.3 E-8
Class 2			
Br-84	1.6 E-2	7.5 E-8	7.5 E-10
I-131	2.0 E-3	8.1 E-8	8.1 E-10
I-132	6.0 E-2	8.9 E-7	8.9 E-9
I-133	2.6 E-2	9.0 E-7	9.0 E-9
I-134	1.0 E-1	7.2 E-7	7.2 E-9
I-135	5.5 E-2	1.4 E-6	1.4 E-8
Class 3			
Rb-88	1.9 E-1	5.3 E-7	2.6 E-9
Cs-134	3.7 E-5	1.7 E-9	9.0 E-12
Cs-136	8.7 E-4	4.0 E-8	2.0 E-10
Cs-137, Ba-137m[e]	5.3 E-5	2.5 E-9	1.2 E-11
Class 4			
N-16	4.0 E+1	1.0 E-6	1.0 E-7
Class 5			
H-3	1.0	1.0 E-3	1.0 E-3

Nuclide	Reactor Coolant[a]	Secondary Coolant[b]	
		Water[c]	Steam[d]
Class 6			
Na-24	4.7 E-2	1.5 E-6	7.5 E-9
Cr-51	3.1 E-3	1.3 E-7	6.3 E-10
Mn-54	1.6 E-3	6.5 E-8	3.3 E-10
Fe-55	1.2 E-3	4.9 E-8	2.5 E-10
Fe-59	3.0 E-4	1.2 E-8	6.1 E-11
Co-58	4.6 E-3	1.9 E-7	9.4 E-10
Co-60	5.3 E-4	2.2 E-8	1.1 E-10
Zn-65	5.1 E-4	2.1 E-8	1.0 E-10
Sr-89	1.4 E-4	5.7 E-9	2.9 E-11
Sr-90	1.2 E-5	4.9 E-10	2.4 E-12
Sr-91	9.6 E-4	2.8 E-8	1.4 E-10
Y-91m	4.6 E-4	3.2 E-9	1.6 E-11
Y-91	5.2 E-6	2.1 E-10	1.1 E-12
Y-93	4.2 E-3	1.2 E-7	6.1 E-10
Zr-95	3.9 E-4	1.6 E-8	7.9 E-11
Nb-95	2.8 E-4	1.1 E-8	5.7 E-11
Mo-99	6.4 E-3	2.5 E-7	1.2 E-9
Tc-99m	4.7 E-3	1.1 E-7	5.7 E-10
Ru-103	7.5 E-3	3.1 E-7	1.6 E-9
Ru-106	9.0 E-2	3.7 E-6	1.8 E-8
Ag-110m	1.3 E-3	5.3 E-8	2.7 E-10
Te-129m	1.9 E-4	7.8 E-9	3.9 E-11
Te-129	2.4 E-2	2.2 E-7	1.1 E-9
Te-131m	1.5 E-3	5.4 E-8	2.7 E-10
Te-131	7.7 E-3	2.9 E-8	1.5 E-10
Te-132	1.7 E-3	6.6 E-8	3.3 E-10
Ba-140	1.3 E-2	5.2 E-7	2.6 E-9
La-140	2.5 E-2	9.3 E-7	4.6 E-9
Ce-141	1.5 E-4	6.1 E-9	3.1 E-11
Ce-143	2.8 E-3	1.0 E-7	5.1 E-10
Ce-144	4.0 E-3	1.6 E-7	8.2 E-10
W-187	2.5 E-3	8.7 E-8	4.4 E-10
Np-239	2.2 E-3	8.4 E-8	4.2 E-10

[a] The concentrations are for reactor coolant entering the letdown line
[b] Based on primary-to-secondary leakage of 75 lbs/day (3.9 E-4 kg/sec)
[c] The concentrations are for water in a steam generator
[d] The concentrations are for steam leaving a steam generator
[e] These nuclides are in secular equilibrium; other radionuclide concentrations are those of the parent

Table 10
Adjustment factors for BWRs

Element Class	Adjustment Factor	
	Reactor Water	Reactor Steam
1	1.0[a]	1.0[a]
2	$\frac{P \cdot WP_n \cdot (R_{n2} + \lambda)}{WP \cdot P_n \cdot (R_2 + \lambda)}$	$\frac{P \cdot WP_n \cdot (R_{n2} + \lambda)}{WP \cdot P_n \cdot (R_2 + \lambda)}$
3	$\frac{P \cdot WP_n \cdot (R_{n3} + \lambda)}{WP \cdot P_n \cdot (R_3 + \lambda)}$	$\frac{P \cdot WP_n \cdot (R_{n3} + \lambda)}{WP \cdot P_n \cdot (R_3 + \lambda)}$
4	1.0[b]	1.0[b]
5	[c]	[c]
6	$\frac{P \cdot WP_n \cdot (R_{n6} + \lambda)}{WP \cdot P_n \cdot (R_6 + \lambda)}$	$\frac{P \cdot WP_n \cdot (R_{n6} + \lambda)}{WP \cdot P_n \cdot (R_6 + \lambda)}$
6 (Zn-65)[d]	10	10

Where:

The subscript n refers to the nominal value of the variable

λ = the radionuclide decay constant

R_{ni} = nominal removal rate for element class i from Table 8

R_i = removal rate for element class shall be calculated by equation in Note [e] of Table 8

[a] Assumes that the ratio of power to steam flow is essentially the same for all BWRs.

[b] Assumes the ratio of coolant mass to power level is approximately constant. When hydrogen water chemistry is employed, the adjustment factors shall be 0.8 in reactor water and 5.0 in reactor steam.

[c] The tritium concentration in the reactor water and steam is expected to be equal and is controlled by the loss of water from the main coolant system by evaporation or leakage

[d] Adjustment factors are for zinc addition plants using natural zinc. Use of depleted zinc would result in a lower adjustment factor and the decrease is a function of the reduction of Zn-64.

Table 11
Adjustment Factors for PWRs with U-Tube Steam Generators

Element Class	Adjustment Factor		
	Reactor Water (f_i)	Secondary Coolant	
		Water	Steam
1	$\frac{P \cdot WP_n \cdot (R_{n1} + \lambda)}{WP \cdot P_n \cdot (R_1 + \lambda)}$	a	$\frac{FS_n}{FS} \cdot f_1$
2	$\frac{P \cdot WP_n \cdot (R_{n2} + \lambda)}{WP \cdot P_n \cdot (R_2 + \lambda)}$	$\frac{WS_n \cdot (r_{n2} + \lambda)}{WS \cdot (r_2 + \lambda)} \cdot f_2$	$\frac{WS_n \cdot (r_{n2} + \lambda)}{WS \cdot (r_2 + \lambda)} \cdot f_2$
3	$\frac{P \cdot WP_n \cdot (R_{n3} + \lambda)}{WP \cdot P_n \cdot (R_3 + \lambda)}$	$\frac{WS_n \cdot (r_{n3} + \lambda)}{WS \cdot (r_3 + \lambda)} \cdot f_3$	$\frac{WS_n \cdot (r_{n3} + \lambda)}{WS \cdot (r_3 + \lambda)} \cdot f_3$
4	1.0	$\frac{WS_n}{WS}$	$\frac{WS_n}{WS}$
5	b	b	b
6	$\frac{P \cdot WP_n \cdot (R_{n6} + \lambda)}{WP \cdot P_n \cdot (R_6 + \lambda)}$	$\frac{WS_n \cdot (r_{n6} + \lambda)}{WS \cdot (r_6 + \lambda)} \cdot f_6$	$\frac{WS_n \cdot (r_{n6} + \lambda)}{WS \cdot (r_6 + \lambda)} \cdot f_6$
6 (Zn-65)[c]	10	10	10
6 (Co-58)[d]	10	10	10

Where:

The subscript n refers to the nominal value of the variable

λ = the radionuclide decay constant

R_{ni} = nominal removal rate for element class i from Table 9

R_i = removal rate for element class i calculated by equations in Note [b] of Table 9

r_{ni} = nominal removal rate for element class i from Table 9

r_i = removal rate for element class shall be calculated by equation in Note [f] of Table 9

f_i = reactor water adjustment factor used in the secondary coolant adjustment factor, i.e. $f_i = f_1$ for element class 1, $f_i = f_2$ for element class 2, etc.

[a] Noble gases are rapidly transported out of the water in the steam generator and swept out of the vessel in the steam. Therefore, the concentration in the water is negligible and the concentration in the steam is approximately equal to the release rate to the steam generator divided by the steam flow rate. These noble gases are removed from the system at the main condenser.

[b] The concentration of tritium is a function of the inventory of tritiated liquids in the plant, the rate

Table 12
Adjustment Factors for PWRs with Once-Through Steam Generators

Element Class	Adjustment Factor	
	Reactor Water (f_i)	**Secondary Coolant**
1	$\frac{P \cdot WP_n \cdot (R_{n1} + \lambda)}{WP \cdot P_n \cdot (R_1 + \lambda)}$	$\frac{FS_n}{FS} \cdot f_1$
2	$\frac{P \cdot WP_n \cdot (R_{n2} + \lambda)}{WP \cdot P_n \cdot (R_2 + \lambda)}$	$\frac{(\lambda + r_{n2}) \cdot WS_n}{(\lambda + r_2) \cdot WS} \cdot f_2$
3	$\frac{P \cdot WP_n \cdot (R_{n3} + \lambda)}{WP \cdot P_n \cdot (R_3 + \lambda)}$	$\frac{(\lambda + r_{n3}) \cdot WS_n}{(\lambda + r_3) \cdot WS} \cdot f_3$
4	1.0	$\frac{WS_n}{WS}$
5	[a]	[a]
6	$\frac{P \cdot WP_n \cdot (R_{n6} + \lambda)}{WP \cdot P_n \cdot (R_6 + \lambda)}$	$\frac{(\lambda + r_{n6}) \cdot WS_n}{(\lambda + r_6) \cdot WS} \cdot f_6$

Where:

The subscript n refers to the nominal value of the variable

λ = the radionuclide decay constant

R_{ni} = nominal removal rate for element class i from Table 9

R_i = removal rate for element class i calculated by equations in Note (b) of Table 9

r_{ni} = nominal removal rate for element class i from Table 9

r_i = removal rate for element class shall be calculated by equation in Note (f) of Table 9

f_i = reactor water adjustment factor used in the secondary coolant adjustment factor, i.e. $f_i = f_1$ for element class 1, $f_i = f_2$ for element class 2, etc.

[a] The concentration of tritium is a function of the inventory of tritiated liquids in the plant, the rate of production of tritium due to activation in the reactor coolant, the rate of release from the fuel, and the extent to which tritiated water is recycled or discharged from the plant. The tritium concentration given in Tables 6 and 7 is representative of PWRs with a moderate amount of tritium recycle.

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[c] Adjustment factors are for zinc addition plants using natural zinc. Use of depleted zinc would result in a lower adjustment factor and the decrease is a function of the reduction of Zn-64.

[d] Adjustment factors are for zinc addition plants using natural or depleted zinc.