ENCLOSURE 3

--- Not Regulatory Positions ---

ALTERNATIVE FUEL HANDLING ACCIDENT TRANSPORT METHEDOLOGY

ASSUMPTIONS FOR EVALUATING THE RADIOLOGICAL CONSEQUENCES OF THE ALTERNATIVE FUEL HANDLING ACCIDENT TRANSPORT METHEDOLOGY

This calculational tool provides input parameters for the alternative DBA FHA tranport model and is ment for s only. This Enclosure provides a general description of the alternative fuel handling accident transport methodo (herein referred to as the alternative model) within the spent fuel- or reactor pool water. This methodology can applied when the chemical form of iodine within the fuel pin gap is derived from the initial conditions under w operations are taking place. These initial conditions consider, among others: a time period between power ope the movement of recently irradiate fuel to account for both radioactive decay and less decay power; the use of s or reactor pool water temperature to determine internal gas temperature and pressure; and, the availability of io evolve.

The alternative model is incompatible with past models due to fundamental assumptions of the chemical form follows:

> Past Models – Effectively assume the initial conditions of the damaged fuel bundle is at operating temperature and pressure. A small fraction of the available iodine inventory in the fuel pin gap (5 available for release to the pool water instantaneously. The physical form of iodine is gaseous, and chemical form is as elemental iodine, or I2, (4.85 percent) and methyl iodide, or organic iodide, (0 percent). To model the scrubbing effects of iodine in the pool water, a single lumped parameter ha assumed to represent not only the iodine immediately released following the postulated fuel ruptur represented re-evolution of iodine. The re-evolution release was assigned to the immediate release purposes of determining the decontamination factor for simplicity.

> Alternative Model – Assumes the entire fuel pin gap inventory of iodine (100 percent) is available between two separate release phases; the first from the initial gaseous release, the second from re-e Under pool water temperature conditions, the physical form of iodine is likely a solid as CsI, I2 is s methyl iodide as a liquid at the time of the postulated rupture and therefore necessarily available fo instantaneous release. It is readily absorbed in the pool water and slowly re-evolved over a long pe time. The first phase conservatively assumes I2 (4.85 percent) and methyl iodine (0.15 percent) to and subsequently decontaminated by passage through the overlying pool of water. The second pha conservatively assumes CsI (0.95 percent) to completely dissociate into the pool water then slowly into the building atmosphere as I2 due to the low pool water pH.

It is therefore non-conservative to adopt a portion of either model as the initial conditions to derive the chemica iodine are fundamentally different.

The report providing the technical basis for the alternative DBA FHA model can be found under ADAMS Acc Number ML19248C704. The report describes the re-analysis of the original studies using modern data analysi confirm results and conclusions.

Source Term Definition

Acceptable assumptions regarding core inventory and the release of radionuclides from
the fuel are provided in Regulatory Position 3 of this guide. Like-wise, RG 1.183, Revision 1, Appendix J, pro
acceptable analytical technique to compute cycle-specific non-LOCA fuel pin gap inventories. Appendix J pro
example calculation to illustrate the potential improvement in radiological source term achievable by calculatir
bounding gap fractions. In this example, the licensee elects to calculate gap inventories based upon cycle spec
designs and power profiles. The resulting gap fractions are significantly lower than the generic, bounding valu
Regulatory Position 3. The following assumptions also apply.

> The fission product release from the breached fuel is based on Regulatory Guide 1.183, Revision (
> Regulatory Position 3.2 and the estimate of the number of fuel rods breached. Radionuclides that :
> considered include xenons, kryptons, halogens, cesiums, and rubidiums. The chemical form of rac
> released from the fuel to the pool should be assumed to be 95 percent CsI, 4.85 percent I2, and 0.1
>
> All the gap activity in the damaged rods is assumed to be released over two phases:
>
> > Phase 1 - the instantaneous release from the rising bubbles. I2 and organic iodin
> > conservatively assumed to be in vapor form and subsequently decontaminated by
> > through the overlaying pool of water into the building atmosphere. The retention
> > gases in the water in the fuel pool or reactor cavity is negligible (i.e., decontamin
> > of 1). Particulate radionuclides released from the fuel are assumed to be retained
> > water in the fuel pool or reactor cavity (i.e., infinite decontamination factor).
> >
> > Phase 2 - the protected release of CsI re-evolving as I2. CsI is conservatively ass
> > completely dissociate into the pool water. Due to the low pH of the pool water, (
> > Phase 1 absorbed I2 and organic iodine) then slowly re-evolve as I2 into the builc
> > atmosphere.

Phase 1 Release – Initial Gaseous Release and Water Depth

An overall iodine DF is a function of bubble size and rise time through the water column, both of which are fur
fuel pin pressure. If the water depth is 19 feet or greater, an overall effective iodine DF for I2 and organic iodi
computed based on a best-estimate rod pin pressure for the limiting fuel rods in the reactor core at the most lim
in life. The time period between reactor shutdown and the movement of fuel may be used to compute radioacti
and less decay power. The use of pool water temperature based on a full-core offload may be used to determin
gas temperature and thus pin pressure.

For water depths between 19- and 23 feet, an overall iodine DF based on pin pressure is computed as follows:

$$DF_I = 81.046e^{0.305(t/d)}$$

where:

t = bubble rise time (sec), computed as a function of pin pressure, x (psig), as:

$$t(sec) = 9.2261e^{-6E-4*x}$$

d = bubble diameter (cm), computed as a function of pin pressure, x (psig), as:

$$d(cm) = -0.0002 * \mathrm{x} + 1.0009$$

In-lieu of an overall iodine DF based on a best estimate pin pressure, the limiting iodine DF of 667 applied.

If the depth of water is not between 19- and 23 feet, the decontamination factor will have to be det a case-by-case method (see ADAMS Accession No. ML19248C647 for description of technical ba alternative 1.183 Fuel Handling Accident Transport Model)

Calculational Tool: Phase 1 Iodine DF

Note:

pin pressure =	760	(psig)
Overall Iodine DF_I =	**662**	

Phase 2 Release – Re-evolution Release

The re-evolution calculation results in a simple exact transient solution. It has the flexibility to considers the e potential filtration and other removal mechanisms.

The following information is needed:
Site-specific and general parameters:

• V_{pool} – spent fuel pool volume;	1152	(m^3)
• S_{pool} – spent fuel pool surface area;	108	(m^2)
• Q_{recirc} – volumetric flow of recirculation system;	0	(m^3/min)
• F – Overall recirculation filter efficiency for iodine;	0	(0 - 1)
• $N_{I131gap}$ – bundle radioactive iodine in gap (moles);	1.79E-01	(moles)
• $N_{I129gap}$ – bundle non-radioactive iodine in gap (moles);	7.03E-04	(moles)
• K_L = mass transfer coefficient – 3.66E-6 m/s; and,	3.66E-06	(m/s)
• pH – acidity of pool.	4	

Void Space, V	0.0047	(m^3) (A)
T_pool	338.706	(K)
T_gas space	349.817	(K)
I inventory		
I-129	102	(g)

	I-131	4.49	(g)
gap fraction			
	I-129	0.23	(-)
	I-131	0.0155	(-)
Decay time (time after shutdown before FHA event)		24	(hrs)

Note: Vpool, Spool, KL, and Qrecirc must use consistent units. (for the purpose of calculating concentrations i (moles/liter) Vpool must be converted to liters).

Calculation Sequence:

The Calculation sequence is as follows:

1. Calculate amount of iodine (radioactive and non-radioactive) in the fuel pin gap;
2. Calculate volatile iodine fraction in pool;
3. Calculate removal coefficients; and,
4. Evaluate release as either an:
   a. overall release (neglecting time), or
   b. time-dependent release.

Step 1 - Calculate amount of iodine (radioactive and non-radioactive) in the fuel pin gap:

Gas inventory			
P_gas space		760	(psig)
		5.341E+06	(Pa)
Initial gap inventory			
	I-129	23.1540	(g)
	I-131	0.0696	(g)
I-131 Decay factor		0.9172	
Decayed I131 gap inventory (g)		0.0638	
	I-131 factor to account for other isotopes	1.4434	Calculated using the I Inve
Adjusted I131 gap inventory		0.0921	(g)
I inventory in gap for calculation			
mass (g)	I-129	23.1540	(g)
	I-131	0.0921	(g)

Step 2 – Calculate volatile iodine fraction in pool:

Both the radioactive and non-radioactive iodine in the pool affect the radioactive iodine evolution. The calcula operate on moles so iodine isotope quantities must be converted to moles.
For a given mass of iodine, the number of moles of iodine can be calculated from the mass, m, in grams and its weight, M, as:

$$N_{I-131} = \left(\frac{m_{I-131}(g)}{M_{I-131}\left({}^{g}/_{mol} \right)} \right)$$

mol (I) $N_{I\text{-}131} =$ 1.79E-01 (l)

$$N_{I-129} = \left(\frac{m_{I-129}(g)}{M_{I-129}\left(g/_{mol}\right)}\right)$$

mol (I) $N_{I\text{-}129} =$ 7.03E-04 (l)

mol (I) $I_{total} =$ 1.80E-01 (l)

Alternatively, for radioactive materials the number of moles can be calculated from the activity in Becquerels (

$$N_{I-131} = \left(\frac{A_{I-131}\left(dis/_{s}\right)}{\lambda_{I-131}\left(dis/_{atom.s}\right)}\right)$$

Activities in Curies must be converted to Becquerel (1 Ci = 3.7 x 10^{10} Bq).

The radioactive iodine concentration can be decayed accounting for time before fuel movement. If this is done activity of other iodine isotopes at this time should be added to the I-131 activity. In the calculation above the isotopes contributed an additional 4 percent.

Next, determine the fraction of I atoms in the pool that are in I2 (volatile) form by:

- Calculating radioactive and total concentrations in pool by:
  - o C_r = concentration (M) (moles I atoms /L) of radioactive I atoms = $N_{I\text{-}131gap} / V_{pool}$

    $C_r =$ 1.55806E-07 (M)

  - o C_t = total I concentration (M) (moles I atoms /L) = (NI129gap + NI-131gap) / Vpool

    $C_t =$ 1.56416E-07 (M)

Note: Vpool must be converted to liters to calculate concentrations in moles / liter.

- Calculate the H+ concentration:
  - o $C_h = [H+] = 10^{-pH}$

    $C_h =$ 1.00E-04

- Calculate the $[I_2] / [I\text{-}]^2$ concentration ratio, R_i:
  - o $R_i = [I_2] / [I\text{-}]^2 = C_h^2 / (6.0603E\text{-}14 + 1.4708E\text{-}09\ C_h)$

$R_i =$ 4.82E+04

Note: Combined Speciation Rate from Beahm, et. al. Iodine Evolution and pH Control

- Calculate the fraction of I atoms in I2 form:

  o First evaluate B_m (Negative B for quadratic equation)

  ☐ $B_m = 4\, C_t + 1 / R_i$

  $B_m =$ 2.14E-05

  o Then evaluate the volatile fraction, X_e (fraction of I atoms in I2 form):

  ☐ $X_e = (B_m - \mathrm{SQRT}(B_m^{\,2} - 16\, C_t^{\,2})) / (4\, C_t)$

  $X_e =$ 1.46E-02

Step 3 - Calculate applicable removal coefficients:

Radioactive decay removal coefficient:

The radioactive decay removal coefficient, λ_r, is the common one used in the radioactive decay equation:

$\lambda_r = \lambda_{I\text{-}131} =$ 1.00E-06 s-1

Evolution removal coefficient:

The evolution removal coefficient, λ_e, is calculated using the mass transfer coefficient, the pool surface-to-volume ratio, and the fraction of I that is in I2 form.

$\lambda_e = K_L\, X_e\, S_{pool} / V_{pool}$

$\lambda_e =$ 5.02E-09 (s^{-1})

3.01E-07 (min^{-1})

4.34E-04 (d^{-1})

The removal rate is reduced to account for the fraction of iodine that is volatile and thus available to evolve to the gas space.

This evolution rate applies to both non-radioactive and radioactive iodine.

The filtration removal coefficient:

The filtration removal coefficient, λ_f, is calculated using the recirculation system volumetric flow, Q_{recirc}, the volume of the pool, and filtration efficiency, F:

$$\lambda_f = F\ Q_{recirc} / V_{pool}$$

If no recirculation is considered, $l_f = 0$ (or simply not included in the calculation).

If fractional recirculation (Q_{recirc}/V_{pool}) is in the range of 2/day^{-1} (2.3E-5 / s^{-1}) and filter efficiency, F, is approximately 1 the equation results in the following filtration removal coefficient:

λ_f 0 s^-1

Step 4 - Evaluate Release:

The removal coefficients can be used in RADTRAD as follows:

Using a volume in RADTRAD that represents the pool and flow rate that represents evolution to the refuel floor with a volumetric evolution rate such that flow to the refuel floor is as follows:

a. $Q_e = \lambda_e\ V_{pool}$

$Q_e =$	5.78E-06	(m^3/s)		
	3.47E-04	**(m^3/min)**	**1.22E-02**	**(ft^3/min)**
	4.99E-01	(m^3/d)		

b. λ_f is used if recirculation filtration is credited

i. Alternatively a loop and filter can be modeled in RADTRAD instead of using λf. It will return the same result either way.

c. $\lambda_r = 0$ since RADTRAD already calculates radioactive decay.

d. In this calculation RADTRAD calculates the transient depletion of iodine in the pool.

References

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EVOLUTION RESULTS

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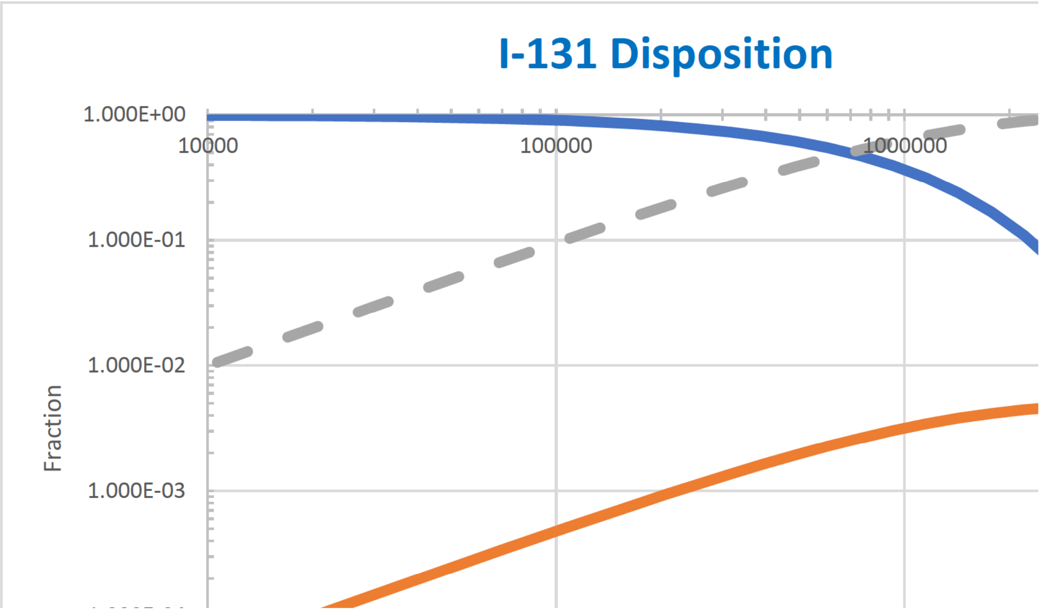
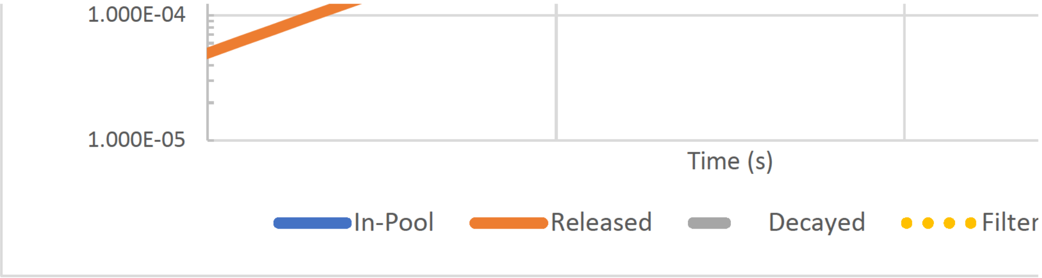
Fractions	Released	Decayed	Filtered	In pool
Asym:	4.99E-03	9.95E-01	0.00E+00	N/A
time	30	days		
At time:	0.0046243	0.9214731	0	0.0739026





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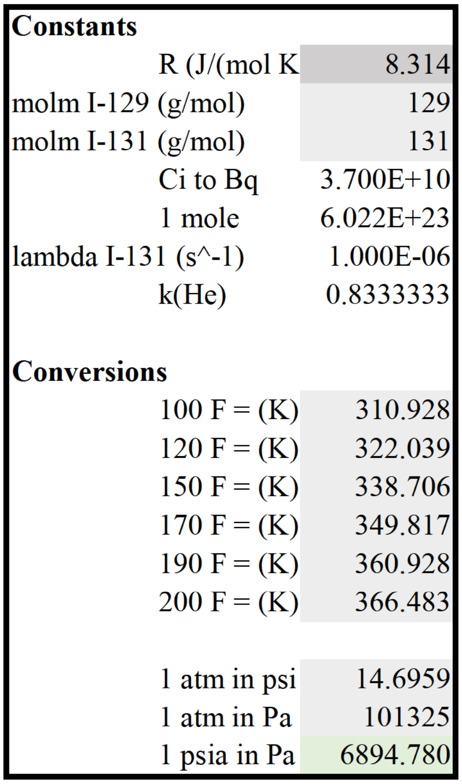

Constants	
R (J/(mol K	8.314
molm I-129 (g/mol)	129
molm I-131 (g/mol)	131
Ci to Bq	3.700E+10
1 mole	6.022E+23
lambda I-131 (s^-1)	1.000E-06
k(He)	0.8333333
Conversions	
100 F = (K)	310.928
120 F = (K)	322.039
150 F = (K)	338.706
170 F = (K)	349.817
190 F = (K)	360.928
200 F = (K)	366.483
1 atm in psi	14.6959
1 atm in Pa	101325
1 psia in Pa	6894.780

entory worksheet

itions

atomic

Bq):

, the
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<== RadTrad Input

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s Accident Fuel Handling Accident,” (ADAMS Accession No. ML19248C647)
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Consequences of Design Basis Accidents at Light-Water NUclear Power Reactors". Washington: US NUclear

Evol DF=1/RF
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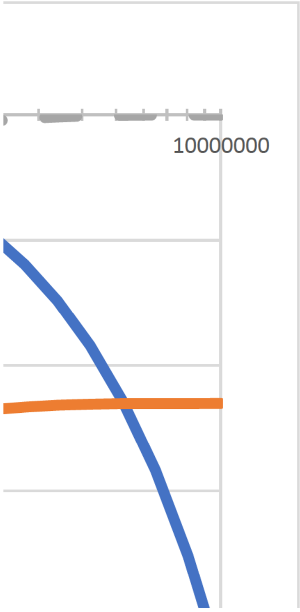

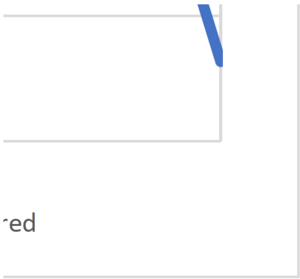
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Inventory from WCAP-7518-L for 42 GWd/MTU burnup on 4-loop W reactor

Note: modern burnup calculations could potentially differ on inventory. Real inventory calcualti

stable iodine production (mostly I-129): 7.22 g/MWt-day.

Time After Shutdown 24 hrs (taken from FHA Calc Worksheet)

Shutdown inventory

I Isotope	quantity a (Ci)	a (Bq)	L (s^-1)	N (atoms)	m (g)	fraction in gap xgap_i
131	5.58E+05	2.06E+16	1.0002E-06	2.0641E+22	4.490E+00	0.0155
132	8.47E+05	3.13E+16	8.3896E-05	3.7355E+20	8.188E-02	0.00172
133	1.27E+06	4.70E+16	9.2568E-06	5.0763E+21	1.121E+00	0.00563
134	1.46E+06	5.40E+16	0.00022005	2.4549E+20	5.463E-02	0.00108
135	1.20E+06	4.44E+16	2.9306E-05	1.515E+21	3.396E-01	0.00318

	m (g)	xgap_I129	mgap_I129 (g)	
I-129	102	0.227	23.154	and any other long-lived and/or inert iodine iso

Note this is a simple test calculation that does not consider ingrowth of iodine from decay of ot

Real inventory calculations should be used.

ons should be used.

Constants	
Ci to Bq	3.700E+10
1 mole	6.022E+23

				Inventory at time of FHA		
agap (Ci)	agap (Bq)	Ngap (atoms	mgap (g)	agap (Ci)	mgap (g)	Isotope
8649	3.2001E+14	3.1994E+20	0.0696	7932.94167	0.06383471	131
1456.84	5.3903E+13	6.425E+17	0.00014	1.03606203	1.0015E-07	132
7150.1	2.6455E+14	2.8579E+19	0.00631	3213.43717	0.00283669	133
1576.8	5.8342E+13	2.6513E+17	5.9E-05	8.7288E-06	3.2658E-13	134
3816	1.4119E+14	4.8178E+18	0.00108	303.357973	8.5858E-05	135
			Total I activity	11450.7729		
			Total I act /I-131 act	1.443446	Output to FHA calc worksheet	

topes should be included in this number

I-131 activity fraction: 0.69278657

her radionuclides.

Decay constant evaluation

t1/2 base	t1/2 units	t 1/2 (s)	L (s^-1)
8.0207	days	692988	1.0002E-06
2.295	hrs	8262	8.3896E-05
20.8	hrs	74880	9.2568E-06
52.5	min	3150	0.00022005
6.57	hrs	23652	2.9306E-05

Asymptotic and time-dependent results

	evolution	radiation	filter	
	lambda e	lambda r	lambda f	lambda
Asym	5.018E-09	1.000E-06	0.000E+00	1.005E-06
Frac	4.993E-03	9.950E-01	0.000E+00	

Time spacing - logunif

num	Log N
10	1
1.00E+07	7
difference	6
divisions	64
delta	0.09375

Overall (asymptotic) release

Asym RF	4.993E-03
Asym DF	200.2662

Time calc

t (day)	30	In-Pool	Released	Decayed	Filtered
t (s)	2592000	0.073903	0.0046243	9.215E-01	0.000E+00

Transient release:

t (s)	In-Pool	Released	Decayed	Filtered	checksum
0	1.000E+00	0.000E+00	0.000E+00	0.000E+00	1.000E+00
10	1.000E+00	5.018E-08	1.000E-05	0.000E+00	1.000E+00
12.409378	1.000E+00	6.227E-08	1.241E-05	0.000E+00	1.000E+00
15.399265	1.000E+00	7.728E-08	1.540E-05	0.000E+00	1.000E+00
19.10953	1.000E+00	9.590E-08	1.911E-05	0.000E+00	1.000E+00
23.713737	1.000E+00	1.190E-07	2.371E-05	0.000E+00	1.000E+00
29.427272	1.000E+00	1.477E-07	2.943E-05	0.000E+00	1.000E+00
36.517413	1.000E+00	1.833E-07	3.652E-05	0.000E+00	1.000E+00
45.315836	1.000E+00	2.274E-07	4.531E-05	0.000E+00	1.000E+00
56.234133	9.999E-01	2.822E-07	5.623E-05	0.000E+00	1.000E+00
69.783058	9.999E-01	3.502E-07	6.978E-05	0.000E+00	1.000E+00
86.596432	9.999E-01	4.346E-07	8.659E-05	0.000E+00	1.000E+00
107.46078	9.999E-01	5.393E-07	1.075E-04	0.000E+00	1.000E+00
133.35214	9.999E-01	6.692E-07	1.333E-04	0.000E+00	1.000E+00
165.48171	9.998E-01	8.304E-07	1.655E-04	0.000E+00	1.000E+00
205.3525	9.998E-01	1.030E-06	2.053E-04	0.000E+00	1.000E+00
254.82967	9.997E-01	1.279E-06	2.548E-04	0.000E+00	1.000E+00
316.22777	9.997E-01	1.587E-06	3.162E-04	0.000E+00	1.000E+00
392.41898	9.996E-01	1.969E-06	3.923E-04	0.000E+00	1.000E+00
486.96753	9.995E-01	2.443E-06	4.868E-04	0.000E+00	1.000E+00
604.29639	9.994E-01	3.032E-06	6.041E-04	0.000E+00	1.000E+00
749.89421	9.992E-01	3.762E-06	7.496E-04	0.000E+00	1.000E+00
930.57204	9.991E-01	4.668E-06	9.301E-04	0.000E+00	1.000E+00
1154.782	9.988E-01	5.792E-06	1.154E-03	0.000E+00	1.000E+00
1433.0126	9.986E-01	7.186E-06	1.432E-03	0.000E+00	1.000E+00
1778.2794	9.982E-01	8.916E-06	1.777E-03	0.000E+00	1.000E+00
2206.7341	9.978E-01	1.106E-05	2.204E-03	0.000E+00	1.000E+00
2738.4196	9.973E-01	1.372E-05	2.735E-03	0.000E+00	1.000E+00
3398.2083	9.966E-01	1.702E-05	3.392E-03	0.000E+00	1.000E+00

4216.965	9.958E-01	2.112E-05	4.208E-03	0.000E+00	1.000E+00
5232.9911	9.948E-01	2.619E-05	5.219E-03	0.000E+00	1.000E+00
6493.8163	9.935E-01	3.248E-05	6.473E-03	0.000E+00	1.000E+00
8058.4219	9.919E-01	4.028E-05	8.026E-03	0.000E+00	1.000E+00
10000	9.900E-01	4.993E-05	9.950E-03	0.000E+00	1.000E+00
12409.378	9.876E-01	6.189E-05	1.233E-02	0.000E+00	1.000E+00
15399.265	9.846E-01	7.668E-05	1.528E-02	0.000E+00	1.000E+00
19109.53	9.810E-01	9.498E-05	1.893E-02	0.000E+00	1.000E+00
23713.737	9.764E-01	1.176E-04	2.343E-02	0.000E+00	1.000E+00
29427.272	9.709E-01	1.455E-04	2.900E-02	0.000E+00	1.000E+00
36517.413	9.640E-01	1.799E-04	3.586E-02	0.000E+00	1.000E+00
45315.836	9.555E-01	2.223E-04	4.430E-02	0.000E+00	1.000E+00
56234.133	9.451E-01	2.744E-04	5.467E-02	0.000E+00	1.000E+00
69783.058	9.323E-01	3.382E-04	6.739E-02	0.000E+00	1.000E+00
86596.432	9.166E-01	4.162E-04	8.294E-02	0.000E+00	1.000E+00
107460.78	8.976E-01	5.112E-04	1.019E-01	0.000E+00	1.000E+00
133352.14	8.746E-01	6.263E-04	1.248E-01	0.000E+00	1.000E+00
165481.71	8.468E-01	7.651E-04	1.525E-01	0.000E+00	1.000E+00
205352.5	8.135E-01	9.312E-04	1.855E-01	0.000E+00	1.000E+00
254829.67	7.741E-01	1.128E-03	2.248E-01	0.000E+00	1.000E+00
316227.77	7.277E-01	1.360E-03	2.709E-01	0.000E+00	1.000E+00
392418.98	6.741E-01	1.627E-03	3.243E-01	0.000E+00	1.000E+00
486967.53	6.130E-01	1.932E-03	3.851E-01	0.000E+00	1.000E+00
604296.39	5.448E-01	2.273E-03	4.529E-01	0.000E+00	1.000E+00
749894.21	4.706E-01	2.643E-03	5.267E-01	0.000E+00	1.000E+00
930572.04	3.925E-01	3.034E-03	6.045E-01	0.000E+00	1.000E+00
1154782	3.133E-01	3.429E-03	6.833E-01	0.000E+00	1.000E+00
1433012.6	2.369E-01	3.811E-03	7.593E-01	0.000E+00	1.000E+00
1778279.4	1.674E-01	4.157E-03	8.284E-01	0.000E+00	1.000E+00
2206734.1	1.088E-01	4.450E-03	8.867E-01	0.000E+00	1.000E+00
2738419.6	6.379E-02	4.675E-03	9.315E-01	0.000E+00	1.000E+00
3398208.3	3.287E-02	4.829E-03	9.623E-01	0.000E+00	1.000E+00
4216965	1.443E-02	4.921E-03	9.806E-01	0.000E+00	1.000E+00
5232991.1	5.199E-03	4.967E-03	9.898E-01	0.000E+00	1.000E+00
6493816.3	1.464E-03	4.986E-03	9.935E-01	0.000E+00	1.000E+00
8058421.9	3.039E-04	4.992E-03	9.947E-01	0.000E+00	1.000E+00
10000000	4.318E-05	4.993E-03	9.950E-01	0.000E+00	1.000E+00

Final DF **200.3**

orm

10^(log N)

10 start time

1E+07 end time

number	Log (time)
	1
1	1.09375
2	1.1875
3	1.28125
4	1.375
5	1.46875
6	1.5625
7	1.65625
8	1.75
9	1.84375
10	1.9375
11	2.03125
12	2.125
13	2.21875
14	2.3125
15	2.40625
16	2.5
17	2.59375
18	2.6875
19	2.78125
20	2.875
21	2.96875
22	3.0625
23	3.15625
24	3.25
25	3.34375
26	3.4375
27	3.53125

28	3.625
29	3.71875
30	3.8125
31	3.90625
32	4
33	4.09375
34	4.1875
35	4.28125
36	4.375
37	4.46875
38	4.5625
39	4.65625
40	4.75
41	4.84375
42	4.9375
43	5.03125
44	5.125
45	5.21875
46	5.3125
47	5.40625
48	5.5
49	5.59375
50	5.6875
51	5.78125
52	5.875
53	5.96875
54	6.0625
55	6.15625
56	6.25
57	6.34375
58	6.4375
59	6.53125
60	6.625
61	6.71875
62	6.8125
63	6.90625
64	7